Examiner's commentary

This is an excellent ITGS essay which does not focus only on IT systems or social and ethical issues, but in its topic and development it examines in depth aspects of all the elements of the ITGS triangle. This essay's strong points include the demonstration of an excellent knowledge of the IT system (Augmented Reality) in the context of education and an effective discussion of the social, ethical and moral impacts of this technology in a specific area of impact (education). Appropriate planning and presentation, clear explanations, adequate images at the proper places and relevant examples made a difficult topic easy to understand and the essay very interesting to read. In the development of the essay, the author has referenced more than 25 secondary sources and one survey. This provided the necessary support for the arguments and allowed an effective analysis of the impacts and implications of the topic, which led to meaningful conclusions.

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Extended Essay
Information Technology in Global Society
(ITGS)
Augmented Reality in Education

Is Augmented Reality (AR) an effective tool for learning in the classroom environment and what are the potential social, ethical and moral implications of using this technology in teaching and learning?

Word Count Main Body = 3910

Date: January 2019

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1.0 Introduction

Augmented Reality (AR) is a technology that is becoming very popular and has a lot of potential in the vast academic sector. It has been argued that AR allows people to understand things better by visualising concepts and ideas they would otherwise had to have imagined or thought very deeply about prior to the proliferation of AR technologies (Mobile, 2016). On this basis, in investigating and exploring AR it is important to establish the potential it has to change the way educators educate students and to allow those students to understand and learn by visualizing information like never before. Additionally, emerging[1] technologies such as AR can be seen to be having an impact on society (Guimaraes, 2015) which have spurred a rapidly increasing use and change in the technology. This is particularly true for the education sector and how it strives to adopt technologies that support the teachers in imparting with their knowledge and students in turn adopting it.

This essay aims to evaluate the use of Augmented Reality with the "modern classroom"[2] (Rivero, 2016) and its role within teaching and learning. In doing so, it is essential to establish the impact this technology has had and in turn discuss the social, ethical and moral implications of using this technology in teaching and learning particularly within the secondary school setting.

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[1] New Technologies

[2] A modern classroom is one that consists of three important features: space, technology and pedagogy.

It is reported that more teenagers have access to the internet and smartphone than any other age group in the schooling industry[3] (Lenhart, 2013). By choosing a setting such as the secondary school, one that already fills the requirements of having the correct IT equipment for AR to be implemented allows for a balanced evaluation of the positives and negatives this emerging technology may have on these students in particular.

2.0 What is Augmented Reality (AR)

Augmented Reality is a new and expanding technology that opens doors for new technologies such as *Just-In-Time Information* [4] (Weiner, 2018), *Computer Aided Design* (CAD) and *3D Technology* which as illustrated in **Figure 1**. It also helps expand our physical world, it does this by adding many different layers of digital information onto it.

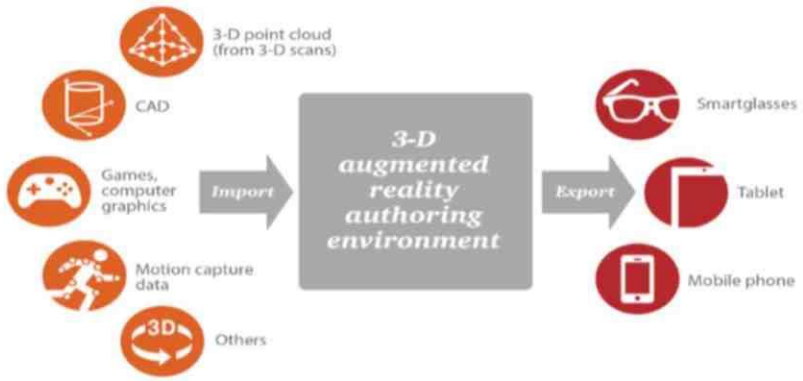


Figure 1
Source: http://usblogs.pwc.com/emerging-technology/how-will-people-create-content-for-augmented-reality/

[3] It is reported that 91% of all teenagers aged 13 to 17 access the internet on their smartphones and tablets occasionally.
[4] Information that is readily available anytime, anywhere.

AR is not the same as Virtual Reality (VR), in fact it is completely different in terms of what it does and how it is used. VR creates a new artificial and virtual world that replaces our physical world through glasses. But with AR we are superimposing[5] virtual information, sound, graphics and videos to the physical environment (Ford, 2016).

2.1 How does AR work in comparisons to VR

AR uses a variety of different types of data such as animations, 3D models, and videos. This is the type of data that is presented to the user, in natural light and synthetic light. Natural light is light that comes naturally from the sun, synthetic light, comes from light bulbs and lamps (LED). A major factor between AR and VR is that with AR the user is aware that he is in the "real world" and this is created by computer vision (Ford, 2016). Computer vision is a technique that allows computers as well as robots and androids[6] to see and understand the world around them similarly to how humans think (Gray, 2011). As shown in **Figure 2** we see how AR can be used to enhance searching.

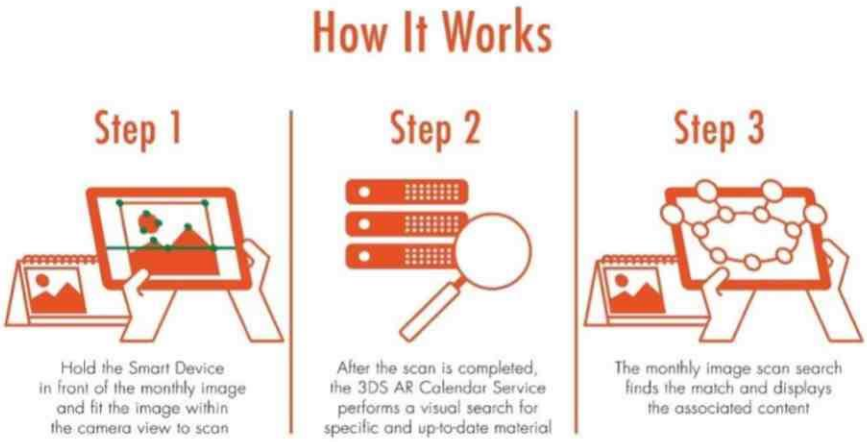


Figure 2
Source: https://www.3dstudio.fi/index.php/augmented-reality-ar/

[5] To lay or place one thing over another
[6] Robots designed to look like humans with real life features

Augmented Reality Vs Virtual Reality

Augmented Reality	Virtual Reality
User will be aware of the real and physical world as only layers are added to the world	Creates a new virtual world where we are so emerged into a new immersive that the user is not aware of the real work he/she is currently in.
Augmented reality is usually used for constructing and demonstrating design. It can also be computer architecture and for planning.	Mostly used for video games and leisure however it could also be used with health to treat PTSD.
Merges physical and virtual objects together.	Full digital experience

Figure 3
Source: https://www.3dstudio.fi/index.php/augmented-reality-ar/

AR works seamlessly on a variety of different products, such as smartphones, tablets (iPad), smart glasses and smart watches (Mobiles, 2016). Other than computer vision, there are four main technological methods that are used in order for AR to work effectively and correctly (Ford, 2016).

2.1.1 The technologies used

Simultaneous Localization And Mapping (SLAM): is a group of algorithms[7] that aim to achieve and solve simultaneous localization and mapping problems. It is also the most effective and sufficient way to render[8] images over any real world objects. SLAM is a technology that helps solve many complex AR simulations that is not specified by a particular software nor algorithm. The effect this has is it makes the user experience a lot better for the student at school, as this reduces any lag resulting in students being satisfied when using this technology (Newgenapps, 2017).

[7] A set of rules filled with calculations that help solve operations in a computer.
[8] A process that generates photorealistic or no realistic image from a 2D to 3D model which is then saved as a scene file.

3D Around: uses technology to ensure that all 3D objects can be projected accurately on electronic devices. Due to the low processing speed and power available in many smartphones, 3D animations would be at a low quality. However, some smartphones such as Apple's iPhone XS have begun to improve the CPU on their phones to allow for high quality 3D animations with the use of AR (Apple, 2018) **Figure 4**.

To ensure that students get the best quality 3D models they will have to invest in top of the line products, meaning that a lot of money will be paid specifically to supply these products if students cannot provide their own, which is a drawback. As argued by (Bakir, 2015) this money can be better spent on non-technological resources as these are more likely to be misused by students, in 2013 2.7 million dollars was misspent on these educational technologies (Bakir, 2015).

Figure 4
Source: https://www.youtube.com/watch?v=mW6hFttt_KE

Pocket scan: Allows the user to receive information after scanning it from their phone. For example, scanning a barcode and having the text revealed on the screen. Further explained in **section 3.1**.

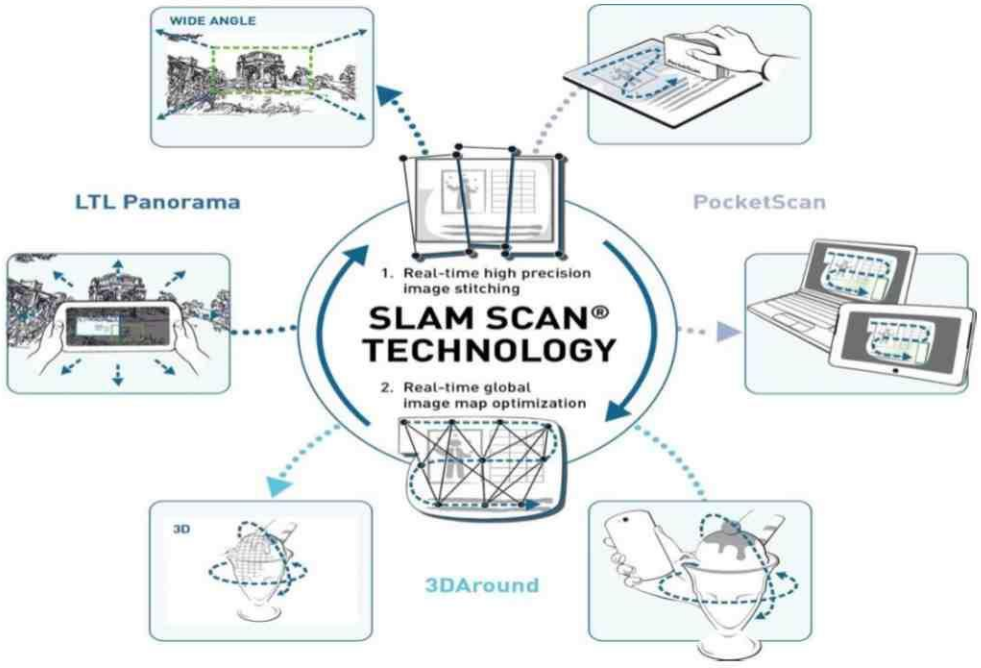


Figure 5
Source: https://3dprintingindustry.com/news/staramba-dacuda-partner-create-app-3d-scan-61723/

Depth tracking[9]**:** uses sensors to measure the distance to a desired target. And this *target* can vary dramatically. Examples include a: dot, line, "x" and much more. The technology involves three different sensors, these include: laser, ultrasonic and infrared. These three sensors all work similarly. They all send a signal and that signal is measured when it is reflected from the object the signal is directed at (Taskinen, 2015)**.** While many of the previous IT systems effect students in the classroom, depth tracking can be used for another educational purpose, outside of the classroom, for example in Physical Education (PE) or any sporting events. Depth tracking can help show the user results that may have not been easily seen previously, such as the exact distance

[9] Sensors that collect data about distance to objects

between 1st and 2nd place in a school race. This also means that school sporting events will be monitored a lot better and students can visually learn how to improve from their previous mistakes by looking at animations and diagrams layered onto videos of them taking part in the event (Douglass, 2013).

2.1.2 Hardware involved with AR

Processors: like many computers Augmented Reality requires a: CPU; GPU; RAM; GPS; WIFI[10] and Bluetooth. AR uses a lot of computerised graphics and videos, so any device trying to run AR smoothly will need a high CPU and GPU. It will also need a strong Bluetooth connection and Wi-Fi to allow radio waves to connect to the device and augment any animation that requires network connectivity. Even though these components result in a better user experience it may impact the students experience as they will have to constantly recharge their batteries for these handheld devices and this could make them less efficient (Hasan, 2016).

Cameras and Sensors: a lot of data is constantly sent and processed by the processor. AR uses cameras and sensors to gather all this information. The cameras will constantly scan the surroundings and this information is used to locate a physical location for the objects and creates a 3D design (Ford, 2016). The use of cameras and sensors can also help teachers a lot more with marking multiple choice exams, examples include Zipgrade (Viebach, 2013)

[10] Wireless fidelity

Projection: This is how all this information is projected, through the many devices available such as headsets, smartphones and AR cameras. These different devices take all the data from the sensors and project the digital content.

Reflection: It is common to find AR devices that have mirrors in them, these are used to help support the human eye so that we are capable of viewing these virtual images.

3.0 Education before Augmented Reality and Technology (primary)

Before the mass development of technology, students spent hours in libraries reading through many different books to find the information they needed. Furthermore, announcements could not be sent over emails and teacher presentations could not be projected on a smart board, everything was hand written. In addition if there were any assignment given students would have to log this information in a diary. After interviewing the Head of Digital Literacy at our school I learned that if at any point you wanted to gather information about a topic and you required the use of the internet, you would have to book a slot for that. And at some occasions you would also have to book a slot for the use of computers in cyber stores. Nowadays things have changed, dramatically. (See Appendix)

3.1 Education with Augmented Reality

In the 21st century around 80% of teenagers all have smartphones (Hammond, 2013). Unfortunately, teenagers these days don't use their smartphones for educational purposes, there are occasions where schools offer students tablets to allow students to take notes and write up research documents for classes, however, the majority use their smartphones for leisure and games.

This does add a negative impact to schools as it has been reported that many students are getting too distracted on their smartphones (Bakir, 2015).

3.1.1 Issues of AR with students

A few years ago a very famous application was available to many teenagers, Pokémon Go, which heavily relied on AR to operate effectively for the user. This game was known to be very distracting and dangerous as users would walk around into unknown areas searching for rare characters in the game. However it ensured that many teenagers were familiar with the technology, meaning that schools could directly implement this new system replacing the old traditional method of teaching (McLeod, 2016). **Figure 6** shows an example of how the user would "catch' a Pokémon while using the app.

Figure 6

Source: https://www.slashgear.com/pokemon-go-ar-plus-apple-arkit-augmented-reality-game-update-20512429/

3.1.2 New opportunities for students with AR

According to (Davies, 2017) many teachers forget the fact that teaching isn't just about reading and writing many books, its more than that, to teach students effectively you must engage them, AR will allow this to happen as it opens up a variety of new ways to teach.

(Davies, 2017) argues that AR will strongly increase productivity, interaction and creativity. Your learning is only limited to how adventurous you are and how much you want to develop your skills and ideas. This means that students will be motivated to work harder to complete more tasks as learning will become an enjoyable task instead of a repetitive boring task that limits many student's potential to visualize and learn new things.

Many students are fortunate enough to own a smart handheld device[11] (Hammond, 2013). This means that many students can use AR to help them figure out problems and further develop their knowledge. This makes the students a lot more independent and builds confidence as students will learn to do their own independent studying to complete rigorous and complex tasks. In addition, students will be eager to find out more about something, taking extended reading to the next level through 3D interactive diagrams to make learning easier for students (Davies, 2017).

3.1.3 Virtually learning with AR advantages and disadvantages

AR allows students to visually learn, a study completed by UCLA shows that students retain 55% of what they visualize, 38% when they verbally hear the information and 7% when the information is read during a presentation or lecture (TOUCH, 2015). **Figure 7** illustrates these results.

[11] About 80% of teenagers have access and/or own a smart handheld device

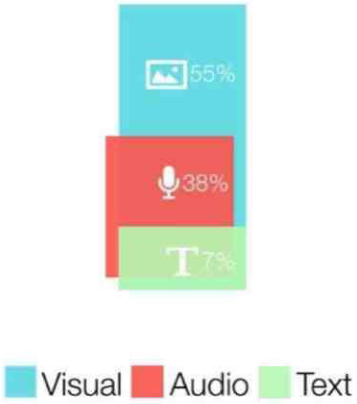


Figure 7
Source: http://tentouchapps.com/visual-vs-verbal/

A subject such as Science for example can be learnt a lot easier if students can visualize diagrams and figures to make it easier for them to understand and effectively explore the word of Science. Another great example would be History, with the use of pocket scanning, students can scan pages in their books to recreate an image of the battle field which helps them retain the information a lot more. **Figure 8** reveals how complex diagram of a brain can be simplified and visualized easily with the use of an iPad.

Figure 8
Source: https://thinkmobiles.com/blog/augmented-reality-education/

Moreover, as stated by (Davies, 2017) many students no longer need to be passive observers as with the use of AR they can be much more active as they develop and learn new skills. Interactive 3D models allow for many more students to pay attention and not get bored of school, as long as they are being active they will enjoy learning and this creates a positive and enjoyable environment for students to learn. Teachers will also find new and interactive ways to teach and students will be able to retain information (Davies, 2017).

However, according to (Catapano, 2015) as teachers start to take the AR approach and advise students to bring their tablets and smartphones to classes for AR use many problems will arise. Firstly, students may misuse these devices and get distracted on social media applications which will limit their learning and result in students wasting time during school and not learning effectively. If not all of the students bring their electronic devices the teacher may not be able to teach them all effectively, as he or she may have planned a lesson that solely relies on their electronic devices. Additionally, devices will be more prone to theft and being misplaced which could be very upsetting. It is also more likely for there to be battery issues if students are not using the latest handheld devices. Networks may also be an issue because if the internet cuts then students will not be able to use these devices in class and this can be time wasting (Catapano, 2015).

The possible implications of this may be that schools will have to move to a cloud based service in order to store all the data on the student's devices, this can include documents, homework and presentations, for example using Google Classroom. While this ensures that all the data is stored in one place and can be accessed with any device with an internet connection and the correct log

in information it results in data being more vulnerable to malware and cyber-attacks. Schools will need to use Secure Socket Layers (SSL)[12] and/or Transport Layer Security (TLS)[13] encryption to make sure that all information stored online by the students is secure and encrypted to prevent data from being stolen. Even though cloud based services allow for data collaboration, they are consequently very expensive and time consuming to set up correctly. Moreover cloud based services may sell the data to third parties which can lead to target marketing, identity theft and data loss (Seshachala, 2015).

Figure 9
Source: http://edtechreview.in/trends-insights/trends/2936-5-schools-that-are-making-the-most-of-ar-vr

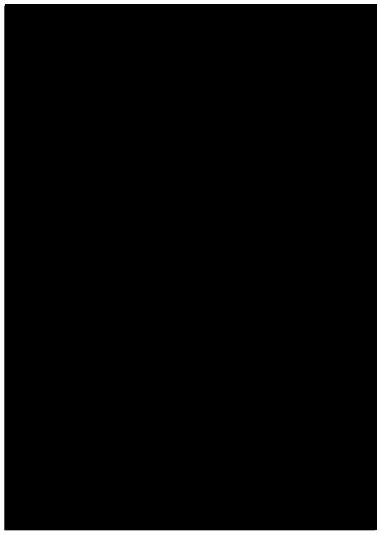
[12] A secure way to transmit data over the network
[13] Alternative method to SSL that also encrypts data being sent over a network

It is argued by (Briggs, 2016) that the traditional method of teaching will soon become obsolete, fortunately enough schools such as **Sevenoaks School (UK)** and **Chandler Traditional Academy** located in Arizona have both utilized AR and teach their students in a superior way.

3.2.1 Sevenoaks School UK

Before implementing this new method of teaching immediately, Sevenoaks had done many experiments such as patterns of usage and all this data was shared with other schools in order to compare their findings (Lawrie, 2017). Fortunately enough they found a way to implement AR and Artificial intelligence into all their subjects varying from Mathematics to Physical Education. Sevenoaks has reported that their students are now much more engaged both in and out of lessons and have noticed that they are also more inspired and stimulated to explore and expand their knowledge. (Debroy, 2017)

3.2.2 Chandler Traditional Academy



Similarly, AR has had a positive impact on Chandler Traditional Academy, even though students have reported to being baffled on using Augmented and Virtual Reality in their STEM[14] studies because for many of them it was their first time using it. And while it was reported that the introduction of this emerging technology was very costly, it was cost effective in the long term, as many experiments could be repeated without purchasing any new equipment. But more than that, it also made experiments a lot safer as students where no longer exposed to hazardous and dangerous materials/equipment (Frank, 2016). Overall the use of these surfacing technologies has ended the beneficiary for both teachers and students. As it has been reported by many Chandler teachers this implementation has resulted in students being a lot more innovative and active in class (Debroy, 2017).

Ultimately we can see that with the direct implementation into the school systems there has been a positive impact on the school's morale because they feel they have contributed to reforming the process of teaching and learning in the school environment.

3.3 Future of Augmented reality in education

As technology as a whole continuous to improve and increase in its use rapidly, many industries will begin to prepare new ways to utilize this technology in the schooling industry (CleverBooks,

[14] A school or course that specifically focuses on Science, Technology, Engineering and mathematics

2017)**. Figures 12, 13 and 14** show the current use of technology at school, and the demand for new emerging technologies to be implemented into schools by both teachers and students. Even though AR can be very distracting, for example with games like Pokémon go where users "hunt" for Pokémon's, it can promote collaboration in the classroom as well as well as new methods of teaching in the class (Boghossian, 2016).

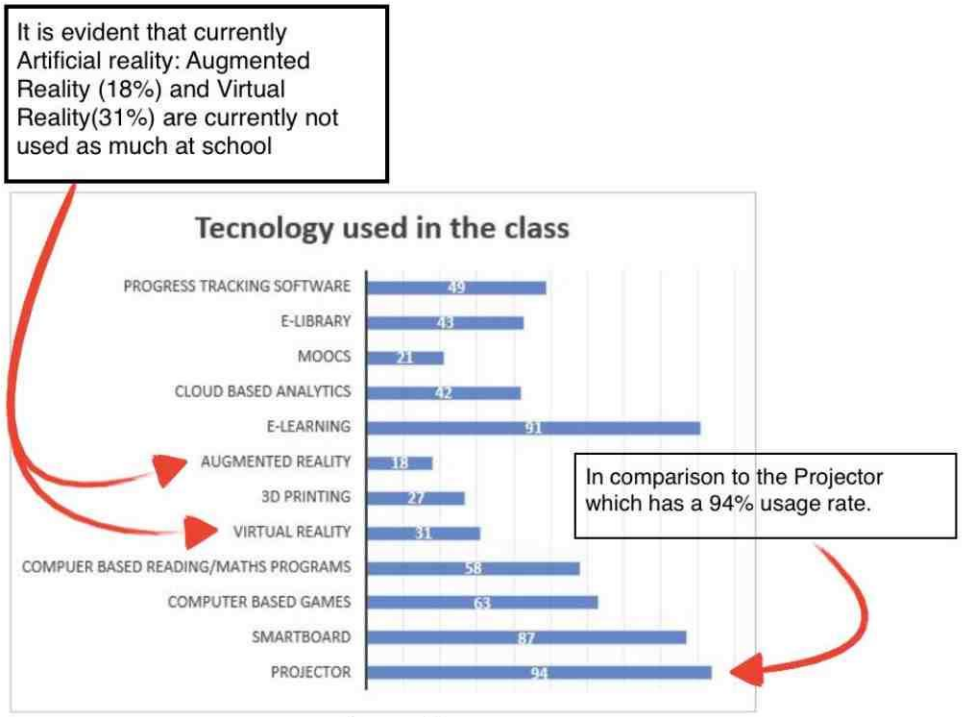


Figure 12

Figure 12 illustrates the current technology used in class.

Source: https://www.cleverbooks.eu/technology-in-a-classroom/

It is evident that emerging technologies like artificial reality (AR and VR) and 3D printing are highly demand to be implemented in schools in the future.

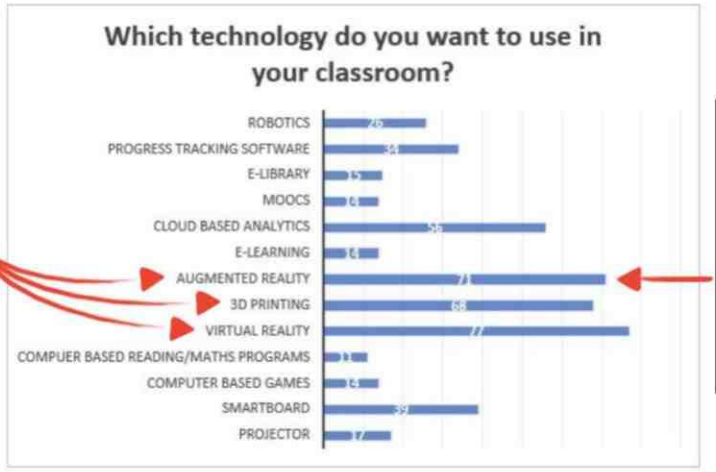


Figure 13 also shows that demand increase in these emerging technologies. As the demand for AR increased from 18% to 71%

Figure 13

Figure 13 illustrates the technology that both teachers and students would like to see at school

Source: https://www.cleverbooks.eu/technology-in-a-classroom/

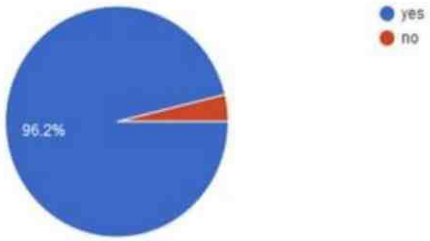


Figure 14

Figure 14 shows the demand from both students and teachers for the use of AR Geometry apps that help students visualize instead of workbooks

It is strongly evident from the results that the answer is **yes** and many teacher and students would prefer to use tis app instead of workbooks

Source: https://www.cleverbooks.eu/technology-in-a-classroom/

It has been stated by (Mills, 2017) that Artificial intelligence will soon replace employees, keeping this in mind schools should be educating their students to prepare them for a technological future, by using AR students will get a head start with artificial technology and this may help them to get a better job in future, because as **Figure 15** suggest by 2020 most jobs will be requiring technological skills that can be achieved through AR's immersive, creative, cognitive and collaborative features. (Davies, 2017)

Figure 15
Source: https://www.weforum.org/agenda/2016/01/what-is-the-future-of-your-job/

In future students can benefit a lot with AR, as these advancements will improve students: knowledge base, participation, interest in content and intellectual curiosity.

Source: http://mobileedar.weebly.com/future-of-ar.html

Additionally, in future as this technology continues to improve it will result in better quality and more reliable information by making the learning environment more productive with the advancements in the three dimensional models that can be visualized by these students.

Below is an example of how a student can visualize a complex blueprint of a building into a simple 3D model in a matter of seconds.

Figure 16
Source: http://mobileedar.weebly.com/future-of-ar.html

4.0 Social, Ethical and Moral implications

While there are many advantages that come with implementing AR in schools, there are many Social, Ethical and Moral issues that are also involved.

If many schools implement this emerging technology they improve their learning techniques, however they increase the digital divide specifically in the educational sector, creating a sociocultural gap (Guimaraes, 2015). This is because some schools cannot afford this technology so students will not learn essential IT skills at a young age nor develop and learn through the internet (Gray, 2011).

By implementing AR, teachers will have to be educated and trained on how to use it effectively, this is very time consuming and can be expensive to set up courses with professionals. This may decrease the teachers morale as they become demotivated to be trained again resulting in a high turnover for many schools as teachers do not feel the need for this new implementation (Guimaraes, 2015).

(Greenfield, 2015) argues that using smart handheld devices may distract students more than it will benefit them. As this opens opportunities for these students to check their social media accounts and procrastinate a lot more as they are more vulnerable to online distractions. While these handheld devices do make it easier to collaborate and use AR effectively in class, they may also result in more cyber bullying in the school environment which is unethical and creates a negative and abusive social environment for these students, and this can be very demotivating and hurtful (Greenfield, 2015)**. Figure 17** shows how social media has contributed to cyber bullying.

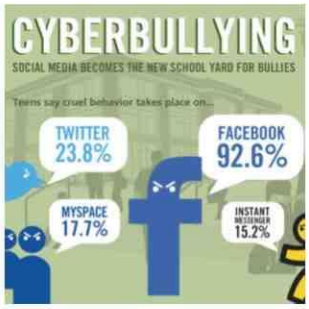


Figure 17

Source: https://www.livetiles.nyc/does-the-digital-classroom-increase-cyber-bullying

5.0 Stakeholders

There are many stakeholders involved with this emerging technology, examples include students, teachers, schools and the government.

5.1 Students Recommendations

If students are capable of owning a smart handheld device they should be responsible to charge it and bring it to all lessons ready for use. Students should also use them solely for educational purposes and not for their own social needs. They also have to make sure that they are responsible and must have their device password protected to ensure that their data is secure.

5.2 Teachers

If the students are using their handheld devices to help them take full advantage of AR then it is expected that the teacher creates a Virtual Learning Environment (VLE)[15] while this may result in cyber bullying, teachers must strictly monitor this online environment to ensure that it is safe and secure for students to use at school and home. Teachers must also assign all their students with correct login details to ensure that they can securely access the VLE and not just when they are connected to the school network.

5.3 Schools

Even if using tablets and smartphones at school results in distractions and a loss in productivity, schools can monitor internet searches, and prevent students from accessing specific websites, such as social media websites and online websites for games, these websites can be blocked to prevent students from getting distracted. In addition, schools may decide to configure the devices they provide the students to ensure that no games can be downloaded on them and so they are solely used for education and learning purposes. (Greenfield, 2015)

5.4 Government

To maximize the number of school benefiting from AR, Governments may decide to supply the correct equipment needed in order for schools and students to use this technology effectively. The Government may also decide to provide this equipment to schools that may not be able to afford this through a government grant to help close the gap on the digital divide with this new IT technology.

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[15] An online safe working environment that allows students and teachers to share important material, as well as allows students to collaborate together.

6.0 Conclusion

To conclude, from the findings in this essay it can be established that AR opens up new doors and brings many advantages to the modern classroom. In future as this emerging technology continues to develop and improve it will be common that many schools will be using AR and other technologies as a new method of teaching and it is expected that the implementation of this new technology will become the new main tradition of teaching and engaging students in class. However, it can be seen that even though this emerging technology does make it easier for students to understand, develop and learn AR may make it *too* easy for students to access readily available conceptual ideas which may ruin the student's motivation to search and to do extended reading on certain topics. Nevertheless as shown with Sevenoaks and Chandler Traditional Academy both schools have reported that their students have become more engaged. Showing that AR has a positive impact on schools both in the U.S. and U.K. While these schools will benefit from this they may also have to implement a BYOD[16] policy in order to make sure all students benefit equally in class. However if students can't afford these devices then the school will be obliged to provide it for them, the school will also have to ensure that the student will be responsible and use the device correctly. Even though this emerging technology may take time to be used and implemented effectively, in the long run it will be much more effective and as shown with the two secondary schools provide better grades and ultimately a better learning environment.

[16] Bring your own device.

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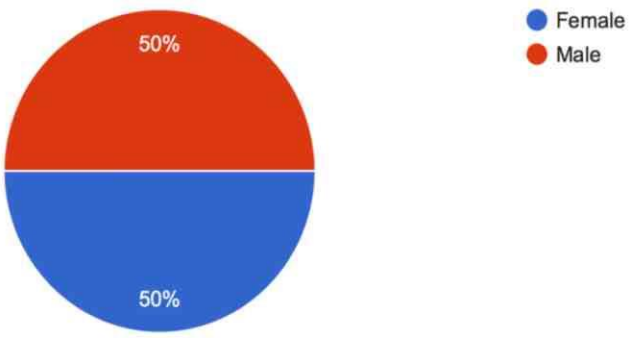
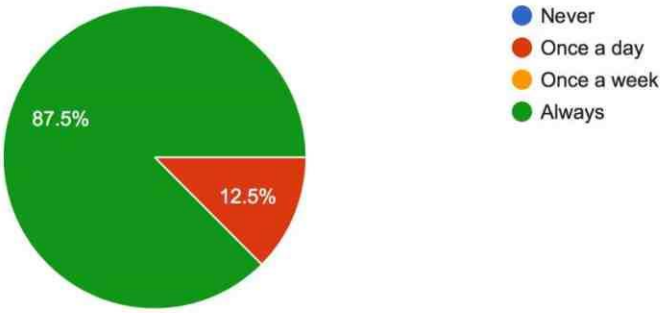
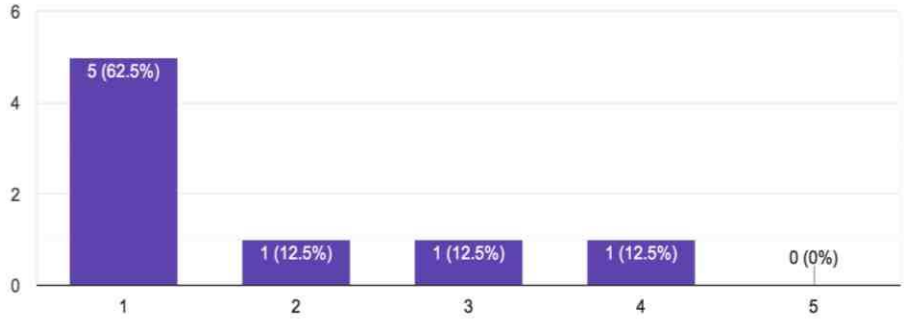
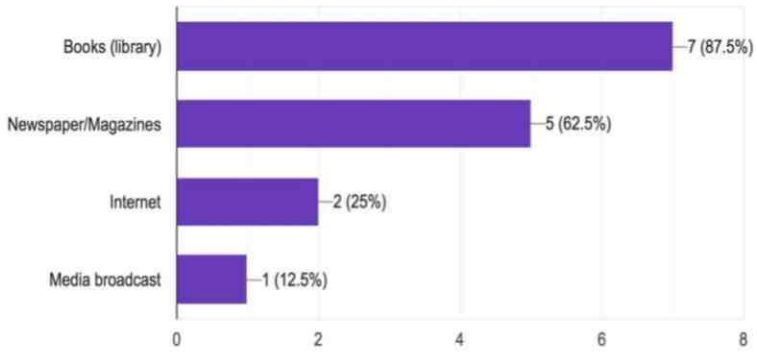
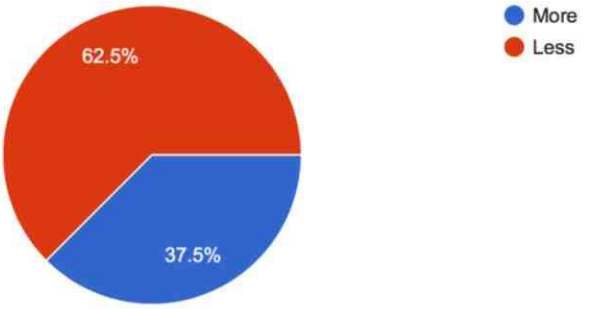
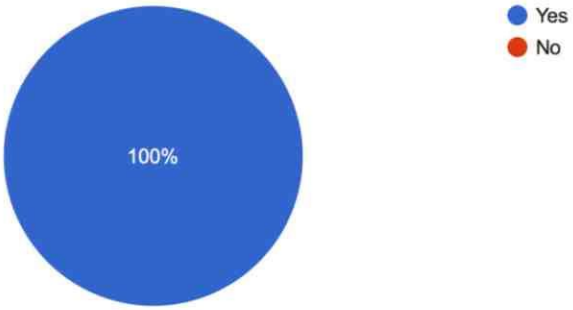
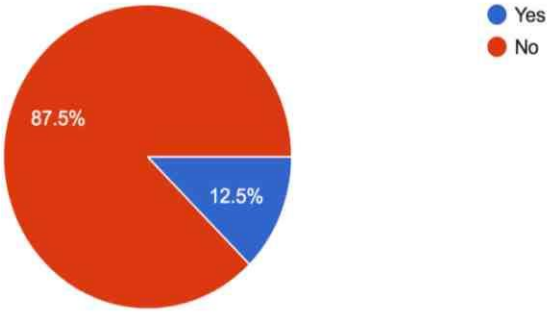
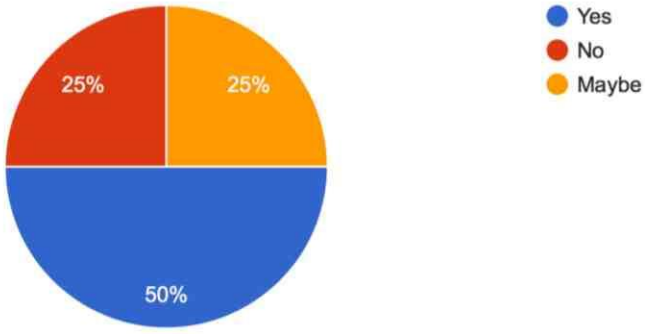
7.0 Appendix

Gender?	
How regularly do you check the internet?	
How easy was it to access the internet when you were in secondary school?	

How did you gather secondary research when you were at secondary school?	
In your opinion, has it become easier or harder to gather information.	
Do you find information now is more or less meaningful	

Do you support the fact that we are becoming too connected and reliant on our digital devices	
Do you think it is a good idea to use more technology to teach children	
Do you feel that older and more traditional teaching and learning methods are better than the newer ones that rely on technology	

When you were given a research project back in secondary school, what difficulties did you face when gathering information?	was very time consuming as all of the information was all over the place and it was your responsibility to try and find the best information for the research that you were conducting. Often the information needed was not available so you would have to rely on many sources of information to get what you wanted... Limited resources available, limited view points as we were restricted to the local community same difficulties which you face today: organisation, time, distractions, resources and immaturity. can't remember It was taking more time, but when I would get the information I would memorize it easily, so learn more, as it was harder to get it.

PDF forms are not compatible with the Google Chrome PDF viewer plug-in. Chrome users should save the form, then reopen and complete with Adobe reader.

EE/RPPF

For first assessment in 2018

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Candidate personal code

Extended essay - Reflections on planning and progress form

Candidate: *This form is to be completed by the candidate during the course and completion of their EE. This document records reflections on your planning and progress, and the nature of your discussions with your supervisor. You must undertake three formal reflection sessions with your supervisor: The first formal reflection session should focus on your initial ideas and how you plan to undertake your research; the interim reflection session is once a significant amount of your research has been completed, and the final session will be in the form of a viva voce once you have completed and handed in your EE. This document acts as a record in supporting the authenticity of your work. The three reflections combined must amount to no more than 500 words.*

The completion of this form is a mandatory requirement of the EE for first assessment May 2018. It must be submitted together with the completed EE for assessment under Criterion E.

Supervisor: *You must have three reflection sessions with each candidate, one early on in the process, an interim meeting and then the final viva voce. Other check-in sessions are permitted but do not need to be recorded on this sheet. After each reflection session candidates must record their reflections and as the supervisor you must sign and date this form.*

First reflection session

Candidate comments:

I have always been fascinated by technology and the endless opportunities that come with it. After speaking with the head of digital literacy in our school I decided I wanted to learn more about an emerging technology called Augmented Reality (AR), but more specifically how it impacts the modern classroom. I knew that this would be something that interests me a lot because in my personal life I always try to look for ways to use technology to make things easier and more efficient. Since my subject area was ITGS I knew I had to use a variety of different sources, such as websites, books and interviews conducted by myself. I will start by planning out all the key areas that I want to mention throughout my essay and focus especially on the social, ethical, and more implications involved with this technology in the classroom.

Date: 20/01/18

Supervisor initials:

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Interim reflection

Candidate comments:

Progress has been good throughout my essay, but I knew I was lacking some primary research. I decided to create a questionnaire that was sent to all teachers at school. I chose to send it specifically to teachers because I wanted to see how the school experience was for them, how they gathered research without the readily available internet access that we are now exposed to. My supervisor also suggested I add two case studies to my essay. He suggested I look at two schools that have implemented Augmented Reality and what impacts it has had on the students and the school. In addition to this, I also looked at the implications involved with a bring your own device to school policy (BYOD). I decided that with the research I had done on BYOD I would add it to my conclusion to complete my evaluation of the effectiveness of this technology in the classroom.

Date: 15/03/18

Supervisor initials:

Final reflection - Viva voce

Candidate comments:

I have enjoyed the process of completing my extended essay. I have always had a natural love for technology and this essay has helped me grow that love and expand my knowledge on emerging topics such as Artificial Reality. I have enjoyed this adventure into the virtual and artificial world, but more than that I realized that I had learned a lot of things on these topics that I never knew before. Furthermore, I realized how my school can benefit from the research I have done and because of this will soon present to my teachers different apps and technologies that use Augmented Reality to help create a more enthusiastic and engaging learning environment for students.

Date: 20/1/19

Supervisor initials:

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