

Student creation of techniques to make learning
stick: an inquiry into the impact of student created
techniques on student retrieval and application of
knowledge in history

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A Research & Development Project

Submitted for the MSc in Learning & Teaching 2018

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ABSTRACT:

This paper details school-based research carried out to gather students' perceptions about how subject knowledge is retained and their perception of low stakes tests. The intervention was carried out with a sample of 64 students in Year 9, where two history teachers collaborated to construct and implement low stakes tests and evaluate their effect upon students' analytical writing. One class of 32 students also experimented with three techniques for remembering key information; dual coding; elaboration and using concrete examples. Questionnaires were employed to gather preconceptions at the start of the research project and at the end to evaluate any change in student views, this led to both qualitative and quantitative data; data was also gathered via qualitative techniques via semi-structured interviews with eleven students in two focus groups. Most students valued being able to choose the method of remembering the key information. Most students value repetition of retrieval tasks to embed substantive knowledge, however there was debate about the value of low stakes testing. Overall, students creating and evaluating their own techniques of remembering learning seemed to boost their self-confidence and lead to retention of knowledge over time. The key findings from this study have been collated to inform future use of low stake testing and analysing student essay writing.

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Section 1: Introduction:

1.1 Rationale:

The extensive and varied content:

Under Michael Gove, as Education Secretary, the government altered school qualifications and curriculum, responding to claims literacy and numeracy was subpar despite increasing numbers of students gaining good grades (DFE and Morgan 2013). It was argued the British education system was falling behind, 'compared to the world's best education systems' (DFE Gibbs, 2017). The desire to improve the British Education system led to a substantial reform of GCSEs. The new specification was 'modelled on the heavily fact-based systems in Hong Kong and Singapore' (Walker 2013). The more rigorous, GCSE specifications will be assessed for the first time in summer 2018. The specification for History includes an increased amount of substantive knowledge. The designated scope of study includes history from three eras, on three-time scales, from three geographical contexts including 40% British History, (DFE 2014).

There has been a shift in how schools are measured by the government. The new measure of accountability (DFE and Laws 2013), encompasses the whole grade range. Progress 8, measures how students have achieved in comparison to their expected attainment. Therefore, it is important students across the whole range access the new specification. 86% of respondents to the 2017 Historical Association survey thought the new GCSE was not appropriate for low prior attainers, 75% thought there was not a manageable amount of content, (Burn and Harris 2017). It seems important to consider methods whereby this substantive knowledge can be retained securely by all learners.

2. The longer time-span over which students need to recall what they have studied.

There has been an shift to a three-year GCSE, (Burn and Harris, 2017) over 44% of respondents to the Historical Association's annual survey state Key Stage 3 in their schools is taught over only two years. This trend has grown over the past 3 years, showing students need methods to retain what they learn over a longer time-span. In 2015 31.5 % of Comprehensives, academies and free schools taught at two-year Key Stage 3, this has risen to 44.8 % in 2016, (Burn and Harris, 2017). The removal of National Curriculum levels for KS3 caused a shift in focus. Schools are under pressure to move students to GCSE work as early as possible and over a longer time frame, with many 'adopting GCSE-style questions at Key Stage 3' (Burn and Harris 2017), raising concerns about how to access the assessment criteria designed for 16 years olds in Key Stage 3. The new GCSE is more rigorous, the Edexcel specification states, for 16-mark essay students must use wide ranging specific knowledge and justify the 'criteria' 'applied in the process of reaching the overall judgement' (Pearson 2015). The need in the new GCSE for students to create their own valid criteria for their judgements seems beyond the previous specification where students presented possible arguments.

3. The demand for more than simple factual recall

The new GCSE seems closer to the style of analysis required at A level, presenting the issue of how to enable all students to become adept at complex analysis. In the new Edexcel GCSE (2016) students are faced with eight question types, three require students to identify criteria and justify their judgements based on these criteria. In the previous Edexcel GCSE (2009) there were six question types with the top element of the mark scheme described as 'prioritis[ing] consequences or sees link between them' (Edexcel 2009) which appears a less demanding skill than formulating your own criteria.

The new GCSE 's for all subjects have an increased amount of content, leading to discussions with colleagues, some explained they value of low-stakes testing based on their attendance at PiXL Conferences. PiXL is a not-for profit partnership of over 1,600 schools, who 'share best practice to raise standards,' (PiXL 2017). The English team use 5-a-day starters where students complete a sheet of five recall questions. Other departments use low stakes quizzes; therefore, it seems important to evaluate the role of low stakes testing as it garners support.

It is important to remember within the new GCSE there are only 8 marks out of 168 (Edexcel GCSE 9-1) for pure substantive content; the rest is based on application of this knowledge; therefore, this cannot be the sole answer to enabling students to succeed on the new GCSE. The conflict of content over skills has long been a debate within the History teaching community, with the distinction between 'substantive historical knowledge and second-order knowledge' (McCrory 2015) being a useful way to think about students' progress and attainment.

The dual pressures of the wide-ranging content alongside the linear assessment at the end of a three-year course means it is important to consider what skills and techniques we are equipping students with to retain this knowledge and apply it at the end of the course.

1.2 Context

School A, an all-girls comprehensive school, attained an average Progress 8 score in the summer of 2017. The History GCSE results were in line with national average, yet lower than the expected rate of progress. The History Department at School A consists of two full time teachers, and one-part time teacher. School A is an upper school with an intake from multiple Middle Schools, where History is taught by non-specialists within a limited time frame. Students are engaged and eager to research events, but

often reluctant to make judgements. At the Middle Schools students tend to carry out projects. School A is a PiXL school and this year's development plan involves the use of LORIC (Leadership, Organization, Resilience, Initiative and Communication) skills across the curriculum. These transferable skills were identified by the National Career Service, staff are encouraged to identify opportunities using these skills within the classroom. Students are dedicated to producing high quality work, at times this appears to hinder their conceptual understanding. Students spend substantial periods of time organising their exercise book, which while commendable, impinges on their class time devoted to analysis. Developing students' initiative within the History classroom is a clear focus. As noted in my Part 2 assignment, Ofsted had concerns about the limited scope for students to develop as independent learners. The report commented on the lack of opportunities to work in small groups therefore the concept of student collaboration is important to the History department moving forwards. History GCSE at School A takes place over three years starting in January of Year 9. Arriving when the current Year 11s were in Year 10, I became aware students had retained little from their Year 9 curriculum. While their note books contained the relevant content and practice questions the Year 11's seem to have little memory of this learning. When revisiting the content in Year 11 they appeared eager to learn and edit their previous notes. Therefore, it seems imperative to alter the Year 9 curriculum to avoid this becoming an ongoing problem at School A. Currently five out of seven sets are taught by specialists, with the lower attaining groups taught by Geography specialists. Through informal discussion with Year 10 students, the majority have a reasonable memory of the Year 9 curriculum, yet when tested, they struggle with analysis. Therefore, the combination of making the learning memorable alongside developing students' understanding of what analysis is and how to carry out analysis seems key to supporting student progress.

1.3 Aims

This inquiry will investigate how students retain substantive knowledge and the relationship between retention of knowledge and the application of this knowledge. Students creating their own techniques to make their learning stick during their initial learning might enable them to retain this knowledge over a greater period. Empowering students through explaining research about memory could impact on their retrieval practice and engagement with the substantive content. Engaging students in metacognition might enable them to invest their time into techniques leading to retention of knowledge alongside the application of this knowledge. Exploring the relationships between conducting low stakes testing, different methods of retaining the knowledge, and the application of knowledge, from a student perspective might shed light on how far they feel ‘fingertip’ knowledge is important to being able to analyse. From a History teacher’s view, this inquiry might suggest ways to structure content to support the retention of knowledge based on cognitive psychology research. In my Part 2 assignment I explored the perception of students at School A about collaborative and independent learning demonstrated students value independence and collaboration. Students felt only confident learners can be independent learners, and feared time pressures and distractions when working collaboratively, might lead to a decrease in the standard of their work. Therefore, through students leading on their learning and co-creating their techniques for retaining key knowledge, perhaps they can become more confident in their own abilities which could impact on their written analysis. The development of student confidence and self-esteem through collaboration with peers and open-ended tasks might embed a greater ability to create analytical answers in an examination. The inquiry will inform how School A structures their History curriculum alongside its advice for the feeder Middle Schools on the importance of student led learning and analysis.

Literature Review-

Section 2: a review of techniques to make learning stick:

2.1 What are the key questions about making learning stick?

Students need to understand, comprehend and acquire new knowledge before any consideration can be given to the process of making this stick. If students engage in knowledge acquisition the next process is ensuring this is held in 'memory until it is needed' (Reisberg 2001 p131). According to Baddley's modal model (Medin et al 2001) information is first processed in the working memory before entering the long-term memory. The processes of retaining memories relies on embedding them in long-term memory. Cognitive psychology research argues it is the interaction between working memory and long-term memory that is essential for processing and retention of knowledge and creating long lasting memories. Effective remembering, it is argued, stems from paying careful attention to the material when it is first presented, (Medin et al 2001) and being engaged in thinking about the meaning of the material and how it fits into your pre-existing schemas. It is stated 'efficient knowledge storage and retrieval requires frameworks' (Mellanby and Theobald 2014, p.46) to acquire new knowledge, strengthening the argument, prior learning is key.

The phonological loop holds sound for a very short period and then the articulatory control process produces our own 'inner speech' (Medin 2001, p161), this is seen to be important for acquiring language and new words. The visuo-spatial sketchpad seems more relevant to this study, this is where visual and spatial images can be 'maintained and manipulated' (Medin 2001, p162), this element of the working memory is involved in planning and executing spatial tasks. It is essential students manipulate their understanding of events in their visuo-spatial sketchpad as planning and relationships are integral to analysis.

It must be remembered this is just the working memory, while things maybe understood they are not retained. Working memory does have a capacity limit; therefore, it could be suggested when students need to analyse and manipulate information they should not also be required to understand new information but instead have direct access to the substantive knowledge. Willingham (2004) presents, for undergraduate psychology students, a simplified version of memory encoding explaining whether ‘something is stored depends on what you do with it’ (Willingham p 179), arguing if the mind determines you may need to use this material again the information is stored. This demonstrates the selection of what substantive knowledge students are asked to revisit and how often is also key to making their learning memorable. Willingham bases his claim, emotion influences memory, on Cahill and McGaugh’s 1995 study where participants were told different narratives about a set of slides and tested on their recall of these slides. He reviews a range of studies from the 1980s and 1990s and concludes ‘the emotionality of an event does affect how memorable it is’ (Willingham 2004).

The first issue is the process of making long term memories in a history specific context. The second issue is how, once students have made memories, they retrieve these over a long period of time, (which can be measured through low stakes testing). Then in terms of this inquiry the third element is how students apply their memory of the substantive content to new environments, in this case analytical questions.

2.2 What does cognitive psychology argue makes ideas stick in students’ long-term memory?

Long term memory:

Cognitive psychology explains to make ideas stick, concepts need to be embedded in the long-term memory. It is clear ‘memory is neither a single entity nor a phenomenon

that occurs in a single area of the brain' (Bransford et al., 2000) for information to be recalled after a period of more than one week it needs to be within the long-term memory, explaining the brain is 'not a unitary construct' (p124). The idea that memory is multifaceted is supported by the claim 'the brain is actually not designed for thinking' (Willingham 2010 p.3) suggesting the brain's main purpose is to carry out tasks without undue effort, its processes are designed to alleviate effort to enable the brain to carry out multiple actions. Maybe by creating automaticity of thought, through retention of substantive knowledge, could improve students analytical processing skills. Brown et al (2014) states the most effective learning strategies are not intuitive, supporting Willingham's' claim, it's this aspect suggests students who are secure in their substantive knowledge can use more of their energy on unpicking the dilemmas or prioritising factors within the analytical question they have been asked. Yet this colloquial text is a summary of cognitive psychology research includes anecdotal evidence alongside research conducted with university students, therefore it is important to not overstate these claims. Willingham in his 2010 book simplifies the idea, the acquisition of knowledge occurs in the working memory between the phonological loop, central executive and visuospatial sketchpad (Willingham 2004) by arguing thinking is effortful, uncertain and slow (Willingham 2010). Underlining the problem is how under examination conditions can we support students to make thinking automatic, certain and speedy. Long term memory is not a set of 'discrete isolate fragments of information' (Fordham 2017) but instead 'the central dominant structure of human cognition', which is needed for students to 'be able to think effectively' (Willingham 2010). It is clear working memory has a limited 'space' for thinking, therefore we need to focus on developing the links between working and long-term memory when developing strategies for learning (Clark et al. 2012). Therefore, it is important the inquiry includes frequent opportunities for students to

practise recalling information under test conditions to acquire automaticity of thought while also including space for the slow and effortful analytical thought process.

Rote learning:

While rote-learning has been disapproved of within modern educational thinking, there seems to be some weight to the argument some level of ‘surface learning’ can assist with the processes needed for deep learning (Mellanby and Theobald 2014). There is a wealth of media coverage reporting rote-learning within the Chinese system leads to academic success, ‘Whereas Westerners see memorisation and understanding as mutually exclusive, Chinese tend to see them as related phenomena’ (Clow ,2013). The support within the British media for Amy Chua’s 2011 book, *Battle Hymn of the Tiger Mother*, alongside Gove’s statement British students need to ‘start working hard’ before they end up ‘working for the Chinese’ (West-Knights 2017) demonstrates a belief in the rote learning methods of China, notably the Shanghai ‘mastery’ methods are admired by the British government. The evidence for this claim is based on Shanghai’s top results in the PISA (Program for International Student Assessment Tests) and has led to British government funding of £41 million for over 8,000 primary schools to use the maths mastery approach. The support for rote learning seems strongest when applied to the mathematical or scientific field with the DfE basing their reasoning for funding the mastery maths programme on the fact the number of 15-year olds who are ‘functionally innumerate’ is 10% lower using these methods than those currently used in the UK (Gibb 2017). While there is a great depth of research suggesting the automatization of the substantive knowledge acquired through rote learning can ‘free up’ the working memory to engage analytical tasks; it is important to note the Chinese method of rote learning doesn’t encourage independent thought, which is appears so vital to success under the new GCSE criteria. West-Knights (2017)

explains the concept of 'assessing the rule of various monarchs' was seen as heresy by the Chinese teachers at the school she visited, demonstrating while rote learning leads to success in retention of knowledge it is perhaps not the sole method needed.

Although West-Knights is a journalist and may have chosen controversial language, the heart of the article demonstrates rote learning has a positive effect on retention.

Retaining substantive knowledge:

Cognitive psychology research suggests it is important students are exposed to knowledge and practice over a series of delayed sessions if the goal is to retain the information longer. While there is some evidence cramming works in the short term, it seems to lead to a sharp drop off in knowledge retention. 'Memories become stronger when we use them' (Fordham 2017) suggesting power in the use of regular low stakes quizzing. Brown et al (2014) support this, arguing retrieval practice is more effective than review by re-reading, which, merely offers 'the illusion of mastery' (p.16) Coe's review of 'What makes Great Teaching' states the technique with the lowest utility is re-reading, (2014) highlighting the idea students are unaware of the effectiveness of their methods of learning. Students tend to view re-reading as an effective method for consolidating learning, perhaps based on the illusion created by an increasing sense of 'familiarity or perceptual fluency' (Bjork and Bjork 2011, p.56) which can be perceived as a level of understanding, but this is a subjective concept. It seems students would benefit from understanding the value of different techniques based on cognitive psychology research to allow them to be engaged in the process of retaining substantive knowledge. Coe's review is part of research conducted for the Sutton Trust, a private UK foundation which aims to use research to improve social mobility. Drawing on research by Dunlosky et al. (2013) Coe argues the least useful learning technique is re-reading, supporting the idea merely re-presenting the information in

the same way is not altering students' memory. It seems important for learners to be actively engaged with the information to be most effective.

Interleaving knowledge:

Some history teachers argue interleaving knowledge is key to student success; if they are first introduced to the idea of monarchy in Year 7 and this knowledge is built on at GCSE, it will allow a complex analysis at A level of the strengths and weaknesses of monarchs (Fordham 2017). This idea of building up students' understanding and knowledge in successive layers is supported by the view long term memory needs secure meaning to aid effortful retrieval of substantive knowledge. To make learning stick over a long period, Willingham argues it should be incremental and based on repeated cycles, where the 'mental facility ... repeats[s] the target process again and again' (Willingham 2012 p.114) this supports the idea interleaving and distributed practice are essential alongside memorable learning experiences where students create links to established schema.

Techniques of retrieving knowledge:

Willingham supports the claim maintenance rehearsal, repeating material, which keeps the information in the 'articulatory loop of working memory' (Willingham 2004, p187) is a way of retaining the memory, he points out this doesn't move the information into the long-term memory. This claim is based on a 1979 study where participants examined a penny, an object people have viewed on a repeated basis, demonstrating 'sheer repetition of a stimulus' (Willingham 2004, p192) doesn't necessarily lead to the details being encoded in the long-term memory. Therefore, the multifaceted explanation of how long-term memories are created needs to be revisited. Repetition, it is suggested, can be helpful alongside other techniques. Based on Ebbinghaus's study, a

German psychologist in 1885, 'repetition is necessary' yet is more effective when accompanied by rest periods (Mellanby and Theobald 2014, p29) supporting the argument spaced repetition of learning and to some extent interleaved practice could be effective.

However, studies focusing on demonstrating recall of learning have shown 'activation sets into motion' (Bransford et al, 2000, p125) encoding of new knowledge in the long-term memory. Bransford et al, explain practice increases learning, resulting in a structural change of the brain, based on neuroscientists' research on rats where the weight and thickness of the cerebral cortex has altered suggesting the 'brain is a dynamic organ' (Bransford et al, 2000, p126) altered by experience. While this refers to studies on rats, the basic idea that repeated experience can consolidate learning in the long-term memory is relevant when planning how students learn. This research suggests all students can learn and retain information if they are within a 'stimulating physical environment and an interactive social group' (Bransford et al, 2000, p125). This is supported by Muijs (2012) who argued the connections between neural nets are unlimited and it is these structural changes that are important to retaining learning.

Feedback:

Dunlosky reviewed ten strategies for learning based on the premise that some seemed to be effective and others - for example re-reading - were perceived to be effective by students. The most effective learning strategies based on this review were practice testing and distributed practice as they 'boost student achievement' (Dunlosky 2013 p 13) which is the key measure currently relevant in the school context. However, he explains practice testing is most valuable when combined with feedback. He bases his argument on research from 1909 which showed practice testing improved student performance, while this seems dated research it is supported by an example of

university students in 2005 and McDaniel et al's research in a Middle School Science classroom in 2011 therefore this seems a worthwhile strategy to consider. Students benefit from retrieving a correct answer as this strengthens their memory of this item, indirectly they benefit from incorrect answers as students can direct their attention for further practice onto these items. Dunlosky argues the most important aspect of test taking is feedback, when students 'continue testing themselves' (Dunlosky 2013 p14) until they correctly recall an answer from memory as this will increase their chances of remembering the items in the actual exam. While he champions feedback for substantive knowledge it is important to also consider feedback to longer analytical answers. In conversation with my History colleagues at School A we discussed how we give feedback to students. The school policy is to use the S. I. R. process where the teacher records a Success normally linked to GCSE criteria then formulates a question in the form of an Improvement to move the student on and then leaves space for the student to Respond. In the recent departmental review, it became clear students infrequently respond to marking which my colleague explained was perhaps due to a lack of time or urgency to learn new content. Suggesting it is imperative students understand cognitive psychology research to understand the progress they can make, based on engaging with S.I.R. Dunlosky's ten learning techniques are used in the Sutton Trust article by Coe (2014) suggesting this holds weight in the current educational climate and is endorsed by CEM and Durham university, suggesting Coe has confidence in the research explored in Dunlosky's review.

Low stakes testing:

Brown et al explain a study conducted initially in 2005 and repeated in 2007 in an American classroom where two classes 'scored a full grade higher on material they had been quizzed on,' (Brown et al 2014, p35) showing testing has a significant positive

effect. However, this study doesn't explore the full reason for the increase; while students may have had an intention to learn, their technique for learning is not recorded nor are students' opinions. This was conducted in a Middle School in America. Brown et al, a text produced for the general reader, rooted in academic studies simplifies the arguments supporting the use of retrieval and testing. He argues it offers two key benefits, highlighting what information is stored and what is not; secondly this practice of recall strengthens the connections to previous learning, schemas, and suggests it makes it easier to remember this information in future (Brown 2014). Another study in a Middle School in America, compared student's retention of textbook material in Social Sciences over a whole academic year demonstrated students' performance was 'significantly greater for quizzed material than for non-quizzed material, (Agarwal et al, 2012 p439). This research compared quizzing to re-reading material and demonstrated students' performance improved when quizzing had taken place. Interestingly, students also seemed aware of the impact of the quizzing with 97% reporting the quizzes had 'increas[ed] their learning and 65% reported the quizzes decreased their test anxiety, (Agarwal et al, 2012 p 441). Agarwal et al's research was in a school setting with the quizzes (low stakes tests) delivered by classroom teachers therefore suggests this might be a viable technique to try at School A. However, the impact on student perception should not be over looked as this metacognition reflection and subsequent engagement with the process complicates determining which element is causing increased student performance. Agarwal et al used research by McDaniel (2012) in the same school to counter claims student were merely memorising specific answers, questions and styles of tests were altered yet students still performed better on previously quizzed material compared to non-quizzed material.

Memorable learning:

Willingham (2010) argues to make learning memorable it needs to be challenging and force the brain to make new connections between established knowledge and new knowledge. To engage in critical thinking, you need to have a secure knowledge base supports the argument substantive knowledge is the basis of learning, before analysis can occur. However, merely knowing 'a lot of stuff' (Willingham 2010 p44) is insufficient to access the higher order skills of comparison and analytical thought. This is taken further when he argues 'shallow knowledge is better than no knowledge' (Willingham 2010p 49) echoing the concept of teaching the 'Big Picture' referred to in edition 107 of Teaching History (2002) where an overview of substantive knowledge gives students an outline to make judgements. This is supported by the idea of initially teaching students a synoptic framework of History, as proposed by Shemilit and Blow, which would be 'continually re-visited and expanded upon,' (Howson, 2007 p 47) enabling students to have historical schemata to connect to new substantive knowledge about other topics. The basic substantive knowledge used frequently needs to be stored as an 'implicit procedural memory' (Mellanby and Theobald 2014 p46) thereby being separate from the working memory freeing up space on the visuo-spatial sketchpad for application of the content. 'Memorisation and making connections are two crucial components of learning,' (Muijs 2012 p54) demonstrating while schemata are important it is not just having the pre-existing set of knowledge that matters it is connecting one idea to schemata then taps into a whole cluster of information embedding the learning more securely in the long-term memory.

Mnemonics:

The use of mnemonics might improve students' retention of knowledge by giving the clues about the bigger ideas. Mnemonics have been used since Ancient Greece,

suggesting this might be effective to embed learning in the long-term memory. There are two main systems: peg-word systems, where lists are organised into structures, and method of loci, where mental images of places are associated with the items to be recalled. Neither of these are the kind of mnemonics generally referred to in education which are normally first letter mnemonics used to 'turn lists of items into an integrated single unit' (Reisberg 2001 p156). It is argued while this method assists in memorizing material it is of little use for understanding this material, therefore, supporting the argument multiple methods need to be used to secure knowledge in the long-term memory. Drawing on this argument, alongside the assumption 'pictures are better remembered than words', Medin (2001 p319) suggests using simple visuals could help students retain information over a longer period. However, the use of pictures alone is perhaps not as useful compared to the combination of pictures and words suggesting caution needs to be applied to choosing this technique (Bransford et al, 2000).

Schema:

Willingham (2010) argues those who start with more knowledge gain more knowledge as time goes on, showing all students need strategies to be able to gain and secure more knowledge. Schema exist within your long-term memory as a collection of 'generic properties of a concept or category' (Heath and Heath 2008 p53), this pre-recorded information can hook on new knowledge. He argues teachers intuitively utilise schemas to simplify complex information, basing this on the idea of proverbs which have been remembered for centuries. The fact schema exists supports the idea proposed by Brown et al (2014) engaging in elaboration could be a key method of retaining learning. He argues elaborative interrogation has some promise, allowing the student to self-explain, encouraging 'students to actively process the content they are

focusing on' (Dunlosky 2012 p 18) This supports Willingham's argument that engagement with the content is key.

Elaboration:

Dunlosky argues there is a lack of research into elaborative interrogation, yet the summary article from the National Council on Teacher Quality(NCTQ)'s review of strategies suggests asking probing questions, elaboration by another name, is one of the six strategies they think work(Pomerance et al., 2016).The NCTQ review is interesting as it is a collective of researchers and ex-teachers based in the USA comparing studies, notably without government funding. They are a 'nonpartisan, not-for-profit research and policy organization committed to modernizing the teaching profession' (NCTQ 2018); it is within this context that their summary findings are most useful as they claim to seek out 'concrete solutions to help solve teacher quality challenges' (NCTQ 2018). There are six strategies championed by Pomerance et al (2016) including pairing graphics with words, which is referred to as dual coding elsewhere, and linking abstract concepts with concrete representations, also called using concrete examples, as helpful for taking in new information. They suggest probing questions which encourage elaboration ensures students connect information to deepen their understanding. Yet it could be argued as learning via connecting information to established schema is the basis of elaboration, this is a way of learning new knowledge. This review is referenced in summary research on the blogsite run by the Learning Scientists who are Assistant Professors of cognitive psychology based in America who have a helpful summary poster of six key ideas that can help with effective learning (2018). This blog was the result of the Assistant Professors tweeting #AceThatTest and making connections with educators, professors and students about techniques for retaining learning.

Elaborative rehearsal:

It is suggested that elaborative rehearsal, where you think about what the 'to-be-remembered items mean, and how they are related to each other' (Reisberg, 2001 p148) has a significant positive effect on recall. Reisberg refers to this learning as relational, demonstrating the importance of schemas and use of analogies for securing deep memories. It is argued it is easier to remember 'JFK FBI NATO' than 'JFK FBI INAT' as the former taps into concepts, or schema, already in place in our long-term memory (Heath and Heath 2008). Empowering students with knowledge of how the brain works shifts their thinking might allow them to operate on a more personal level creating emotional long-term memories (Burn et al 2013). 'Factual knowledge only becomes meaningful in the context of a clear conceptual framework,' (Burn et al 2013) therefore understanding the role of schema seems essential for students to gain and retain new knowledge. Based on this idea of using existing schema, it can be seen 'knowledge of one thing can directly support the knowledge of another' (Fordham 2017).

Use of imagery:

Enabling students to engage with the learning material and gain feedback on their responses is important. Willingham (2010) argues 'memory is the residue of thought' demonstrating the way in which students are exposed to knowledge is important, they need to be actively engaged to be able to remember. The fact is not all memories are alike and there is the issue of 'storage strength' and retrieval strength' (Fordham 2017) comes into play when trying to get students to remember key examination material. Brown et al (2014 p11) argues learning is stronger when it matters, when the abstract is made concrete and personal. For example, 'the brutal removal of a teddy

bear's ear' (Burn et al 2013) is a clear and emotionally charged symbol enabling students even in Sixth Form to remember the events of the lesson they participated in in Year 7. Therefore, using imagery, however gruesome, could help student remember information, by engaging emotional memories. Heath and Heath (2008) argue using concrete ideas allows memory more 'hooks' for an idea supporting using pre-existing schemas embeds new substantive knowledge in a deeper manner. Yet this claim is rejected by Willingham who argues, based on incidental memory tests conducted in the 1970s that an 'intention to learn has no effect at all' (p190 Willingham 2004). He elaborates arguing if intention had a significant impact on learning then studying would be an easier task. Reisberg, (2001) supports this using the 1985 study of researchers' personal experience that purely having a desire for improving your memory is insufficient as the researcher scored lowest in the class despite having a strong intention. Resienberg argues 'intention does matter' (2001 p152) not in terms of how securely the information is retained but in an indirect manner as the person will select their own strategy and approach which may or may not be the most effective technique. Dunlosky (2013) supports this argument explaining students often value ineffective strategies due to a lack of knowledge about the process of learning.

Meta-cognition:

Heath and Heath argue some people are unable to improve as 'they are unable to distinguish between incompetence and competence' (2002 p 121), based on Dunning and Kruger's research, 1999, which explored strategies to improve students' metacognition. Perhaps through self-regulated learning students can become more effective learners and retain key ideas in their long-term memory. If teachers employ metacognition instruction student can monitor their progress, ultimately 'assess the kinds of strategies they are using' (Bransford et al 2000 p17). Allowing students to

choose which technique they should use seems logical, if they are then engaged in assessing the value of this strategy on their desired aim of retaining key information. If students become confident in their own metacognition 'rather than relying solely on external indicators' (p 17) they may be able to be more confident and ultimately engage more effectively with the process of securing knowledge in their long-term memory. However, this is a challenging task to 'develop the habits of mind to reflect spontaneously on their own thinking' (p21). There is a link between feedback and metacognition, it has been suggested feedback on correct answers is important as it improves student's confidence in their own abilities (Agarwal et al, 2012). Where students were given immediate feedback on answers they had guessed, their retention of correct knowledge increased alongside their reported confidence. It seems a culmination of factors affect student performance in retention of key knowledge, with students becoming confident in their ability to alter their own level of retention, as a valid starting point for making learning stick.

Overall, cognitive psychology suggests there is merit in understanding the process of how your brain makes memories as this can then be utilised to undertake more effective methods of learning. The use of repetition, mnemonics, elaboration and feedback all seem to be viable methods for effective learning. Underpinning these methods, it seems key to connect new substantive knowledge to pre-existing schemas within students' brains to embed the conceptual understanding of the new learning.

2.3 What does literature about History teaching suggest makes ideas stick in students' long-term memory?

Long term memory:

Fordham explores cognitive psychology research in relation to history teaching aimed at classroom teachers. He highlights how cognitive psychology is regaining traction by being 'lauded by government ministers' (p37 Fordham 2017) yet states this is an idea worth exploring as it has a wealth of research. He proposes seven methods that may impact on creating stronger memories: Retrieval practice, spaced practice, interleaving, dual coding, elaboration, concrete examples and the power of story. Counsell argues teachers need to plan for students to secure substantive knowledge and create tasks to enable students to understand the power of secure substantive knowledge (Counsell 2017). Therefore, Counsell supports Fordham's summary suggesting specific tasks focused on creating long term memories are important in History teaching. Underpinning Dennis' research project is a reflection on Willingham's claim lessons need to be designed around 'what will it make students think about' (2009) which further supports Counsell and Fordham.

Low stakes testing:

Dennis explores the claim low stakes testing is key to retention and use of substantive knowledge, (2016) this claim is co-examined within the context of Willingham's summary of cognitive psychology (2009). He concludes testing 'secured knowledge' (Dennis p25 2016) demonstrating some support for this method. Fordham counsels caution on the use of low stakes quizzes explaining learning lists of facts can work against the purpose of attaining understanding as students are 'more likely to remember something if it is meaningful' (p40 Fordham 2017). He defines retrieval practice as 'any activity that asks us to recall something from memory,' (p30 Fordham 2017) this clarification is needed as there has been a tendency to see only low stakes

quizzes as retrieval practice. It is important students engage in effortful retrieval of substantive knowledge to develop their understanding. The specific history substantive knowledge becomes, over time, schemata allowing students to interpret their understanding of new historical knowledge, therefore retrieval tasks such as timelines and connecting ideas in diagrams are perhaps more effective than low stakes quizzing as they allow students to velcro their ideas together (Heath and Heath 2008).

Dual coding:

Dual coding is the idea of presenting information in more than one way, (Fordham 2017), with text and visuals. Fordham alludes to Kolb's view of preferred learning styles critiquing the concept of dual coding. The concept of preferred learning styles is now seen as outdated and unhelpful within the history teaching community, Fordham argues dual coding may help all learners while recognising the way this technique has been used in the past. The NCTQ review stating the second lowest utility method is imagery use for text learning, dual coding, (Coe 2014), to some extent echoing Fordham's reservations. However, dual coding as defined by the learning scientists blog (2018), students can create their own combination of key ideas in visuals and key words, argues students are more likely to remember something if it is presented 'with both text and visuals' rather than just one i.e. text or visuals (Fordham 2017). Dennis explores the historic use of mnemonics, a dual coding process, explaining there seems to be a lack of research evidence supporting their usage, yet he concludes there some sort of device, is needed to structure students' learning (2016). Dennis alludes to some support for mnemonics as a method of memorable learning as a contrast or support to low stakes testing, it is the 'storage of memories' (Dennis 2016 p28) is perhaps because students' retrieval of key information for the low stakes

testing is based on the way in which they initially learnt and understood new knowledge.

Elaboration:

Elaboration, linking newly acquired knowledge to existing schemata, might increase the storage strength of the new knowledge. This is not just in the manner how students learn the information but also how they use what they have learnt, for example giving students tasks where they spend time thinking about and articulating the links between previous and new knowledge, (Fordham 2017). This is echoed by the claim 'factual knowledge only becomes meaningful in the context of a clear conceptual framework' (Burn et al 2013). Concrete examples are argued by Fordham to be a technique which assists in remembering more abstract ideas (2017). Hirsch's argument, we use past knowledge to interpret (Counsell 2017) our present experience is used to support the claim, elaboration and concrete examples embed schemata in students' long-term memories. She argues schemata are a shorthand enabling students to gain layers of meaning from substantive knowledge within context demonstrating within history it is not just recalling the key terms leads to progress but rather the use and understanding of that term in context. Hammond's (2014) research showed more complex analysis was based on wider or use knowledge rather than just the topic specific knowledge. Hammond and Counsell's research suggest elaboration is a relevant method to explore when learning substantive knowledge as it links pre-existing knowledge with the new.

Concrete examples:

Using Top Trump cards about the League of Nations shows the use of concrete examples can be powerful when students are asked to apply this knowledge and create

judgments. The teacher described their practice suggests while creating a list of concrete examples was important, it was the repeated use of this information that developed students' analytical writing (Burn et al 2013). This demonstrates it not just one technique which embeds knowledge in students' long-term memory rather maintaining their interest and ensuring they use 'that knowledge in different ways', (Burn et al 2013 p 42).

Stories:

Fordham mentions using stories, acknowledging there is limited research due to the focus on maths and physics education. However, History is by its very nature a story, or narrative, 'historia' means enquiries in Greek and 'histoire' means story in French. It is this combination of narrative and argument is essential to improving in History. Despite the lack of literature on this technique it remains important as the desire for analysis must not overshadow the engaging narrative of events. The difference between the fields of science and history is shown by the fact history is a cumulative 'rather than a hierarchical subject' (Counsell 2017 p92) while in science it may seem illogical to teach content out of order as students need to understand one before the other in History the non-hierarchical content is evident due to the range of content. Therefore, having a sense of story within the big picture of history could make substantive knowledge more memorable.

Overall, literature about History teaching suggests teaching developing students' schemata is key. It is suggested this is carried out using elaboration, dual coding and retrieval including low stakes testing.

2.4 What impact does cognitive psychology suggest testing has on students' retention of knowledge?

The paradox of learning versus performance is a constant in education, teachers need to observe and measure the attainment of students. Learning can be defined as the 'more or less permanent change in knowledge or understanding' (Bjork and Bjork 2011 p57) which is only partially evident through any testing. Creating desirable difficulties through testing can increase the storage strength of the learning. Testing as a means of retention of knowledge is seen to be powerful in the short term yet its long-term impact seems to be rarely researched, (Carpenter et al 2008). Retrieval under testing conditions maybe a 'powerful memory modifier' (Bjork and Bjork 2011, p57) implying testing can have a positive impact on retention of knowledge.

There is a wealth of research demonstrating taking tests leads to information being more likely to be remembered (Carpenter et al 2008,). Carpenter's review argues using tests as 'learning devices' (Carpenter et al 2008, p761) can improve learning and retention. Yet it is noted experimenters found the highest level of recall was for items which had been previously tested, (Carrier & Pashler 1992) highlighting a concern about which items should be included in the recall tests.

Carpenter et al (2008) explore the use of testing within their case study research in an 8th grade classroom in the United States focusing on students' retention of factual knowledge. There is an acknowledgement previous studies have been conducted in college level situations and often in laboratory settings, this research gives some level of comparability to an inquiry set in a secondary school in the UK. Carpenter's 2008 study extends the 1940 Sones and Stroud research based on 7th grade students over 42 days, Carpenter's research lasted one-year addressing the issue of long-term impact. The study demonstrated testing was beneficial supporting previous studies (e.g. Carpenter & DeLosh 2005;2006 Carpenter &Pashler 2007 Carpenter et al 2006)

Interestingly the 16-week delayed testing did not seem to have a negative effect on the retention of knowledge, supporting the claim information is ‘better retained when it has been reviewed on two or more occasions’ (Carpenter et al 2008 p766).

It is argued within a college level course ‘the benefits of tests appear to grow more pronounced’ (Kornell et al 2011p 86) with longer intervals, delayed testing is supported by effortful retrieval strengthening neural pathways. Yet re-testing students after 9 months there was a low level of recall with 8th grade students, Carpenter suggests this is consistent with real-world learning and studies conducted with adults. Merely testing alone does not seem the most appropriate action to ensure students have a secure level of substantive knowledge. Perhaps applying research based on college students is inconsistent with teenagers whose brains and learning techniques are still developing. College students generally have a vested interest in making progress in their course compared to students in 8th grade who have not chosen their curriculum. It is acknowledged when interviewed the students involved in Carpenter’s study (2008) reported using re-reading information as preparation for tests, therefore the way students prepare needs to be examined. Kornell states ‘tests without feedback are not an efficient way to study’ (2011 p95) demonstrated testing alone does not prevent forgetting, perhaps discussion and understanding of the material is what makes information memorable.

The benefits of testing appears to ‘grow more pronounced as the retrieval interval from restudying or testing to a final test increases’ (Kornell 2011 p86). Using recall testing within a scheme of learning has been empirically demonstrated to have a positive effect on the learner’s retention of the knowledge (Carrier & Pashler 1992). The actual act of retrieval under test conditions is seen to be a powerful learning event. While the use of mnemonics appears to benefit learners under short term

testing this does not seem to have potency over a longer period, raising questions about how students learn the information needed for a test (Wang and Thomas 2000). Wang and Thomas's research using mean word recall demonstrates with delay rote learning results in the lowest number of recalled words with the use of loci as resulting in the highest level of retention. Loci was defined as learning to remember information based on 'landmarks in an imaginary walk' (p334 Wang and Thomas 2000). Using organisational or imagery-based techniques, dual coding, showed a more consistent recall from no delay to delayed testing, suggesting this method of learning information could be effective to demonstrate progress under testing conditions. Wang and Thomas (2000) suggest mnemonic training might help college students who do not generate their own methods of consolidating learning, which strengthens the argument this inquiry might benefit students by teaching them possible methods of retaining key information. By arguing the benefits of mnemonics was 'due to more than the instruction to convert the words into mental images' (p565 Roedinger 1980) strengthens the view learning information for testing should be conducted using a variety of methods.

The effects of distributing practice, i.e. testing over a long period of time are seen to have an increasing impact on retention. If students study the same information on multiple occasions and are tested frequently this will strengthen their retention. The mathematical formulae present by Benjamin and Tullis (2010) demonstrates while in theory this is a strong relationship, there are inconsistencies in the reality of the results. It is argued to strengthen levels of performance under testing the processing on the 'two study occasions must be of an interactive, rather than independent nature' (Benjamin and Tullis 2010, p238) suggesting a level of collaboration could be beneficial.

Cognitive psychology demonstrates repeated testing over a longer period has a greater impact on retention.

2.5 What impact does literature about history teaching suggest testing has on students' retention of knowledge?

Literature about history teaching focusing on testing is rather limited. Dennis explores the view testing students regularly will directly lead to improved attainment (2016); highlighting how this seems short sighted, as if it were that easy, why haven't schools been using this technique before. Donaghy (2014) roots his research in the work of Didau, exploring repeated testing leading to greater retention than repeated studying. Donaghy's results suggest the testing itself is the cause of the retention as many students improved their retention of knowledge over the series of tests. However, Donaghy's questions were repeatedly tested until students gained secure knowledge compared to Dennis who mixed questions each week therefore their contradictory beliefs could be due to their methods.

Dennis used low stakes testing to give students independence, based on Hirsch's argument if students have knowledge they can perform at a higher level (2016 p 22). This seems laudable, however the basis of Gove's 2009 curriculum change seemed to be anything if emancipatory in creation, the focus on valuing rigour and what he deemed 'proper' suggests the powerful determine the knowledge basis needed to be part of society. Therefore, students need to be equipped with techniques to improve their chance of retaining and understanding the amount of substantive content.

Dennis argues while testing seemed effective in the short term, time scale is important as students are examined on linear courses and increasingly schools are teaching GCSE content in KS3 (Burn et al 2017). Dennis critiques previous research based on testing

knowledge students had learnt initially a week prior therefore there was little time for forgetting to have occurred. He argues Donaghy's research lacked a timescale which Dennis addressed in his own research. Dennis's small-scale research supports the argument low stakes testing is powerful as a method of increasing student performance, however it is unclear whether this was due to the observable effect of being measured, the feedback the students received or the repetition of effortful retrieval. Donaghy (2014) demonstrates low stakes testing led to progress on end of topic assessments where 15 out of 21 students achieved 'at least in line with their target grade' (Donaghy 2014 p47). This small-scale research certainly demonstrates progress in attainment over a relatively short period, but it is difficult to conclude the improvement in low stakes testing directly related to the improvement in end of unit assessments.

Dennis (2016) explores one student response about the emotional connection to being measured, be it low stakes or not, leading to engagement with the learning, yet he explains there is a lack of literature about the 'social and motivational effects' (2016 p25) of low stakes testing. Donaghy (2014) supports this claim concluding the use of testing impacts on engaging students with the precise content being tested.

Therefore, it seems pertinent to conduct student focus groups to explore student's perception of the impact of low stakes testing upon their progress. Literature based on History teaching suggests low stakes testing can have impact on retention, but it is not wholly convincing.

2.6 What impact does collaborative work have on student retention of knowledge and engagement with tasks?

Collaboration can a variety of types of cooperative learning, either created groups such as jigsaw groups or through students learning together to understand new

content. Collaboration for this inquiry is defined as students ‘working together in a group small enough everyone can participate on a collective task that has been clearly assigned’ (Cohen 1994), where students engage in the task without direct supervision. Cooperative or collaborative learning has been defined by the DCSF as independent learning where teachers operate in an enabling or supportive capacity where students self-regulate their own learning (Meyer et al 2008).

Collaboration is seen to impact on student retention of knowledge due to results on achievement tests. The metadata analysis (Johnson et al 2000) of over 164 studies where cooperative learning was used seemed to promote higher achievement than competitive or individualistic efforts. Considering ‘cooperation is superior to competition in promoting achievement and productivity’ (p56 Johnson et al 1981) could mean it matters how the results of low stakes tests are shared with pupils. Yet caution is urged about these findings as the effect sizes were calculated on a variety of tests including standardised and non-standardized tests (Johnson et al 2000) which may skew the results. This is supported by Cohen’s (1994) claim the literature is inconsistent showing frequency of collaboration does not directly link to achievement. Cohen concludes there is enough evidence to suggest low achieving students’ benefit being in heterogeneous groups rather than solely low achieving groups, therefore grouping must be considered in this inquiry. TGT (Team Game Tournaments) are the most widely used cooperative learning technique and appears to have the largest number of positive effects on achievement (Slavin 1980). Students operate in small heterogeneous groups to work together to achieve a group score on quizzes. Slavin questions the effects of TGT on Social Studies research cases, arguing students may be learning methods to approach high level material but the results may be skewed as their ‘learning of the facts may not correspond enough to the content of the post-test to show a difference’ (Slavin 1980 p334) as he explores the issue of process versus

factual knowledge. Therefore, it is relevant to consider the relationship between low stakes quizzes and analytical writing completed by students in this inquiry as students may improve on their analysis but not necessarily on their low stake quizzes.

Collaboration impacts engagement due to an increase in friendliness (Sharan 2015) where students are encouraged to co-operate rather than compete. Yet caution needs to be applied as Mercer (1995) argued collaboration is not inevitably useful, and students need to be instructed in how to collaborate effectively. Engagement might be more important than collaboration, as ‘students in classes using cooperative learning generally report greater liking of school than do traditionally taught students’ (Slavin 1980 p338) suggesting part of the reason why collaboration leads to increased student achievement. Collaboration appears to lead to ‘increased motivation and confidence’ (Meyer et al 2008 p2) and increase attainment as students each take on part of the information, not overloading their working memory (Muijs 2012). Kahl and Woloshyn’s (1994) study explores not just collaboration but the use of elaboration. Students worked together to generate answers to why questions. In free recall and immediate associative matching tasks student in ‘cooperative elaborative interrogation’ (Kahl and Woloshyn 1994 p471) outperformed the control group however their performance was very similar the group who used elaboration but not collaboration. This study is intriguing as the results showed little gains in terms of achievement for the students who worked in a collaborative manner contradicting the work of other researchers (Davidson and Shearn 1990; Watson, 1991). As students didn’t use their prior knowledge to support or clarify new information in this study, suggests the use of cognitive psychology perhaps is more important to improved retention of knowledge than collaborative learning techniques.

Overall collaboration does seem to improve student engagement however its impact on retention of knowledge seems to be less well explored within the literature.

2.7 Defining research questions

There seems to be great support for the use of elaboration and dual coding as techniques for learning and retaining new information. The use of repeated testing seems to lead to higher retention rates. While collaboration does seem to have some value for increasing engagement it has a less convincing effect on retention of knowledge. The key seems to be using schemata to secure new learning within student's long-term memory. For this inquiry there will be four key research questions:

1. What are students' perceptions about memory making?
2. How do students' respond over time to regular low-stakes testing ?
3. What impact does students' learning about cognitive psychology related to memory making have on their engagement with retrieving substantive knowledge?
4. What impact does low stakes testing, and creation of memorable learning summaries have on students' analytical writing?

Section 3: Methodology

3.1 Overview

Exploring the value of low stakes testing, based on Dennis (2016) and Donaghy's (2014) findings, I decided to create a bank of questions in collaboration with the history department. I had reservations about the value of low stakes testing alone, as Reisberg (2001) and Willingham (2010) suggested it was the use of multiple strategies that embed knowledge in the long-term memory. I decided to compare two classes, one control class who undertook a series of pre-determined low stakes tests taught by my colleague and my class who would also gain some understanding of cognitive psychology and metacognition exploring techniques of remembering substantive knowledge. Alongside my colleague we decided to use classes with similar target grades, to evaluate the impact of the low stakes testing alone compared to empowering students with knowledge of the reasoning behind repeated testing and creating revision notes.

This research was conducted over five months with two classes in Year 9 at School A studying GCSE Edexcel Early Elizabethan England. Year 9 consists of a seven-class cohort, based on their predicted attainment, from highest to lowest. Class 3 and Class 4 are the most similar in terms of predicted attainment and SEND students, therefore I chose to use these two classes despite the fact they had different teachers.

This was applied research project sought to evaluate the impact of the initiatives of using low stakes testing and teaching about cognitive psychology. Kurt Lewin argues research is 'deliberately intended to change the life chances of disadvantaged groups' (p344 Cohen et al 1993). The focus of this research project was to evaluate the impact on students' chances of retaining key substantive knowledge and the impact on their analytical writing in Year 9 to support students at risk of not achieving their target

grades in Year 11. One of the limitations of this research project is its timescale, the full value of this intervention will not be apparent until these students reach Year 11. Use of two classes taught by myself and a colleague allowed for collaboration in the design of the intervention via the structure and choice of the low stake tests and analytical questions. A mixed methods approach was chosen, due to the small sample size where quantitative data would not give definitive results. Qualitative data allowed me to learn as much as possible by understanding students' responses to the intervention. There was no control group to compare the impact of low stakes testing, as both classes adopted this intervention so by adding in qualitative data I was able to look in detail at the nature and quality of work the students produced. The methods chosen included questionnaires and collecting the scores of low stakes tests to provide data about the students' capacity to recall information in a test over time, alongside analysing student focus group responses', analysing student writing and student created techniques of remembering substantive knowledge.

3.2. The Intervention

The intervention consisted of a six of low stakes tests conducted over five-month period for both Class 1 and Class 2. The questions were predetermined, I constructed the questions, when reviewing them my colleague highlighted one quiz didn't have new questions prompting me to add new questions. The questions repeated within the test series. Test one was all unseen questions as was test three, however all other tests had a mixture of new and previous questions, test five contained questions from all previous tests alongside two new questions. This format aimed to test students on key knowledge they would need for the analytical questions, the tests focused on concrete examples. This test format was not designed for students to gain mastery of the specific questions (Donaghy 2014) but along the lines of Dennis (2016). While

School A ensured through line management meetings departments were carrying out low stakes tests there was little discussion about the method of creation of these tests. Therefore, subject meetings with the History team focused on planning which elements of substantive knowledge we wanted students to focus their thinking on (Willingham 2009).

Class 1 were taught an introductory lesson where they were given a simple summary of the literature from Willingham (2012) and Brown (2014). They also received a handout of the learning scientists blog (2017). At regular intervals Class 1 had time, in pairs, to create their own technique for learning the information in a memorable manner. They were restricted to choose from dual coding, elaboration and concrete examples, to enable students to evaluate the strategies (Bransford 2000) while working in collaboration to ensure engagement (Slavin 1980).

3.3 How to investigate the steps introduced i.e. methods and what data collected.

To investigate students' responses and perceptions; I conducted an initial questionnaire giving qualitative and quantitative data about student's perceptions before any intervention had occurred. The scores students in both Class 1 and Class 2 on the six low stakes tests were collected, to track student performance. The questionnaire was completed again at the end of the intervention. Two focus groups, one from each class, Class 1 - five students, Class 2- six students- were conducted to gather further qualitative data about students' perceptions of the interventions. To gather information about the impact of the interventions on analytical writing; students' essays were marked by myself and my colleague according to the Edexcel Mark scheme. The essays of matched pairs were coded to analyse the type of knowledge and use of knowledge to support analysis. Once students had written their initial pieces of analytical writing my colleague and I moderated our marking.

3.4 Ethics

it was important to ensure the best interests of the students were at the heart of the investigation. I decided both classes would use low stakes testing as there seemed to be a wealth of cognitive psychology research as well as education research demonstrating its positive impact on student performance.

However, there was little research on the use of exploring the use of teaching students about long term memory, so this seemed appropriate to just use with one class until a positive effect could be measured.

The other five classes experienced low stakes testing based on the pre-existing scheme of work. It is normal practice within School A for students to take part in low stakes testing and write analytical essays, however as this data was going to be used anonymously for this research it was made clear to both Class 1 and Class 2 at the beginning of the project their results would be collated and analysed to inform the ongoing development of the History department at School A.

Students in both classes were informed at the beginning of the unit they were involved in the research and could choose to consent to their participation in the questions and focus group.

The initial page of the questionnaire (Appendix B) explained the students had a choice to complete the questionnaire or not. Students were told their answers would be kept anonymous, it was explained to them their names were only required to compare their answers at the beginning and end of the research. On the questionnaire there was an opt-in box for students to tick if they wished to participate in the focus group. The answers from the questionnaires were anonymised during my analysis, with the matched pairs being given pseudonyms for comparison.

Completion of the questionnaire was explicitly made non-compulsory, in Class 2 18/32 the first questionnaire, and 27/30 of Class 1 and 22/32 Class 2 completed the second

questionnaire. The questionnaires were conducted on paper in class time then to explain their opinions with no time limit.

I chose the students who had opted into the focus group on both questionnaires to ensure the students still wished to participate in the focus group at the end of the project. Before the focus group started they were informed their comments would be made anonymous and the data stored on a password protected file. It seemed important to conduct the focus group during normal lesson time as this is how the SLT (Senior Leadership Team) at School A carry out their focus groups. I did not remove them from a core subject, and at the beginning of the interview I asked if any student wanted to return to their lesson rather than be in the focus group. No student returned to lessons. There was no time limit set for the focus group, students were encouraged to freely express their ideas.

My research was conducted within BERA research guidelines and gained ethical approval via the CUREC form (Appendix A). Data collected has been stored securely in a password protected file. Questionnaires were named but have been kept stored in a locked filing cabinet. The focus group conversations were audio recorded and kept in a password protected file, will be deleted after the completion of my dissertation, students were made aware of this prior to the recording of the focus groups.

Transcriptions and matched pairs descriptions use pseudonyms. To avoid adding to the workload of my colleague the data collected was photocopied from their normal mark book and anonymised, a scan of this is kept in a secure password-protected file. All student identities have been anonymised. I followed normal school procedure of data protection of student data, and I have not included anything passed to me in confidence in my role as a teacher. All documents created by students will be safely destroyed after the completion of my dissertation.

3.5. Method of research

When approaching which methods to use for each research question it became apparent a mixed methods approach was useful to allow for triangulation of data. My research questions compared data from both classes to evaluate the impact of the additional input Class 1 received in terms of explanation about cognitive psychology.

Summary of methods used to answer each research question

Method	Questionnaire	Low stakes test	Analytical writing	Focus group	Use of cognitive psychology technique
RQ 1	/			/	
RQ2		/	/	/	
RQ3	/	/		/	/
RQ4		/	/	/	/

RQ1: What are students' perceptions about memory making?

Students perceptions were gathered via the questionnaire, the six initial questions were open ended to allow students to express their views and referred to any type of learning, (Appendix B). To find out the view of students about memory and learning, was conducted via open ended questions.

Question one and two aimed to find students' preconceptions about cognition and process of remembering information. Question three aimed to find out their view about repetition of learning tasks. Question four, five and six were linked to the issue of engagement and collaboration. The student's responses to Question two, four, five

and six were coded to allow for analysis, this coding arose from most the common words used in the responses.

The second part of the questionnaire focused on History, asking students to rate a variety of possible strategies for retaining substantive knowledge. A rating scale was used to compare the intensity of their responses. This section of the questionnaire was quantitative, converting the Likert scale into numerical data to tally the number of student responses rating each method. Students were asked to record their names, for comparability purposes, it may have led to some bias based on the knowledge the teacher researcher would know what they had chosen. However, the triangulation of this data with the qualitative responses from the initial six questions and the focus groups discussion may account for any issues.

Quantitative approaches were used to investigate student perceptions. Questionnaire responses were typed into a spreadsheet to allow data analysis and coding. Students had the opportunity to write comments, which might ‘substantially augment and explain the findings from the quantitative data’ (p42 Menter et al 2011) of the questionnaire section where students rated comments on the Likert scale.

Semi-structured interviews via focus groups were used to extrapolate the specific comments given by the students on the questionnaire as ‘complementary qualitative data (p41 Menter et al 2011) delving more deeply into their thinking.

During the focus groups the researcher took a subordinate role with outline questions to stimulate and focus discussion raising the next question when the first one had been exhausted. Through discussion the researcher was able to react to the responses of students ‘develop[ing] hypotheses’ (Cohen et al 2013 p412) from the questionnaire responses.

To some extent the responses of Class1 demonstrated the mutual trust, as the class taught by myself ‘co-construct[ed] the interview’ (p410 Cohen and Manion 2013)

students' expanded and responded to each other's comments compared to Class 2 where the students did not know the researcher except in an authority role leading to shorter answers. This demonstrates caution needs to be applied to the data from the focus groups as it 'is socially constructed within the interaction of the group,' (p114 Merriam and Tisdell 2015).

RQ2: How do students' respond over time to regular low-stakes testing?

The impact of the intervention of repeated low stakes testing was measured from the first test to the fifth test. These kinds of tests are normal class room practice and gave quick feedback on student performance. The statistics available from this method were analysed using their mean (Cohen et al 2003). While non-parametric tests seem to be best used in specific situations such as one class, one-year group. As the research was underpinned by finding 'information about exactly what a student has learned' (p319 Cohen et al 2003) criterion-referenced tests seemed most useful to evaluate the amount of substantive knowledge retained by students.

The impact of low stakes testing will also be measured via the qualitative comments of the student focus group with regards to their perception of the impact of the low stakes testing.

RQ3: What impact does students' learning about cognitive psychology related to memory making have on their engagement with retrieving substantive knowledge?

Class 1 was given summary information based on cognitive psychology research suggesting dual coding, elaboration, and concrete examples have positive impact on retention of knowledge. This was delivered during Lesson 1 and revisited in lesson 10 (see Appendix C). The students also received a handout (Appendix D).

After each set of new substantive knowledge students worked in pairs or small groups to create techniques to remember key information, they were given at least 15 minutes each time for this to occur (Appendix E). Students were seated based on similar target grades, with those less engaged seated near the front to encourage their participation and allow teacher support with ideas.

Students were set retrieval practice, as homework monitored by parental signature as evidence. While this technique of students self-testing, (Mellanby and Theobald 2014; Willingham 2012; Coe 2014) has support it was difficult to manage and relied on the student's self-regulation (Heath and Heath 2008). Class 2 did not carry out retrieval practice for homework.

RQ4: What impact does low stakes testing, and creation of memorable learning summaries have on students' analytical writing?

Class 1 had not only the six low stakes tests, but lessons about cognitive psychology research, and created their own techniques for remembering key information and retrieval practice for homework.

The scores of both classes analytical essays based on the exam board mark scheme gave numerical data.

Students' analytical essays were coded (Counsell 2016) and compared on a matched pairs basis, to evaluate any change in student use of substantive knowledge. I chose to use matched pairs to conduct the analysis in a timely manner. There are inherent limitations of the between-participant design of this research project, due to the range of students' academic attainment and engagement with history within the two groups.

I chose to compare six pairs of students with comparable FFT target grades have chosen History GCSE and have completed the questionnaires. This allowed

comparability removing some of the problems student engagement might have upon their written work, (Churches and Dommett 2016).

As I wished to compare students of similar attainment it seemed best to use FFT scores; the Fischer Family Trust a non-profit organisation estimates students GCSE results based on their previous attainment in national tests, their gender and month of birth. FFT 20 is based on schools in the 20th percentile for progress and predicts student attainment based on how similar 'pupils nationally performed in the subject last year,' (FFT, 2018).

The matched pairs were selected on:

- a) Their FFT 20 grade
- b) They had completed the initial questionnaire
- c) They had chosen History GCSE on their initial preference form handed into School A.

The pairs consisted of:

- 1) Gloria Class 1 and Ellie Class 2 FFT5
- 2) Sarah Class 1 and Elaine Class 2 FFT5
- 3) Rachel Class 1 Alice Class 2 FFT6
- 4) Blossom Class 1 and Aaminah Class 2 FFT6
- 5) Sugar Class 1 and Claire Class 2 FFT7
- 6) Nazam Class 1 FFT8 and Amy Class 2 FFT8

I was unable to find students with FFT of lower than Grade 5 who met the criteria in both classes.

Discussion with History colleagues raised the issue of analysing the content and phrasing students used in their analytical essays. A coding system was created in advance, based on the exam mark scheme and on reflection and analysis of student

work. This comparison allowed a measure of the amount of substantive knowledge recalled under examination conditions.

Matched pairs essays were compared based on coding their use of knowledge:

- a) General knowledge
- b) Period knowledge
- c) Specific knowledge lacking detail or examples

Specific knowledge supported by details or examples (Counsell, 2017)

General knowledge in this context was defined as any knowledge student could have acquired outside of the History classroom and could be applied to any period. Period knowledge shows an understanding of the Elizabethan Era itself. Specific knowledge was defined in this instance as details specific to the exam specification of Early Elizabethan England showing clear understanding of the context, supported by specific details or just showing clear understanding.

Their analysis in relation to the specific question was coded:

- a) No application to question
- b) Vague or poorly expressed application to question
- c) Direct application to question

No application to the question was defined as where knowledge was ‘dumped’ and not explained at all. Vague or poorly expressed application was where in an implicit or clumsy manner the student had attempted to link the detail to the conceptual focus of the question, Direct application was where the knowledge was used to support an argument. The qualitative research method of pre-determined coding was used to determine what features were defined as analysis and therefore evaluate any subsequent improvement.

3.6 Collaboration

I was aware of possible difficulties collaborating as my colleague was a new member of staff whom I line manage. This power dynamic may have influenced the collaboration aspect as despite asking for feedback at every stage, limited feedback was offered by my colleague, just 'yes looks fine'. The different levels of engagement with pedagogy and the project between the researcher and the other practitioner may have affected the data collected. My colleague was perhaps more focused on establishing themselves in the school and understanding the new specifications and content for both A level and GCSE's which they had not previously taught.

3.7 Limitations

By the ninth lesson students had chosen whether to continue with History GCSE into Year 10 therefore this may impact their engagement with History.

The disadvantage of using two classes was the impact of the different teacher's interpretation of the tasks set. Class 2 were set the analytical writing as homework pieces except for the final assessment while Class 1 completed three of the five assessments in class, one as homework and omitted one. Therefore, it seemed most valid to compare the analytical writing of the first essay and the final assessment which was conducted with closed books to assess the amount of substantive knowledge retained alongside the development of the student's analytical writing.

The student focus group may have been limited by the dynamics of the interview situation, where the interviewer wanted to move the conversation onwards and may have limited students' responses. I aimed to follow Arksey and Knight's suggestions (Cohen and Manion 2013, p423) avoiding giving signs of approval or disapproval to the responses and rephrasing questions to allow the participants to fully comprehend the

hypothesis or question at stake. However, as a teacher in a position of authority in relationship with the students this may have limited their responses.

There are also limitations in terms of analysing the data. As the student focus group interview was recorded via the sound recorder on a mobile phone not all students' responses were heard clearly leading to a potential for data loss (Cohen and Manion 2013, p426) when transcribing the interview.

There may have been an impact of the interviewer wanting to involve all student participants in the interview, thereby cutting some student responses short, alongside perhaps researcher fatigue as both student focus groups were conducted within a one-hour setting.

3.8 Methods of data analysis

RQ1: What are students' perceptions about memory making?

I coded the students' responses on the open-ended question section of the questionnaire to infer general trends and anomalies in student responses. The coding was based on key words used by students, selected as I read through the questionnaires in alphabetical order.

I compared the students' responses on the Likert scale, converting Extremely to 5 and not at all to a 1, to create numerical responses for easy comparison, on the initial and final questionnaire. I analysed the key trends from the two focus group transcripts by looking at each question in turn.

RQ2: How do students' respond over time to regular low-stakes testing?

To assess the impact of low stakes testing I compared the mean scores of Class 1 and Class 2 over the five tests to see if their scores increased over time. I compared the

standard deviation of Class 1 and Class 2 to see the range of the scores. I compared the scores of the matched pairs to allow for a case study response.

I analysed the key trends about low stakes testing from the two focus group transcripts to understand their views about the importance of low stakes testing on their memory.

RQ3: What impact does students' learning about cognitive psychology related to memory making have on their engagement with retrieving substantive knowledge?

To assess the impact of learning about cognitive psychology I analysed an informal conversation had with Class 1 alongside the key trends from the focus group of Class 1.

I also analysed the responses to Question 2 from the initial and final questionnaires.

RQ4: What impact does low stakes testing, and creation of memorable learning summaries have on students' analytical writing?

To assess the impact of learning about cognitive psychology I compared the scores based on the exam mark scheme from Class 1 to those of Class 2. I also compared the coded matched pairs analytical writing to evaluate the impact of creating memorable learning summaries.

Section 4: Findings.

4.1 RQ1: What are students' perceptions about memory making?

Student's perceptions about how they remember information was gathered from responses to Question 1, on the initial and final questionnaire, where students were given space to record their answers to: What do you think happens when you try to remember key information?

Initial Questionnaire:

In the initial questionnaire there seemed to be a misinterpretation of the question, most described a technique of revision not a cognitive process. This made it apparent that students didn't know how memory is formed and created a strong basis for the intervention with Class1 investigating the effects of informing students how memory is formed in the long-term memory.

Where students in Class 1 did refer to cognitive processes their responses suggest an awareness of the ideas of connections being formed:

'Synapses in your brain form bridges'

'I think about what I have linked the information to'

'you process the information until it is associated with certain words'

These comments hint at an appreciation of the idea of connection new knowledge to existing schema as a means of connecting and strengthening its retention in long term memory as referenced by Willingham (2010). The comments demonstrate at least one student has some knowledge of the physical structure of the brain, understanding there are nerve links between the areas that retain knowledge.

There was only one response from one student in Class 2 that explained something other than a revision technique, the student commented the:

‘brain focuses on the key information’

This shows initial perceptions were slightly different in both classes, which had an influence on the impact of the interventions.

Final Questionnaire

Again, students tended to write explanations of methods of revision, or techniques they used to make information more interesting. However, some students had moved on in terms of their perceptions of how memories are made.

Students in Class 1 commented:

‘Synapses in your brain start to form links/bridges and the more you think about something the stronger they become helping you remember things

‘Part of the brain regains information...your brain tries to store information’

‘I associate it with things I have learnt before or am interested in’

‘Your long-term memory works to remember information and once it has been gone over a few times your long-term memory remembers it better’

‘Your brain will put it to your long-term memory and you will remember it better’

This demonstrates students had a clearer sense of the process of memory making based on the intervention where they were exposed on two occasions to information based on cognitive psychologists’ explanations about how memories are made.

Students’ responses show a level of understanding of ideas of schema and the impact

of repeated retrieval on strengthening memories in the long-term memory, (Fordham 2017).

Comments from Class 2 were also slightly more focused on the question of what the brain does:

‘It stays in my brain’

‘Your brain tries to focus on specific things regarding a certain topic’

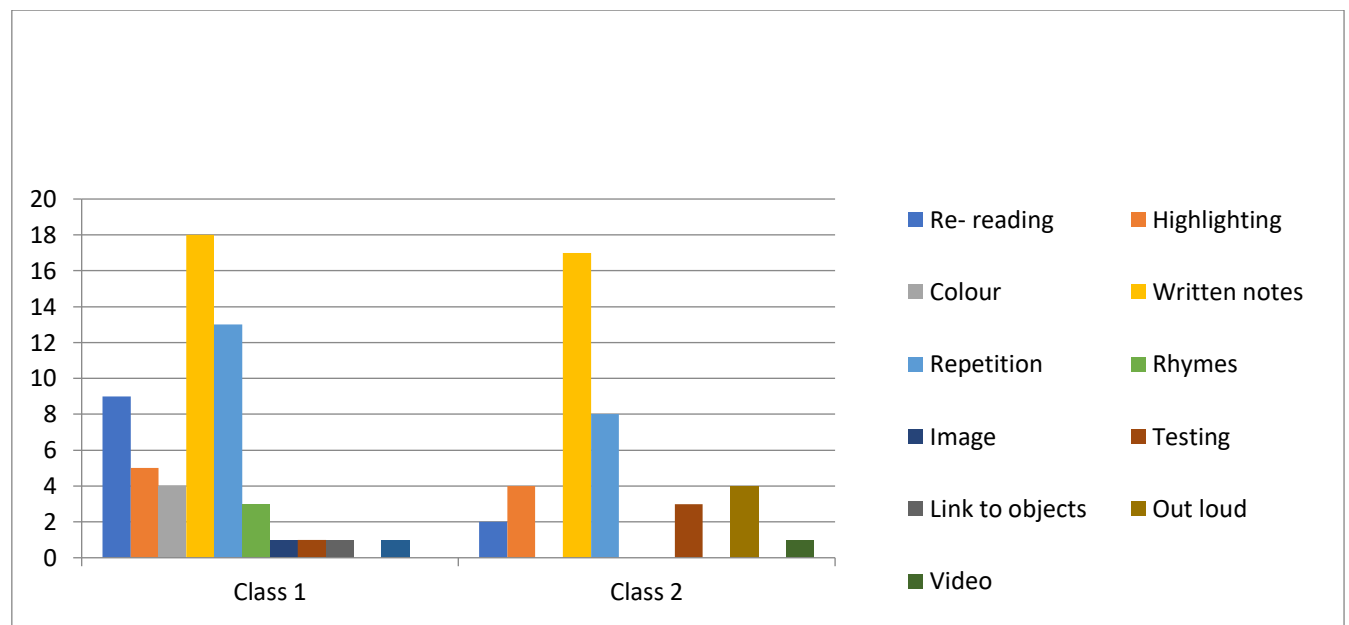
‘A certain part in your brain stores key information where your brain needs to use it’

‘Your brain stores it in a certain part’

Although they recognised the idea of storage, perhaps indicating a distinction between long- and short-term memory, Class 2 students, who had not participated in additional intervention about the process of memory making, did not refer to the importance of connections or the way in which the knowledge is organised to support retrieval.

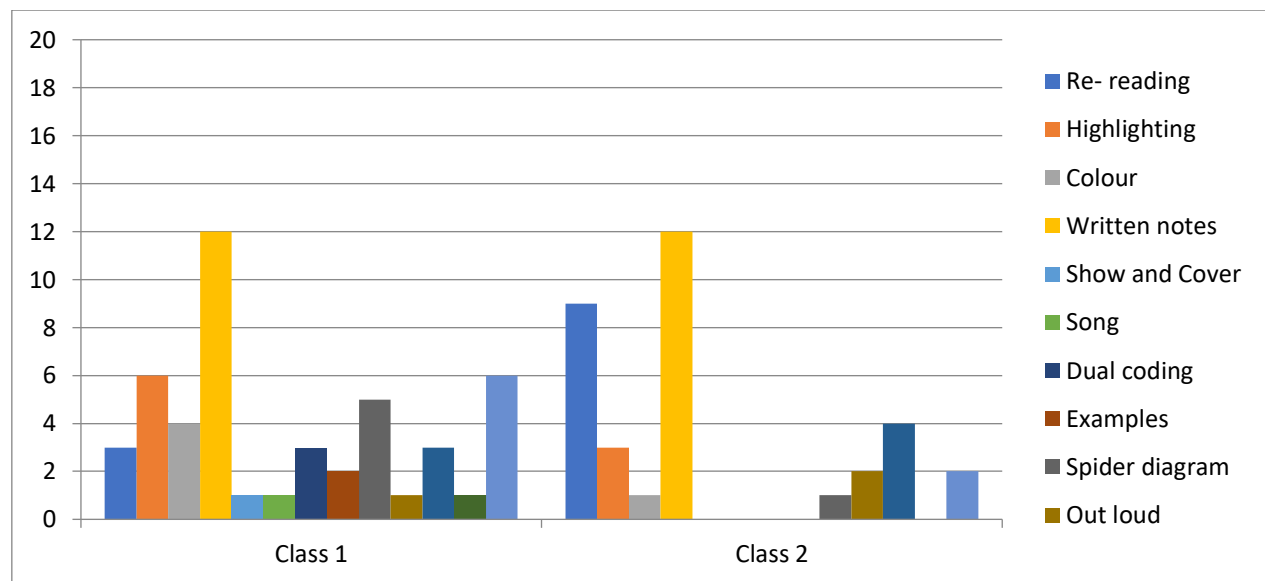
Student’s perceptions about strategies for remembering information was gathered from their responses to Question 2, on the initial and final questionnaire, where students were given space to record their answers to: What strategies, if any, do you use to help you remember key information?

Figure A: A graph from the Initial Questionnaire showing coded student responses to Question 2 indicating strategies students use to help them remember key information.



I coded the students' responses by the key strategies they mentioned, grouping together any mention of writing, including creating posters and flash cards, compared to the use for example, of quizzing or use of colour in their revision notes. Students clearly gave weight to re- reading textual information echoing Dunlosky's (2013) findings that students favour less effective methods of revision such as using highlighting alongside re-reading. This data supports the claim that re-reading creates an illusion of mastery (Bjork and Bjork 2011). However, this shows students place emphasis on creating their own notes which is not supported by the literature. The high frequency with which students identified writing notes as helpful agrees with the way they engage in lessons, appearing confident in creating detailed notes on substantive knowledge, yet this does not always translate to their analytical writing.

Figure B: A graph from the Final Questionnaire: showing coded student responses to Question 2 indicating strategies students use to help them remember key information



After the intervention informing them about how their brains create memories students in Class 1 still value creating written notes, but fewer rely simply on re-reading instead describing a specific method of written notes they created.

Demonstrating students may have begun to assess and the strategies they use (Bransford et al 2000) through their self-regulation of choice of strategy they may become more effective learners embedding their knowledge in their long-term memory. Class 2 still value re-reading alongside creating written revision notes suggesting Class1 have a better understanding of effective revision methods in line with the literature due to their intervention.

Student's perceptions about strategies for remembering information was gathered from their responses to Question 3, on the initial and final questionnaire, where students were asked to circle how often they tend to work on trying to remember information.

Figure C: A graph showing percentages of student responses Question 3 about many time times they attempt to remember key information on both the initial and final Questionnaires.

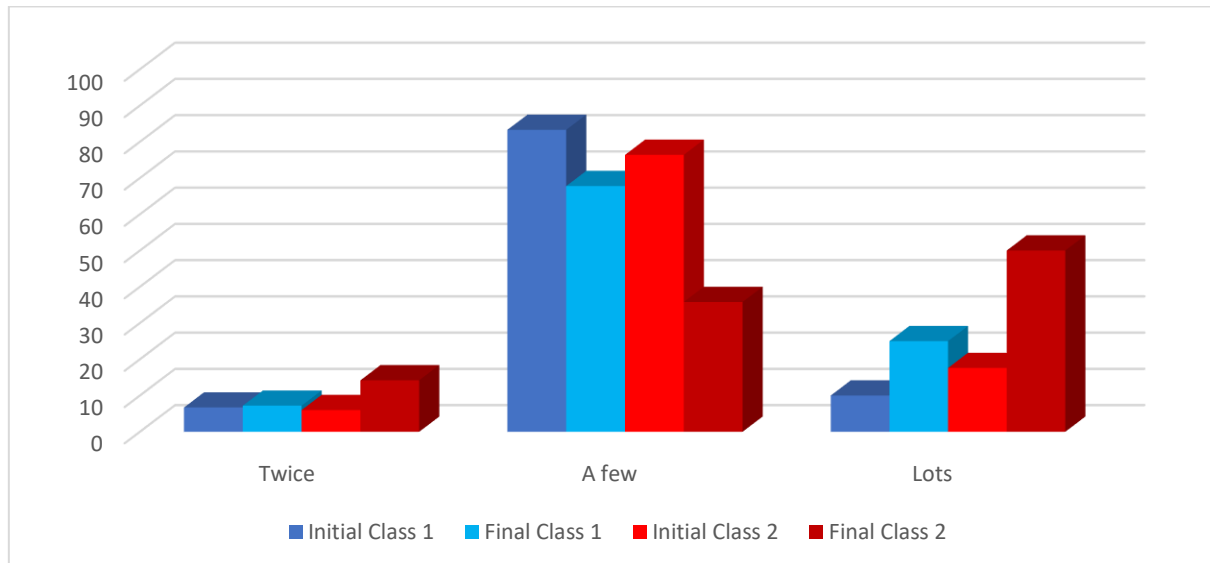
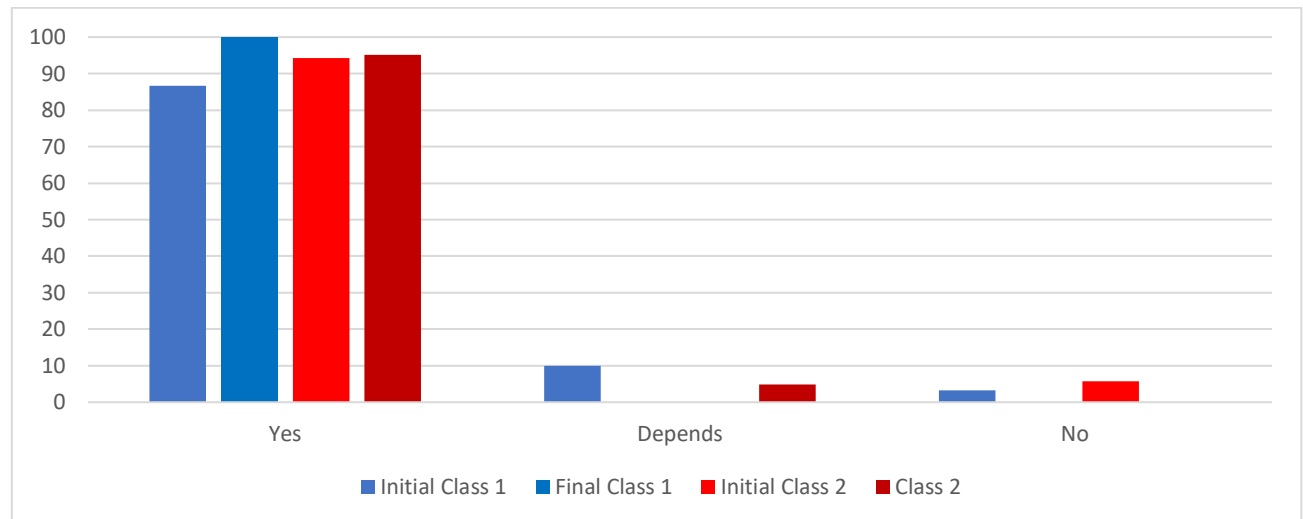


Figure C suggests students' perceptions about the numbers of times needed to revise and retain key information has not significantly changed for Class 1. There does appear to be a slight shift to more students valuing revisiting learning multiple times rather than a few, which may have been the influence of the intervention where they were exposed to information showing it is the spaced repetition of learning that may be most effective (Mellanby and Theobald 2014). In the final questionnaire more, students from both classes said they should revisit work more than three times to consolidate this information, perhaps suggesting the intervention Class 1 received had negligible impact on this aspect.

Student's perceptions about the impact of subject content on remembering information was gathered from their responses to Question 4, on the initial and final questionnaire, where students were given space to record their answers to: How do

you thinking your interest in a topic/subject affects how well you are able to remember it?

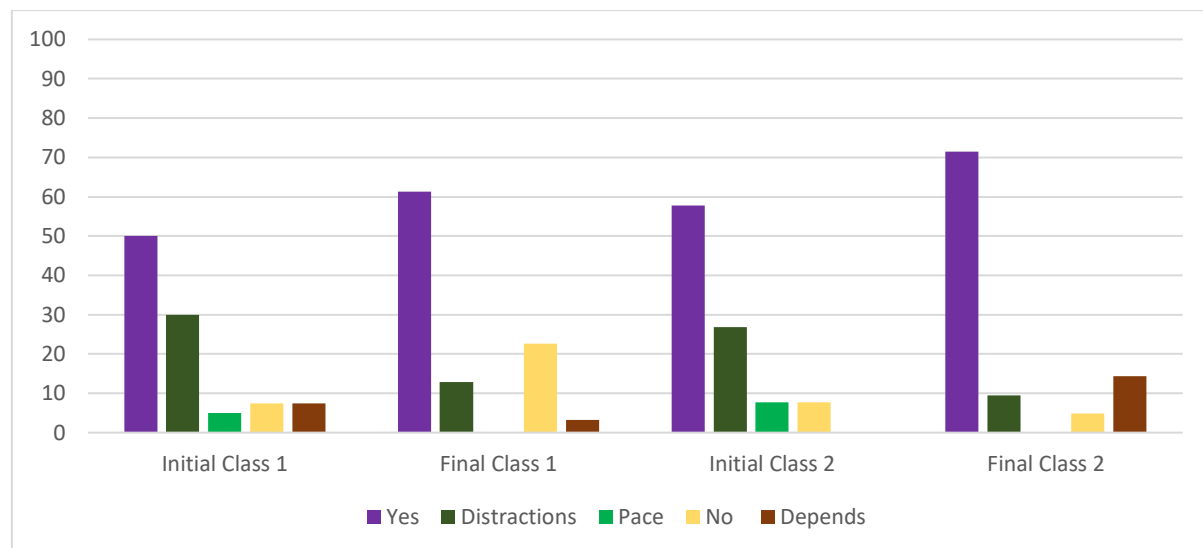
Figure D: A graph showing percentages of student responses to the impact of interest in the topic on their ability to retain key information on both the initial and final Questionnaires.



This data shows minimal change after the intervention. Students in both Class 1 and Class 2 were clearly aware of the link between interest and retention of knowledge before the intervention echoing the literature, students need to be engaged in the content for it be retained and remembered (Dunlosky's 2013; Coe et al 2014). Reisberg 2001 argues merely having a desire for improving is insufficient, this leads to implications, perhaps it needs to be made explicit to students, that they can retain information even if they are not interested in it.

Student's perceptions about the impact of collaboration on remembering information was gathered from their responses to Question 5, on the initial and final questionnaire, where students were given space to record their answers to: How effective/useful do you find trying to revise on your own?

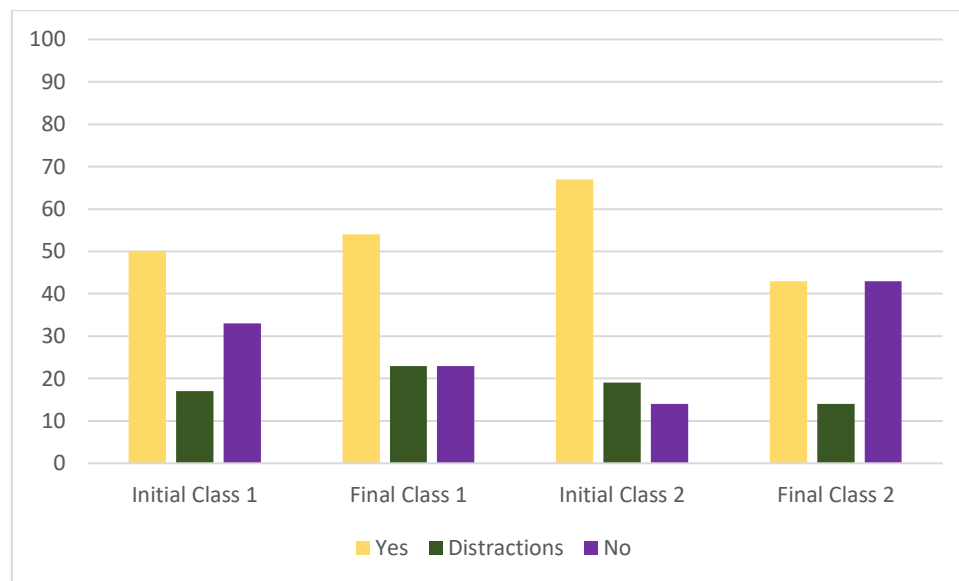
Figure E: A graph showing the percentages of coded student responses about the effectiveness of revising alone from the initial and final questionnaires.



While students still highly value revising alone there is less concern about distraction and pace of revising. This could be because they have moved from mixed Middle School and are now established in the climate of learning that operates at School A. In both classes the number of responses valuing revising alone increased, yet this was most notable in Class 2 perhaps as Class 1 had worked more frequently together during their intervention about creating techniques for remembering content.

Student's perceptions about the impact of collaboration on remembering information was gathered from their responses to Question 6, on the initial and final questionnaire where students were given space to record their answers to: How effective/useful do you find trying to revise with other people? This question was designed to validate student's response to the previous question.

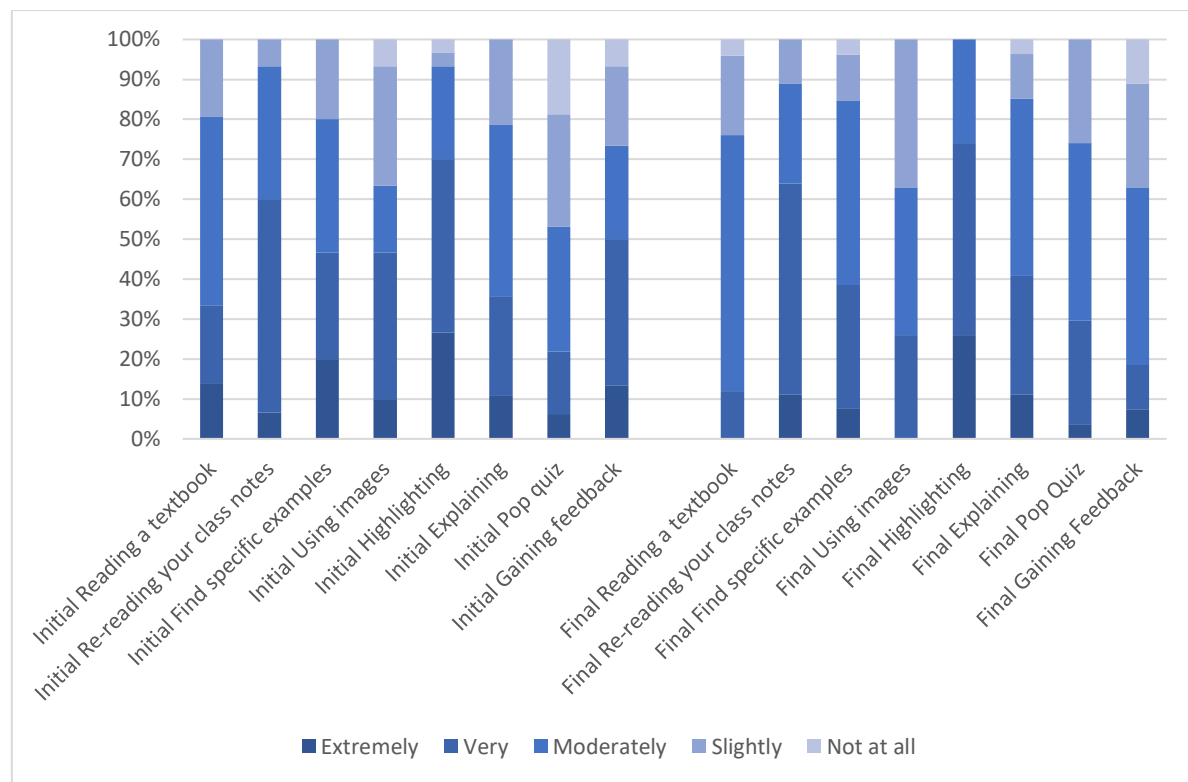
Figure F: A graph showing the percentages of coded student responses about the effectiveness of revising with other people from the initial and final questionnaires.



This graph shows that in Class 1 there was a slight increase in the percentage of responses valuing revising with other people. Yet in Class 2 there was a decrease in the percentage of responses valuing revising with others. This supports the students answers to Question 5 showing that Class 2 greatly value working alone and Class 1 increasingly value working with others. This suggest the intervention of Class 2 meant students begin to value the increase in friendliness (Sharan 2015) which they experienced working together to create methods of learning and see this as having a positive impact on their learning.

Student's perceptions about techniques of learning and remembering key information in History was gathered from their Likert responses, on the initial and final questionnaire, students circled their answers about multiple techniques on a scale of extremely (5) to not at all (1): How effective do you think the following strategies are for helping you to retain key information you have learnt in history?

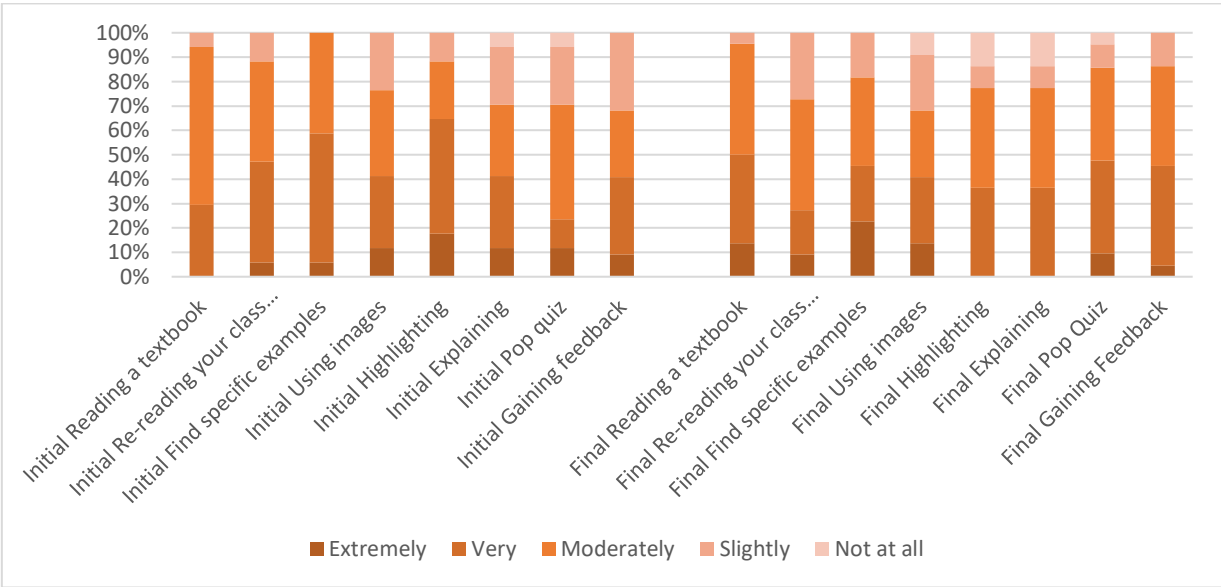
Figure G: Students in Class 1 responses about the value of techniques of learning and remembering key information in History



In the Questionnaire I used to the term ‘pop quizzes’ as a student friendly way of explaining low stakes tests. Students’ were not offered definitions of the terms therefore there may have been some difference in how the methods were interpreted by students. Initially Class 1 highly valued re-reading their class notes and highlighting seeing little merit in pop quizzes and reading a textbook, supporting the argument students are unaware of the effectiveness of their methods of learning, (Coe 2014) and value techniques which offer low input effort and an increasing sense of familiarity, (Bjork and Bjork 2011). In the final questionnaire students in Class 1 still highly value highlighting, perhaps this could be due to the use of colour in the dual coding method of creating memorable notes. Despite receiving information about the ineffectiveness of these technique they still valued re reading their class notes. The biggest change was the decrease in valuing using images, in the initial questionnaire 45% of responses

chose this as extremely or very effective whereas in the final questionnaire this reduced to 25% of responses.

Figure H: Students responses about the value of methods of learning and remembering key information in History

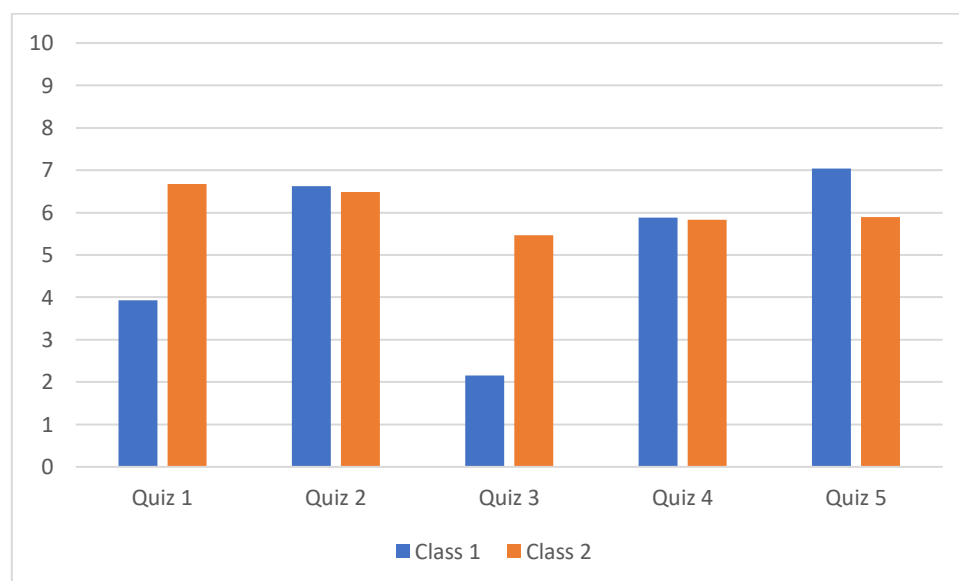


Initially Class 2 selected finding specific examples alongside reading a textbook as most effective techniques for learning information in History. At the end of the intervention Class 2 still valued reading a textbook and finding specific examples, but also valued re-reading their class notes and highlighting. After the intervention of using low stakes tests (pop quizzes) students did value this technique more with an increase from 20% seeing it as extremely or very effective to 40% in the final questionnaire. However, Class 2 still selected reading a textbook as their most effective technique for remembering information in History. It seems this class still value the techniques identified as less effective by the literature, suggesting the intervention of Class 1 maybe useful to inform students about effective revision techniques.

4.2 RQ2: How do students' respond over time to regular low-stakes testing?

Students retrieval of information was gathered from their scores on the low stake tests. I compared the mean scores of Class 1 and Class 2 over the five tests to see if their scores increased over time. I chose to compare their mean score to see the average response.

Figure I: A graph showing the mean scores of Class 1 and Class 2 on low stakes tests over time:



This graph shows for Class 1 there was an improvement from the initial test, suggesting the repetition of questions was important for students to improve. Students in Class 1 on average increased their retention of knowledge from a mean of 3.9 on Quiz 1 to a mean of 7 on Quiz 5. This supports Brown et al (2014) that low stakes testing has a positive impact on retention of knowledge, yet this does not seem as convincing as the literature suggests. There was no steady improvement over time, the use of repeated testing did increase the mean score but after the second quiz the scores did not show

much improvement. This may have been because the questions were repeated, and students were getting the repeated questions correct and the new questions incorrect.

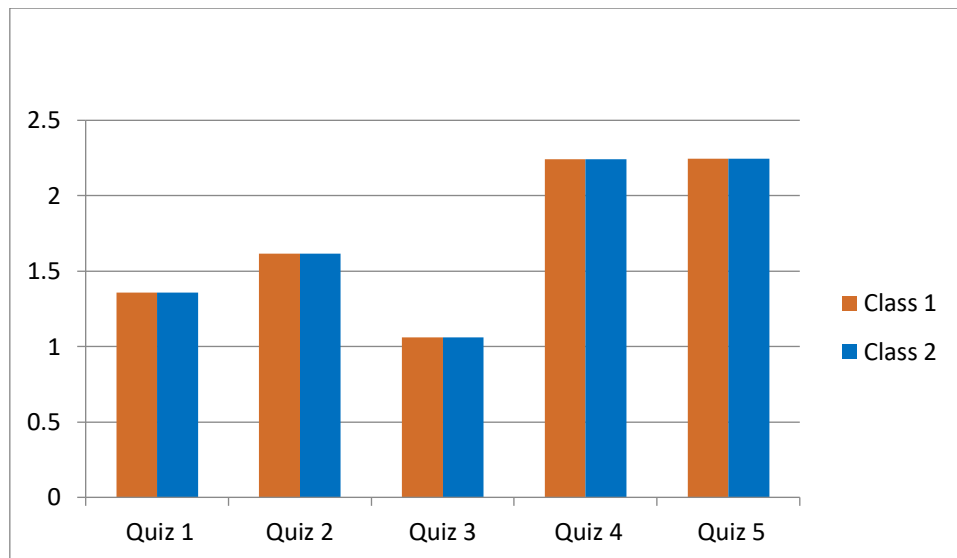
Quiz 3 showed a decrease in the mean score for both Class 1 and Class 2. Quiz 3 consisted of questions not previously posed to the students asking them to recall specific events and new historical vocabulary. The decrease was less for Class 2, who decreased by 1, compared to Class 1 who decreased by 4.5, suggesting that the use of repeated retrieval low stakes tests had limited impact on Class 2 who had retained most of the new information tested for the first time on Quiz 3, but for Class 1 it was the repetition of the quizzes that had an impact on maintaining a steady mean score. Quiz 3 questions used more technical language and closely tied to the GCSE specification. Class 2 consists of students in a higher English set, compared to Class 1, therefore the general literacy of the students may have had an impact on this test as students in Class 1 may not have come across these terms before.

Class 2 maintained a steady level of retaining key information over time, on Quiz 1 students had a mean of 6.6 whereas Quiz 5 the mean was 5.9. This demonstrates for this sample of students on average the low stakes testing had a limited impact on their retention of knowledge suggesting this alone as intervention is perhaps insufficient.

Class 1's mean score over time increased by 3.1 while Class 2's mean score decreased by 0.7. This suggests the intervention Class 1 received about understanding how long-term memory works and creating revision techniques may be useful to helping remember information.

To investigate this phenomenon, I calculated the standard deviation of the mean of each test to see how their retrieval of substantive knowledge changed over time, as a measure of the spread of the scores.

Figure J: A graph showing the standard deviation of scores of Class 1 and Class 2 on low stakes tests over time.

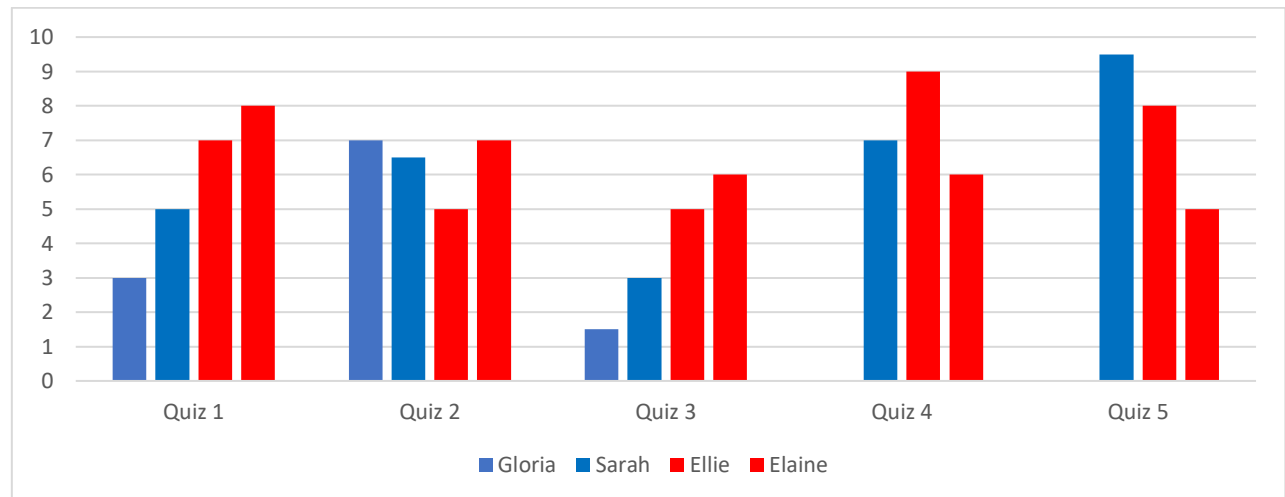


The standard deviation increased over time suggesting that low stakes testing works for some students but not for all (Churches and Dommett 2016). Quiz 3 which included all new questions had a smaller spread of data. Quiz 4 and Quiz 5 perhaps shows the impact of choosing or not choosing History GCSE. These two quizzes happened in Term 4 when students had perhaps altered their intention towards learning history and how far they valued retaining this key information. Therefore, perhaps the wide spread of data was due to the students who knew they were continuing with History GCSE engaging with the process and scoring higher compared to those who had decided they were certainly not continuing past Year 9 gaining lower scores. The high standard deviation means it is tricky to infer from such a small sample size the impact of the low stakes testing. The variables are many. This therefore led me to analyse matched pairs to see if there was a noticeable difference for students at different places on the FFT target scale.

I compared the raw scores of the matched pairs on each low stake test to how their retrieval of substantive knowledge changed over time. I wanted to see if there was a

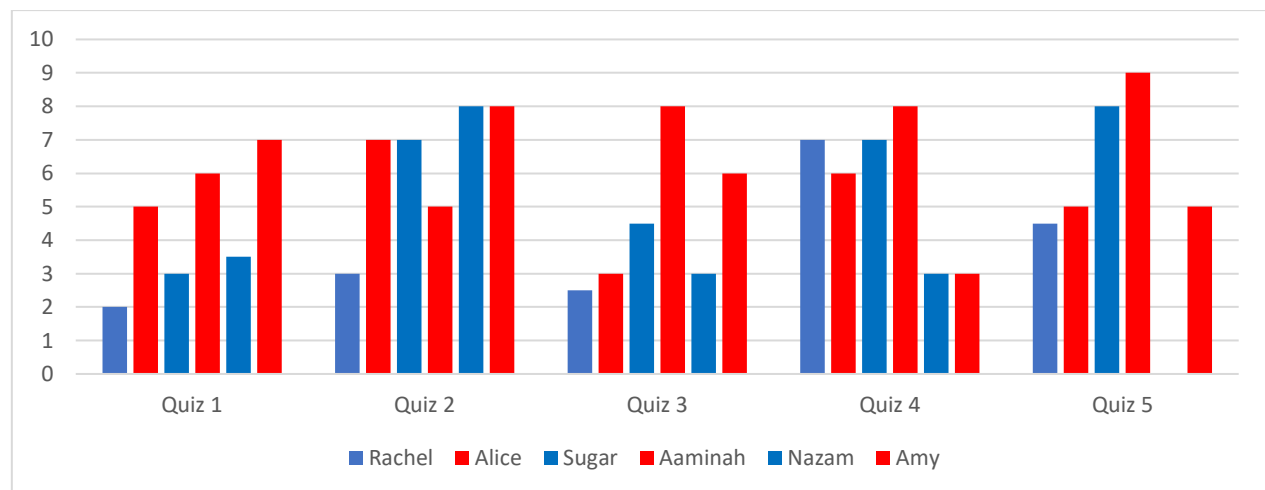
difference across the FFT grades. Students in Class 1 are identified in blue in the following graphs and Students in Class 2 are identified in red.

Figure K: A graph showing the scores of matched pairs students with FFT5 on low stakes tests over time.



This graph shows that Sarah increased her score over time, from 5 to 9. Gloria increased from 3 to 7 over the first two quizzes. She was absent for the last two quizzes. It has become clear Quiz two was a challenge for Class 1 where the majority decreased (Figure H) Elaine 's scores decreased from 8 to 5 over time, Ellie increased from 7 to 8. This suggests for Class 2 there was limited impact of repeated testing. Perhaps the use of revision methods does lead to more retention as Sarah was in Class 1, while low stakes testing over time alone has limited impact on improving retention of knowledge.

Figure L: A graph showing the scores of matched pairs students with FFT6-9 on low stakes tests over time.



This graph shows the higher attaining students. Rachel improved from 2 to 4.5, while Alice did not increase scoring 5 on both the first and last quiz; both these students have FFT6. Sugar improved from 3 to 8 while Aaminah improved from 6 to 9; both these students have FFT7. Nazam improved between the first two quizzes then decreased over time from 3.5 to 3. Amy decreased from 7 to 3; both these students have FFT8. Students in Class 1 with FFT6 and FFT7 saw improvement compared to their peers in Class2 demonstrating there might be some impact of the intervention about using techniques of remembering information. However, across both classes for FFT8 their scores decreased suggesting for high achieving students' low stakes testing is perhaps not the most effective method of increasing retention of substantive knowledge.

Focus Group responses about low stakes testing:

The focus group consisting of students from Class 1 suggested they found low stakes testing helpful especially for learning substantive knowledge. The focus group from Class 2 had a consensus that low stakes testing in class was not beneficial to them.

They argued this was due to the fact they didn't select which items they were tested on and they didn't know the questions in advance.

A student in the focus group of Class 1 stated low stakes tests were helpful to remember:

'like dates and stuff, I find that a lot more helpful.'

The other students in the focus group of Class 1 agreed through non-verbal communication with the student who said:

'I got better'

However, while one student in the focus group of Class 2 did acknowledge the tests were helpful to work out what to focus on next, most of the group did not support this. It was interesting to note that students from Class 2 valued being tested by their family or peers but not the in-class tests perhaps suggesting this issue of students being in control of their own learning is important.

Students from the focus group of Class 1 raised the issue of the repetition of the questions and repetition of the quizzing process, suggesting it was valuable to have a bank of questions used repeatedly.

'you repeated the questions again and again.... And that's actually really helpful.'

'Kind of like the repeating did help like obviously, because it did take a while'

One student from Class 2 argued the repeated testing had a negative effect on her self-esteem,

‘It’s kind of a bit down putting as well’

Another student agreed with this sentiment noting:

‘it might lower your self-esteem in that subject’

Overall there was a clear distinction between the two focus groups with Class 1, who had extra intervention about how memory works, valuing the repeated low stakes tests and Class 2 who felt it had had a negative impact on their self-esteem. This may be due in part to the different class climates alongside the selection of the students present in the focus group dynamic. It could be due to the focus of the intervention creating techniques for remembering delivered to Class 1 focusing on collaboration in a cooperative learning environment as Slavin (1980) reports that collaboration leads to increased confidence and a greater liking of school.

4.3 RQ3: What impact does students’ learning about cognitive psychology related to memory making have on their engagement with retrieving substantive knowledge?

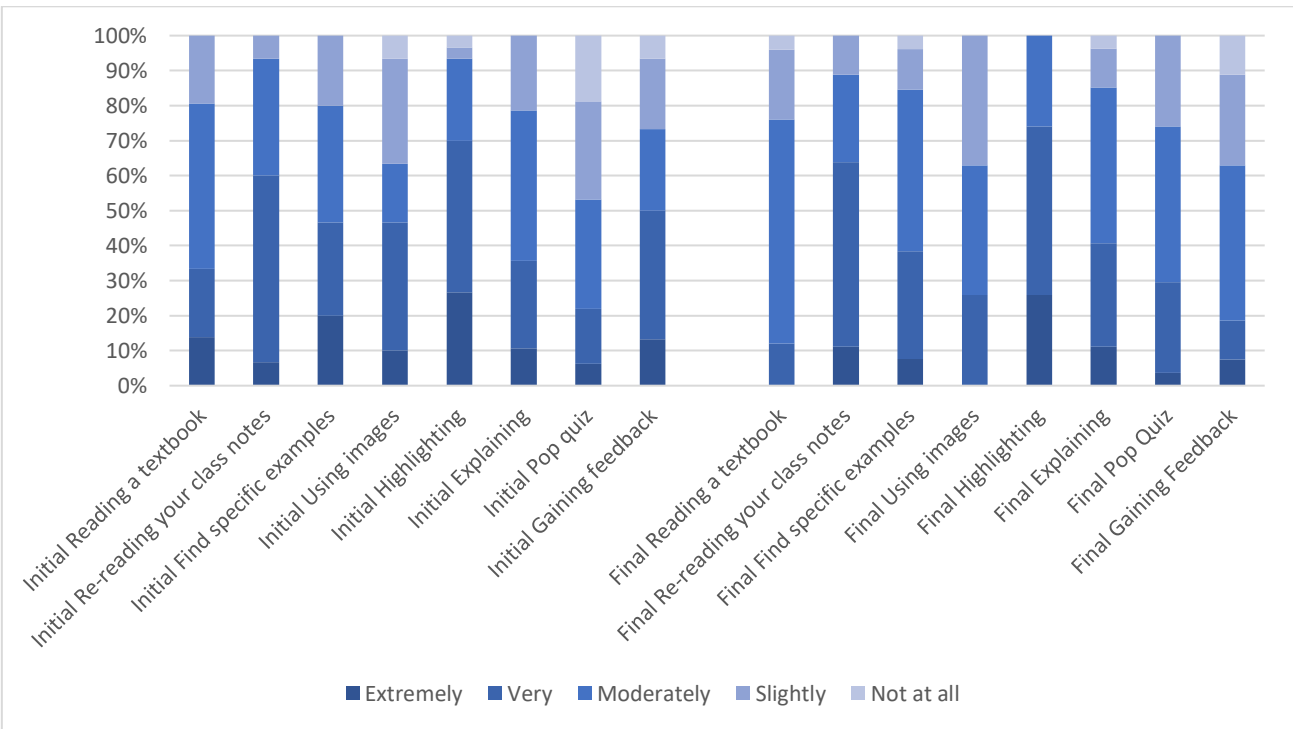
An informal discussion with Class 1 was conducted when they were due to write essay three as they looked bored and disengaged. I was aware I was not following my plan however I felt it was necessary to find their views and the impact of the intervention on their engagement.

Students reported they felt having homework each week was too onerous, this was the retrieval practice homework. Some students felt there was too much content to learn, echoing my concern and the purpose of this project. They said the techniques were only good for learning history, but interestingly also explained this intervention was different to other subjects where they didn’t revise the content until the end of the

unit. While some students were not enthusiastic, arguing it was boring creating a set of revision notes every lesson, this was extended by others who requested more examples of the three techniques. Most of the class argued there was a lot more writing in history compared to other subjects in Year 9, which made me wonder how other subjects were tackling the pressures of the new GCSE. This informal discussion was valuable as it showed the students recognised the same concerns the History teaching community has about this new GCSE, it made me keen to see student’s views at the end of the intervention.

To assess the impact of learning about cognitive psychology I analysed the responses to Question 2 from the initial and final questionnaires: What strategies, if any, do you use to help you remember key information?

Figure M: A graph showing coded student responses to Question 2 indicating strategies students use to help them remember key information from the Initial and Final Questionnaire of students in Class 1.



After the intervention about techniques of remembering information students still highly valued re-reading their class notes with 5% more responses identifying it as extremely or very effective in the final questionnaire. Students continued to value highlighting, with 5% more responses identifying it as extremely or very effective in the initial questionnaire, a total of 75% in the final questionnaire. There was a decrease in the number of students who valued reading a textbook with 30% of responses identifying it as extremely or very effective in the initial questionnaire and 10% in the final questionnaire. 50% of responses identifying gaining feedback as extremely or very effective in the initial questionnaire and yet this reduced to 10% in the final questionnaire. There was a small increase in the perception of low stakes tests (pop quizzes) with 20% of responses identifying it as extremely or very effective in the initial questionnaire and 30% in the final questionnaire. Students' seemed to value the strategies highlighted by the literature (Dunlosky 2013) perhaps demonstrating they now use metacognition to evaluate strategies they use (Bransford et al 2000).

To assess the impact of learning about cognitive psychology I analysed the key trends from the focus group of Class 1.

Students' discussed the revision techniques we had explored, I asked them what they thought helped them remember the information, the student's responses included:

'New method...I did like loads of like different types of sheets with... tables and mind maps'

'I'll simple it down'

'I like the dual coding, it makes that easier'

‘I feel like when I write it down I just get a picture of it in my head.’

‘Breaking down key information, shortening it and simplifying and just breaking it down’

Students in the focus group were confident describing which technique they felt was most effective for them as learners, yet they also acknowledged different students would value different techniques. This agrees with the literature as Medin (2001) argued visuals are useful for retaining information, and supports the research conducted by Pomerance et al (2016), these students seemed to have a sense that transforming information was powerful to secure it within their long-term memory. By learning about cognitive psychology students seem able to understand the process by which they learn factual knowledge, showing they understand the need to make the information memorable in a simplified way, they seem to value the new techniques they have been taught.

The students also spoke about the theme of autonomy and ownership and engagement responding:

‘if I wrote it like personally if there’s a poster of someone else’s and I haven’t wrote it myself, I won’t remember it because I haven’t wrote it’

‘If you’ve done the work they you kind of know what you’re trying to say and like the story behind it I guess’

This shows students still want to create their technique of learning alone or collaboratively rather than a technique or set of notes being given to them. This supports the argument that student’s confidence in their own abilities is linked to

metacognition (Agarwal et al 2012) as they become more confident assessing what helps them learn, they wish to use that technique.

I asked students what they thought about highlighting their notes, they responded:

‘It’s really good; I’ll see it’s highlighted so I know it’s important’

‘It’s good if you don’t exaggerate’

‘I don’t want to do it too much, I think there should be proper key words then I should do it more’

‘like if you just see loads of colours on a page, you’re going to like confuse yourself, in some situations again, it’s like breaking down key information,

‘I find that colours help’

While highlighting is seen as a less effective strategy by Dunlosky (2013) students value this technique, however they did evaluate explaining they need to use it sparingly. Students seem actively engaged in discussing the value of each technique demonstrating a positive learning effect based on the intervention as they could assess what was helping them and showed a level of self-regulation of their learning (Heath and Heath 2002).

When asked about learning about memory and methods of revision, the focus group responded:

‘Help me to break everything down and to like put everything together’

‘You have like the freedom of choosing what you think is your best method’

‘everyone has different ways of remembering things’

‘You get the choice of it as well; you’re not forced to learn that method. You get a bit of freedom with this’

Again, this shows the intervention has impacted their self-regulation and engagement with learning key knowledge. While students disagreed about the number of times needed to repeat information, they did see value in repeatedly revisiting knowledge. Overall the responses of the students in the focus group of Class 1 suggest that learning about cognitive psychology had a positive impact on their engagement with retrieving substantive knowledge.

Overall, learning about cognitive psychology seemed to give students in Class 1 an ability to be confident when engaging in memory making, recognising the value of different methods for retrieving substantive knowledge.

4.4 RQ4: What impact does low stakes testing, and creation of memorable learning summaries have on students’ analytical writing?

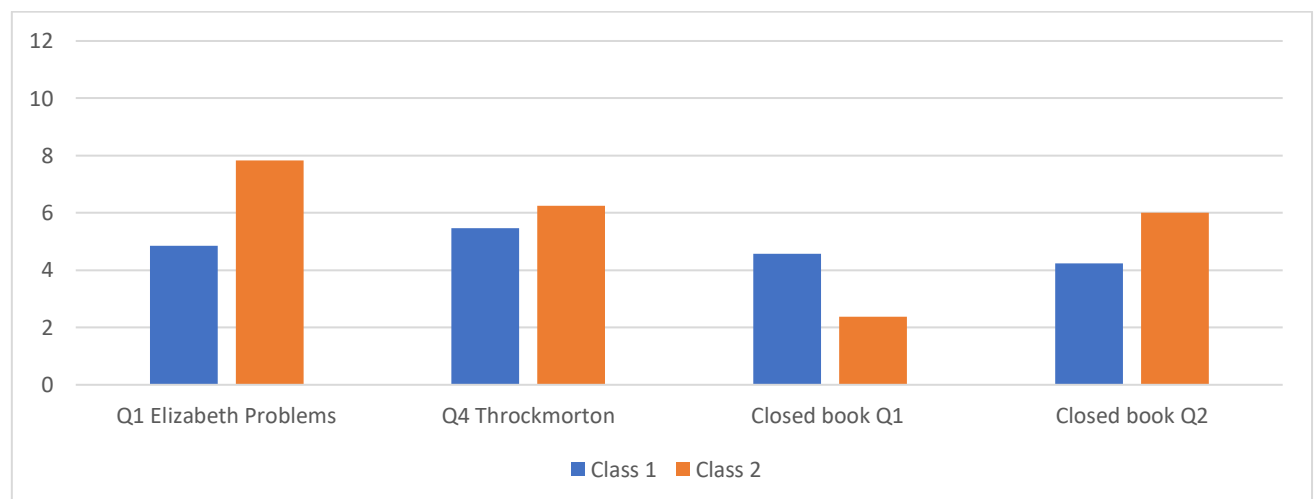
Only Class 1 had an intervention where they created memorable learning summaries. I compared the essays from Class 1 and Class 2 to see how this affected their essay writing. Both classes wrote analytical essays which were modelled on the exemplification material supplied by the exam board. These essays are marked out of 12 based on the exam mark scheme. These were moderated with my colleague to ensure the mark scheme was being applied fairly to both classes.

While students completed six essays it was not possible to compare all of these as Class 1 did not complete essay three and Class 2 did not complete essay five. Class 1 completed essay one and four in class, in the lesson after they had been taught this

content, Class 2 completed essay one in class and essay four for homework. Both classes were able to use their exercise books, and in the case of Class1 their memorable learning summaries, to support writing essay one and four.

The closed book questions were conducted at the end of the intervention. Q1 was based on content covered in class five months previously. Q2 was based on the most recently covered content. When writing these essays students were not allowed access to any notes at all. Students had been told in advance they would be writing two essays but not told the questions. However, due to the reality of life in a school, Class 1 completed the closed book essays first, anecdotally it seemed some students in Class 2 were aware of the topics of the two questions before they sat the final essays.

Figure N: A graph showing the mean scores of Class 1 and Class 2 analytical writing based on exam mark scheme.



Class 1 attained a mean of 4.8 on essay one, 5.4 on essay four showing some improvement occurred. However, Class 2 attained a mean of 7.8 on essay one and 6.25 on essay four, suggesting the low stakes testing alone did not have a positive impact on students' analytical writing. It seems learning about how memories are created and

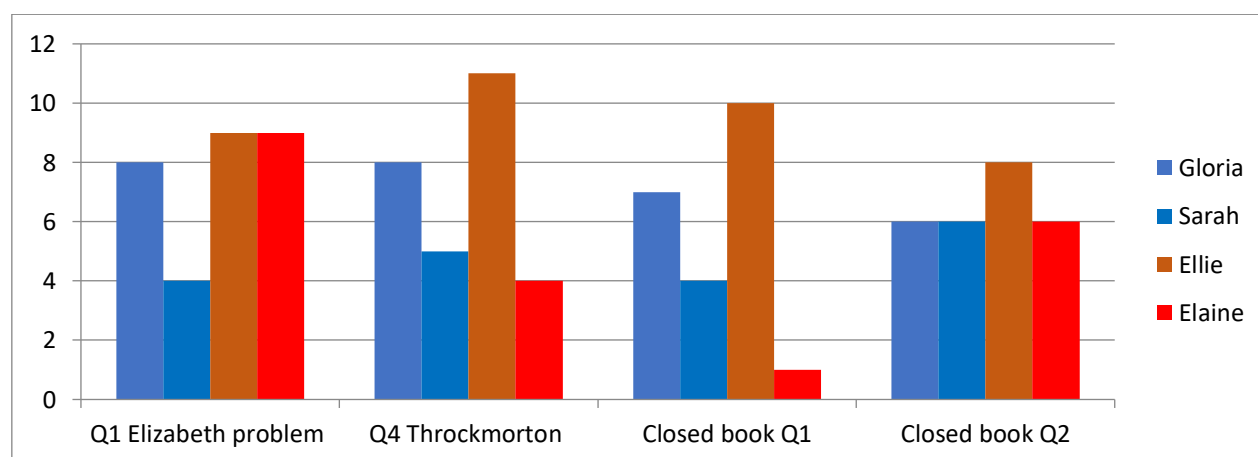
allowing students to collaboratively create learning summaries improved their analytical writing.

On Q1 of closed book test, based on content learnt at the beginning of the intervention, Class 1 attained a mean of 4.5 while Class 2 attained a mean of 2.3 suggesting the additional intervention Class 1 received may have had impacted their retention of substantive knowledge applied to analytical writing.

On Q2 of the closed book test, based on the most recent content, Class 1 attained a mean of 4.5 while Class 2 attained a mean of 6. These were broadly in line with their mean scores on the open book essays suggesting the interventions had limited impact on improving students' analytical writing.

To further investigate the impact of the memorable learning summaries I compared the results of the matched pairs, looking at their results from the low stakes scores, their scores out of 12 on the essays alongside the coded results of the type of analysis and type of knowledge used in each essay.

Figure O: A graph of the scores of matched pairs FFT 5 analytical writing based on exam mark scheme.

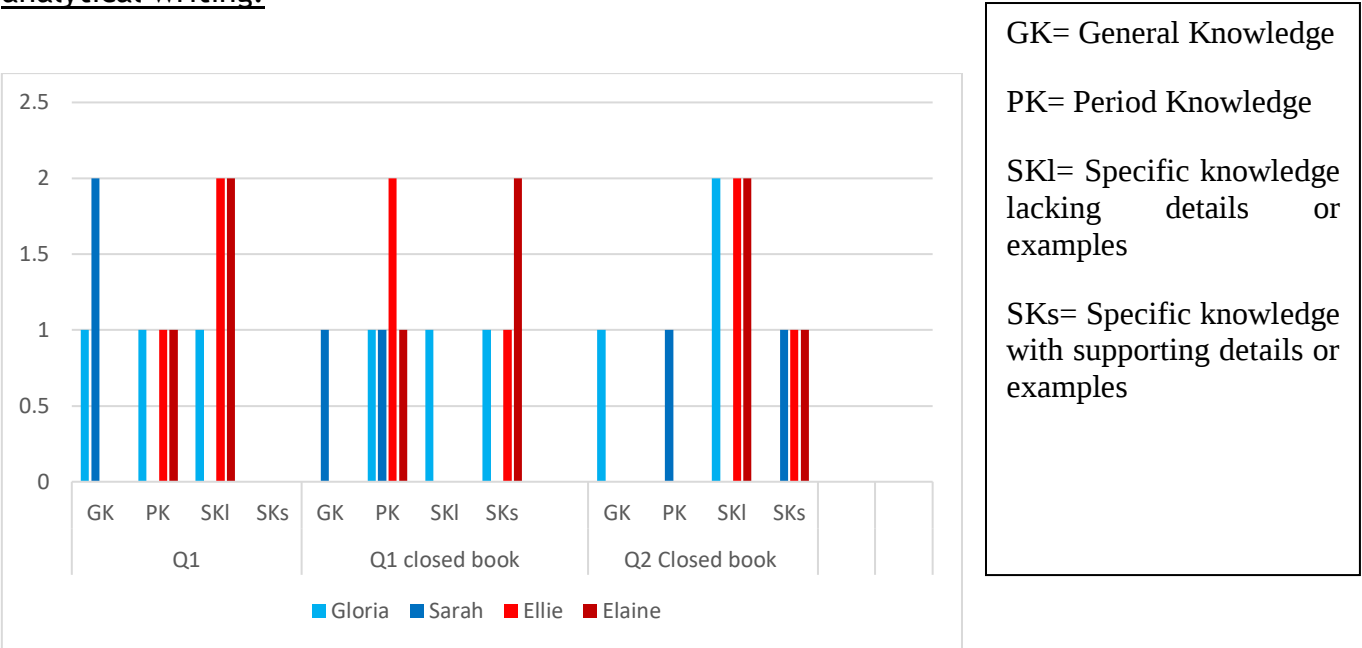


On the open book essays Gloria did not improve attaining 8 on both essays, Sarah improved from 4 to 5, they were both in Class 1. Ellie improved from 9 to 11, Elaine attained 9 then 4, they were both in Class 2. On the closed book questions Gloria attained 7 and 6, Sarah 4 and 6, Ellie 10 and 8, Elaine 1 and 6. Gloria performed comparably on both open book questions, but neither of these were to the level of the open book answers. Sarah improved to some extent over time, this suggests these students in Class 1 were able to retain knowledge to perform at a similar level on the closed book questions to the open book questions. Ellie improved during the open book questions but then did less well but not dramatically on the closed book questions. Elaine did less well on the first closed book question. This suggests for FFT 5 students the use of memorable revision techniques has some impact over the long term.

To evaluate the impact of the interventions on students' analytical writing, their essays were coded based on the type of knowledge they used and then how they used that knowledge. The essays were each distinct and did not overlap. The student's essays were coded based on pre-determined criteria and the coding applied to each paragraph initially for the use of knowledge. This was turned into numerical data for analysis. I used the initial essay and the final closed book two essays to see the retention of substantive knowledge and how retrieving this knowledge affected the analytical writing.

Figure P: Graph of coded analysis of matched pairs FFT 5

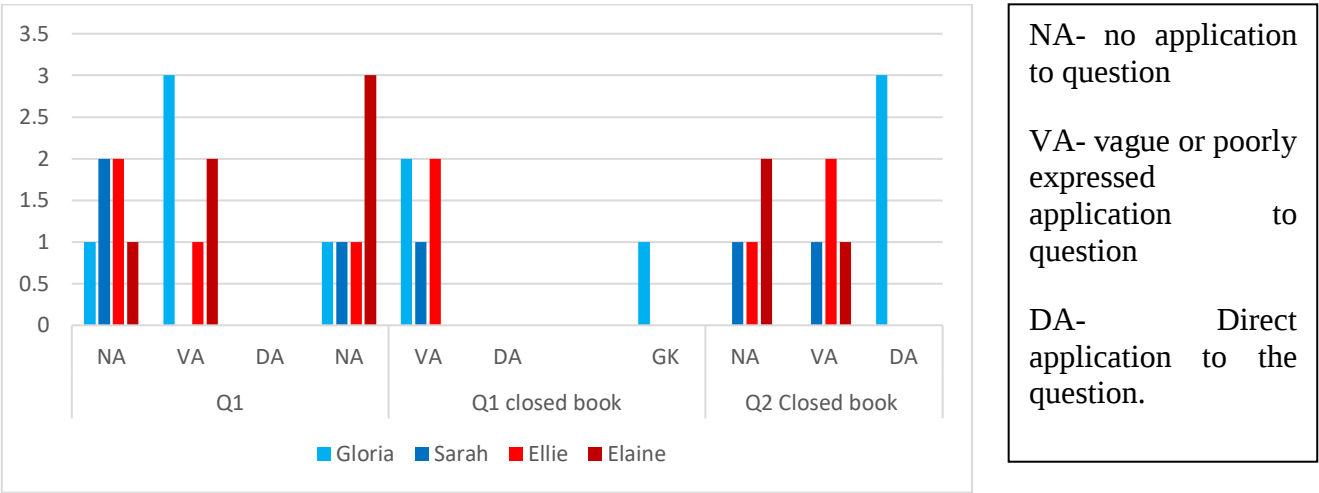
analytical writing.



This graph shows over time Gloria used more specific knowledge. Sarah also used more specific knowledge moving towards using specific examples. These students were both in Class 1, suggesting using memorable learning summaries might help FFT5 students to add more specific knowledge to their written work. Ellie used more specific knowledge supporting lacking details, Elaine maintained her use of specific knowledge, they were both in Class 2 This suggest that using low stakes testing might help students to use specific rather than general details in their writing. It is interesting no one used specific knowledge with example in the first open book essay however in the closed book essays they all did, suggesting the students were unaware this was a desired part of essay writing, hinting it is useful for students to see examples of good writing before attempting analytical writing. Over time FFT5 students benefited from low stakes testing and creating revision strategies to be able to use examples in their written work.

The student’s essays were coded based on pre-determined criteria and the coding applied to each paragraph for their application of knowledge to analyse. This was then turned into numerical data for analysis. While students may have retained and recalled knowledge, the new GCSE requires them to apply this knowledge to score highly in the examination.

Figure Q: A graph of coded analysis of matched pairs FFT 5 analytical writing use of analysis

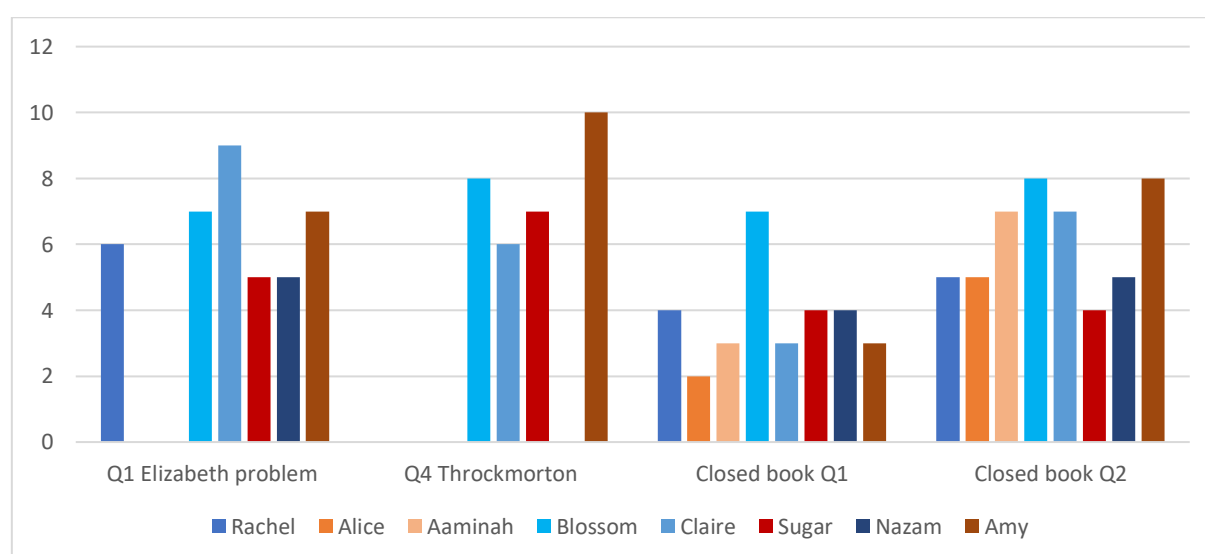


In the first essay none of the FFT5 students directly applied their knowledge to the question. On Q1 Gloria was mainly vaguely applying her knowledge, on the first question of the closed book test this occurred again, suggesting she was focusing on retrieving knowledge as this was based on content learnt at the beginning of the intervention, however on the second closed book question she made three directly applied points. On Q1 Sarah had no application of her knowledge to the question, however on both the closed book questions she made one vaguely applied point. Both students were in Class 1, suggesting the intervention of creating memorable learning summaries might help students analyse their knowledge under test conditions.

On Q1 Ellie had no application of her knowledge to the question, however on both the closed book questions she made two vaguely applied points. On Q1 Elaine was mainly vaguely applying her knowledge to the question, however on both the closed book questions she mainly was not applying her knowledge to the question. This suggests as both students were in Class 2 they were focused on retrieving the information rather than applying it to the question. Therefore, while the low stakes tests may have helped students in Class 2 retain the knowledge it seems the intervention received by Class 1 might have helped FFT5 students retain the knowledge in a way that they could focus on applying to the question, which is the skill required at GCSE History.

It was then important to look at the higher targeted students, FFT6-9, to see the impact the low stakes testing, and creation of memorable learning summaries had on their analytical writing.

Figure R: A graph of scores of matched pairs FFT 6-9 analytical writing based on exam mark scheme.



While Alice and Aaminah, in Class 2 had completed essay one and four, my colleague was unable to locate these essays.

On the open book essays Rachel and Nazam were only present for one essay, Blossom improved from 7 to 8, Sugar improved from 3 to 7, these students were in Class 1. Claire did less well from 9 to 6, Amy did better from 7 to 10. This suggests the low stakes testing and intervention about memory might have had a positive impact on FFT7 and FFT8 students as Sugar and Amy's scores increased.

On the closed book questions Rachel attained 4 and 5, Blossom attained 7 and 8, Sugar attained 4 on both, Nazam attained 4 and 5, they were in Class 1. Alice attained 2 and 5, Aaminah and Claire attained 3 and 7 and Amy attained 3 and 8, they were in Class 2. This shows students in Class 1 had less difference between the essay on the most recent content. This might suggest the intervention Class 1 received about making learning memorable allowed them to retain knowledge to use in the closed book tests.

Over time Nazam improved perhaps suggesting for FFT8 students the use of creating memorable learning techniques helps improve their analytical writing. Sugar improved over the open book questions however did less well on the closed book questions but was consistent across the two questions suggesting that the use of revision techniques leads to a more consistent ability to analyse the retained knowledge across the range of knowledge for higher attaining students. Rachel improved to some extent over time, suggesting these students in Class 1 were able to retain knowledge to perform at a similar level on the closed book questions to the open book questions.

Claire fared less well on the first question of the closed book test, based on content learnt at the beginning of the intervention, Amy did improve over the closed book questions and did better on the second closed book question. These students were both in Class 2, showing there might be limited impact of low stakes testing for FFT 7 low stakes testing but perhaps for FFT8 students' low stakes testing maybe more useful.

Then I coded each paragraph of their initial, and closed book essays to determine what type of knowledge they had used. I then converted this to numbers for analysis.

Figure S: Graph of coded analysis of matched pairs FFT 6-9 analytical writing use of

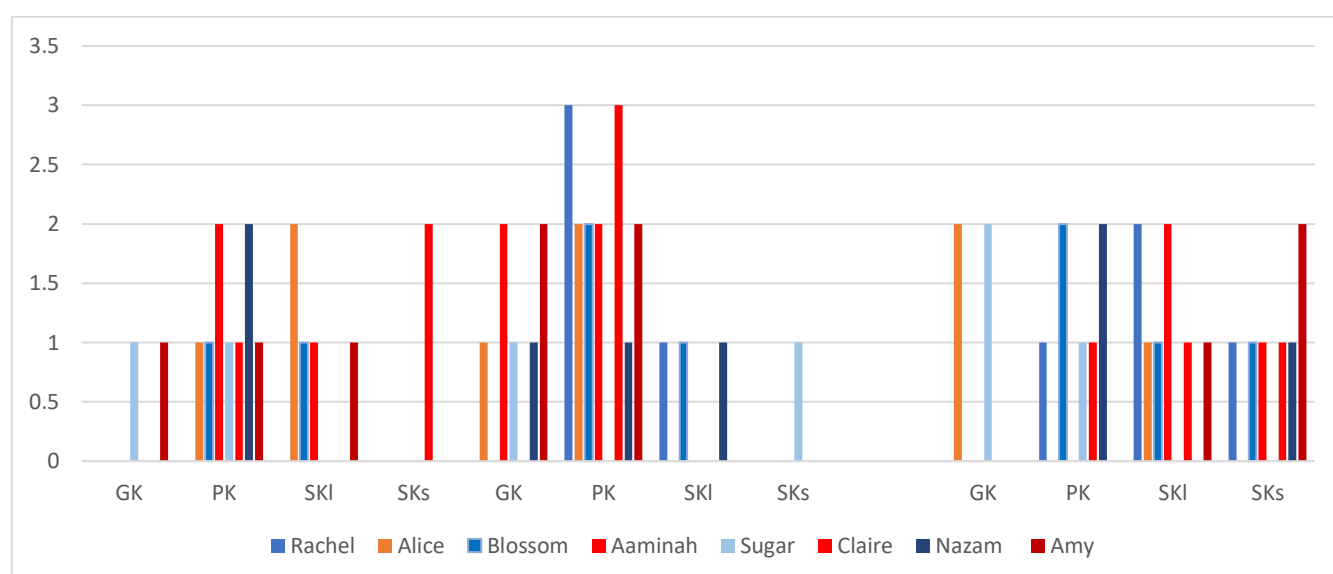
GK= General Knowledge

PK= Period Knowledge

SKl= Specific knowledge lacking details or examples

SKs= Specific knowledge with supporting details or examples

knowledge.

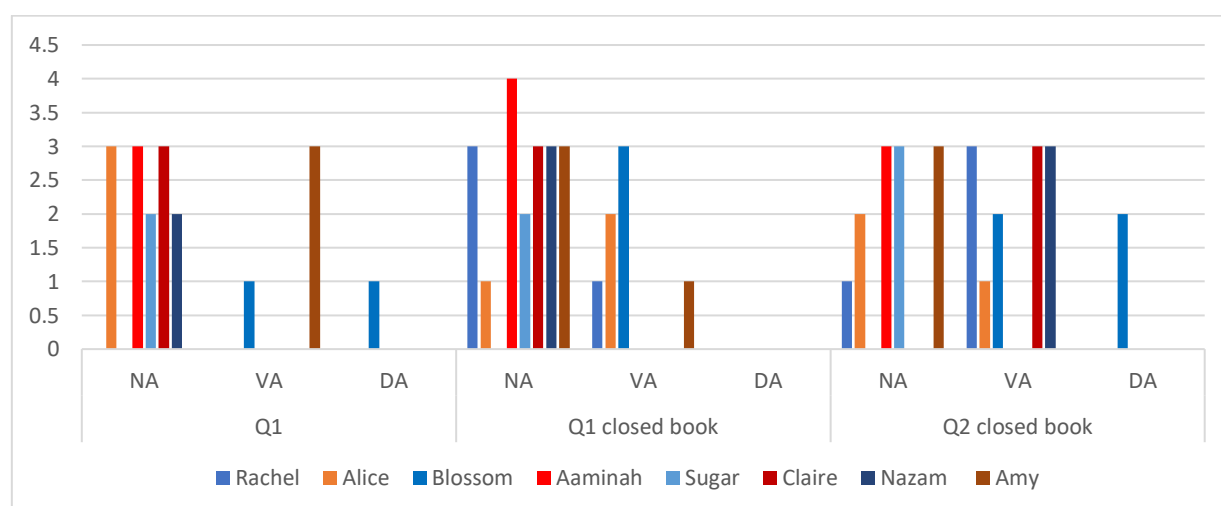


This graph shows that over time Rachel used more specific knowledge. Blossom increased her use of period knowledge, Sugar moved from general knowledge to using some specific knowledge, moved to use specific knowledge with detail in the final essay, these students were in Class 1. Alice used some specific knowledge supporting and lacking details in her final essay, Aaminah moved towards using specific knowledge with details, Claire used fewer specific details in the closed book essays, Amy increased her use of specific, these students were in Class 2. This shows limited

improvement in the type of knowledge used by higher attaining students. They did increase their use of period knowledge, but this does not seem to be affected by which class they were in, therefore for high attaining students the use of low stakes testing and creating revision strategies seems to be of limited use to help them improve their use examples in their written work.

Their essays were also coded based their application of knowledge. This was into numerical data for analysis.

Figure T: Graph of coded analysis of matched pairs FFT 6-9 analytical writing USE OF analysis



In the initially essay only Blossom applied her knowledge directly to answer the question, Amy made one point vaguely connected to the question. On Q1 no student directly applied their knowledge, Rachel and Blossom from Class 1 vaguely applied their knowledge alongside Alice from Class 2. It seems all students were engaging in retrieving their substantive knowledge rather than applying it to the precise question. On Q2 Blossom directly applied her knowledge, and Rachel and Blossom and Nazam also made points vaguely applied to the questions, they were in Class 1. Claire and Alice made points vaguely applied to the question they were in class 2. It seems for

the higher attaining students the interventions had limited impact as they did not seem to improve their analysis.

For the higher attaining students there was an increase in the use of specific knowledge on Q2 which they had just been taught, demonstrating they had an increasing awareness of the need to use more details. However, neither the use of low stakes testing, nor the use of memorable learning summaries seems to have improved their retention of substantive knowledge.

Section 5: Implications:

5.1 Conclusions

RQ1: What are students' perceptions about memory making?

The findings suggest Class 1 have a clearer sense of the process of memory making based on their intervention. Both classes still value writing their own notes as a method of revision however less students in Class 1 valued re-reading their class notes suggesting they were evaluating the effectiveness of the techniques used (Brown et al 2014). Both classes thought repetition is a positive effect on the retention of knowledge, suggesting the use of low stakes testing allows students to see the power in repetition. While both classes see a strong connection between interest and ability to retain information this was not explored fully. Class1 valued increasingly revising with others, suggesting the intervention had a positive effect on their self-esteem and metacognition which was echoed by students in Class 2 raising concerns about the impact of low stakes testing on their self-esteem. Therefore, considering how to boost the self-esteem is important, as the issue of confidence and resilience seems intrinsically linked with students test performance. Neither class seems to overly value the use of feedback which Dunlosky (2013) suggests can have a positive impact therefore this seems an aspect that needs to be explored more.

RQ2: How do students' respond over time to regular low stakes testing?

The scores of students did not seem to increase over time. The focus group of Class, who had the additional intervention, felt low stakes tests were helpful to their retention of knowledge whereas Class 2 focused on the effect on their self-esteem. The matched pairs data suggests for FFT5-7 students low stakes testing alongside the

additional intervention has some positive impact when compared to their peers in Class2. However, this did not seem the case for FFT8 students.

RQ3: What impact does students' learning about cognitive psychology related to memory making have on their engagement with retrieving substantive knowledge?

Students in Class 1 seemed to be more confident selecting the technique they valued after the intervention, from the focus group responses it seemed that they understood the process that was occurring in their visuospatial sketchpad (Medin 2001), realising they needed to transform the information into something memorable to retain the information. Students in Class 1 seemed able to evaluate techniques used by themselves and see the value in techniques other used, perhaps the collaborative element had allowed them to think positively about their learning in a friendly environment. This suggests the intervention received by Class 1 should be used with the whole year group.

RQ4: What impact does low stakes testing, and creation of memorable learning summaries have on students' analytical writing?

Class 1 performed similarly on the closed book essays compared to the open book essays, this contrasted with Class 2 suggesting creating memorable learning summaries had a positive impact on their retention of knowledge used in test conditions, therefore should be rolled out to the whole year group. For the FFT5 matched pairs students in Class 1 improved their use of specific knowledge and application of this to the question compared to their Class 2 counterparts suggesting for this level of student the dual interventions of low stakes testing and memorable learning summaries was effective. However, for the higher attaining students, the type of knowledge and the application of the knowledge did not vastly improve in either class. This could be due

to the limited time frame of the intervention. The purpose of this intervention was to investigate possible strategies students can use to prepare for a terminal examination in Year 11 when they learn content in Year 9 therefore it will only be when this cohort sit their History GCSE that we can fully evaluate these interventions.

Overall, seems to be support for continued use of low stakes testing with History students at School A and value in teaching students' effective techniques for creating memorable revision notes in a collaborative environment.

5.2 Implications

It seems important for students at School A to feel in control of their own learning, therefore any techniques that allow them to boost their self-esteem (Willingham 2004) such as personal target setting, and independence of tasks seems to have some impact on their engagement with history and their engagement directly impacts their retention of knowledge.

Therefore, moving forwards, it seems important to be less prescriptive with task design and empower students with information about why different methods are used; encouraging them to explore different methods before choosing which they think is appropriate at the time. This may be conducted by using the same lesson material created for this study, initially restricting students to three techniques to engage them in evaluation before they explore other methods.

Advice for the feeder Middle Schools will be created via collaboration with the History team and disseminated at a subject specific meeting. It might be useful for Middle schools to explore the use of coding analytical writing to move students on from narratives, this might be more accessible to the non-specialist teachers.

It seems worthwhile to continue to explore using low stakes tests, based on the findings, I created a bank of questions which will be issued to students before any testing begins. Students will then be tested at weekly intervals on these over Year 9,10 and 11 and in subject team meetings conduct reviews of the data on low stakes tests.

School A is focusing on engaging students with the R of the Success Improvement Response marking policy, therefore as a history department it seems pertinent to make students respond to their low stakes tests scores. To engage students further in the process of metacognition, after each test they will fill in a record sheet where they can record their score, which questions they did not get correct and create a new memorable learning technique for one item they didn't get correct. The aim being to engage students repeatedly in assessing their techniques of revision and considering what makes learning memorable to them.

However, it seems student need to engage with the feedback to their essays, as it is clear retaining substantive knowledge is not the only key to improving analysis. There may be some value in engaging students with coding their own and exemplar essays to analyse the types of knowledge and types of analysis used based on the coding system created in these findings (Counsell 2017). This might improve students' confidence in selecting and using retrieved knowledge under test conditions.

This study has highlighted how important it is to analyse the data teachers hold in their mark book, looking for trends and anomalies. The History Department at School A will endeavour to reflect act on the evidence of which specific questions students are finding challenging on low stakes quizzes.

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Appendix A: Headteacher letter Modus Operandi

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Director Professor Jo-Anne Baird



Headteacher

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XXXXXXXXXXXXXXXXXX

XXXXXXXXXXXXXXXXXX

XXXXXXXXXXXXXXXXXX

25/11/2017

Dear xxxxxxxxxxxxxxxx,

I am writing to enquire about conducting research in school this academic year. As you know, I am studying for the Master's in Learning and Teaching at Oxford University, supervised by xxxxxxxxxxxxxxxx. In my final research project: *Student creation of techniques to make learning stick: an inquiry into the impact of student-created techniques on student retrieval and application of knowledge in history*, I will explore techniques for making substantive knowledge in History stick and the effect of this on students' analytical writing.

The research will take place with Year 9 Set 3 and 4 in history working towards GCSE History. I am developing ways of enabling students to use research about how memory works to create their own techniques utilising this information over a variety of tasks both within my lessons and for homework. My research focus is on students' retention and retrieval of knowledge, and explores how effectively students can use the knowledge they have retained to answer analytical GCSE questions. xxxxxxxxxxxxxxxx has agreed to collaborate with me on this project, using the same low stakes quizzing and practice questions – but without the same focus on revision strategies so that we can examine their impact.

By participating in the research, the school would be contributing to a project that will deepen our understanding of methods of making learning stick for students learning history, and so contribute towards developing ways of improving attainment for similar students in the school in the future. It will also contribute to History education more widely.

I hope to conduct this research between January 2018 and June 2018. I would conduct a questionnaire with the students before and after the research to understand their views about effective learning techniques. I would audio record a focus group of students' reflections after the research and record the scores students attain in low stakes quizzes in class, I will also

photocopy some students' written work to analyse their use of substantive knowledge during the research project.

Oxford University has strict ethical procedures on conducting ethical research, consistent with current British Educational Research Association guidelines. The University also recognises, however, that my study is a piece of practitioner research, and that schools already operate with the highest ethical standards. Therefore only your formal consent as head teacher is necessary, and not that of individual parents or staff. However, throughout the research, students and other teachers will be able to refuse to participate in any research activities at any time.

All participants, including students, teacher and the school, would be made anonymous in all research reports. The data collected would be kept strictly confidential, available only to my supervisor xxxxxxxxxxxxxxxx and me, and only used for academic purposes. It will be kept for as long as it has academic value.

If you are happy for me to proceed with this study, please confirm that using the attached reply form. If you have any concerns or need more information about what is involved, please contact me or my supervisor. Further, if you have any questions about this ethics process at any time, please contact the chair of the department's research ethics committee, though:
research.office@education.ox.ac.uk

I look forward to hearing from you.

Yours sincerely,

Caroline Salter

Appendix B: Questionnaire

Why are you being asked to do this questionnaire?

Miss Salter is studying at Oxford University for a Masters in Learning and Teaching.

I feel that it is important to keep learning, which has led me to learn more about education and how students learn.

I have selected this class to be part of my research project as you represent the range of students at xxxxxxxxxxxxxxxx.

I am researching and investigating memory. As a part of this I want to investigate student opinions about memory and learning.

I will analyse the answers alongside the views expressed in student focus groups and the results of your pop quizzes to inform me about how to adapt our history teaching at xxxxxxxx. Your answers will be compared to the findings of other researchers (teachers and academics) into memory and learning.

I would like you to complete this questionnaire honestly and in detail.

If you choose not to complete this that is your choice and there will be no consequences for you at all.

Your name and answers will only be seen by me.

I will share the results of the questionnaires and the low stakes quizzes and classwork and homework with my supervisor and teachers at WGS.

However, your answers and information will be anonymised. NO-ONE apart from yourself and Miss Salter will know who wrote what.

Details about you:

Name:

Please circle to show which: History Class: 9/3 or 9/4

Which Middle School did you go to?

Would you be interested in taking part in a focus group to discuss your learning in History?

☐ Yes

☐ No

Wo

What do you think about memory and learning?

These questions can be answered using any examples or information. This is not limited to learning in History.

1. What do you think happens when you try to remember key information?

Explain in this box

2. What strategies, if any, do you use to help you remember key information?

Explain in this box

3. When you need to learn key information how often do you tend to work on trying to remember it?

Please circle

Once

Twice

A few times

Lots of times

4. How do you think your interest in a topic/subject affects how well you are able to remember it?

Explain in this box

5. How effective/useful do you find trying to revise on your own?

Explain in this box

6. How effective/useful do you find trying to revise with other people?

Explain in this box

By 'effective' I mean how well it works for you.

a) Reading a textbook

Extremely Very Moderately Slightly Not at all

b) Re-reading your class notes in your exercise book

Extremely Very Moderately Slightly Not at all

c) Finding specific examples to support your arguments

Extremely Very Moderately Slightly Not at all

d) Using images to simplify key information

Extremely Very Moderately Slightly Not at all

e) Highlighting particular words or phrases in your exercise book

Extremely Very Moderately Slightly Not at all

f) Explaining what you can remember in discussion

Extremely Very Moderately Slightly Not at all

g) Doing pop quizzes

Extremely Very Moderately Slightly Not at all

h) Gaining feedback on written extended answers

Extremely Very Moderately Slightly
Not at all

Thank you for taking your time to complete this questionnaire, it is appreciated 😊

Miss Salter

Appendix C: PowerPoint Slides from Lessons

Lesson 1:

Feedback on Assessment...

SIR

Fill in your response

Overall...

Success: Great use of specific information

Improvement: Creating own arguments using the evidence

Purple: Achieved Grade 3 on this assessment OR the last one

Green: Achieved Grade 2 on this assessment OR the last one

Red: Achieved less than Grade 2

You are going to be involved in a research project...

Why are you being asked to do this questionnaire?

Miss Saffer is studying at Oxford University for a Masters in Learning and Teaching. I feel that it is important to keep learning, which has led me to learn more about education and how students learn.

I have selected this class to be part of my research project as you represent the range of students at Windsor Girls' School.

I am researching and investigating memory. As a part of this I want to investigate student opinions about memory and learning.

I will analyse the answers alongside the views expressed in student focus groups and the results of your pop quizzes to inform me about how to adapt our history teaching at Windsor Girls' School. Your answers will be compared to the findings of other researchers (teachers and academics) into memory and learning.

Would like you to complete this questionnaire honestly and in detail.

If you choose not to complete this that is your choice and there will be no consequences for you at all.

Your names and answers will only be seen by me.

I will share the results of the questionnaires and the low stakes quizzes and classwork and homework with my supervisor and teachers at WGL.

However, your answers and information will be anonymised. NO ONE apart from yourself and Miss Saffer will know who wrote what.

Early Elizabethan England

Lesson Objectives:

Understand these lessons are part of a research project

Describe the people of Tudor England

Explain the roles of people in Tudor England

Prioritise the roles of people in Tudor England

Starter: on a mini white board in pairs

What do you know about the Tudors?

Who lived in Tudor England?

P12

1. How many people did Elizabeth rule?
2. Who was at the top? And who was at the bottom?
3. What does the term rural mean?
4. What does the term merchant mean?
5. What does the term government mean in Elizabethan England?

- a) How was your wealth measured in Tudor England?
- b) What was the key role of the monarch?
- c) What did the nobles expect to be involved with?
- d) What does the term destitute mean?
- e) Why did the monarch need the nobles and gentry?
- f) What was the key role of the gentry?
- g) What are the differences between the yeomen and tenant farmers?
- h) What does the term surplus mean?

What does research suggest about learning and remembering?

'if nothing has changed in long-term memory, nothing has been learned'

'memory is the residue of thought'

understanding is remembering in disguise

Willingham-Why Don't Students Like School? 2012

How does memory work?

What are the 3 stages of memory?

Where is information stored?

(Barton, L and Winter, S (2016))

What is working memory?

(Barton, L and Winter, S (2016))

What is long term memory?

What are the 3 types of information that gets stored in your long term memory?

(Barton, L and Winter, S (2016))

Research suggests...

We're more likely to remember something if it is presented to us in more than one way

Brown (2014)

'repeated reading provides the illusion of mastery'

'some kinds of difficulties help' you learn'

'when learning is easy it is often superficial and soon forgotten'

(Willingham 2012) 'not all intellectual abilities are hard wired'

The learning scientists blog 2017:

'the most effective learning strategies are not intuitive'

Cognitive psychology suggests these 3 methods might be helpful:

- a) Elaboration- explaining in detail
- b) Dual coding- using images with words
- c) Concrete examples- giving precise examples

See handout

We will also do pop quizzes as they have been shown to work and for homework you will practice retrieving what you have learnt

9/3 will do the same quizzes but wont be learning about the methods

How can you remember this?

Work in pairs to create something to help you remember

Who lived in Tudor England?

You can use any of these 3 ideas

- a) Elaboration- explaining in detail
- b) Dual coding- using images with words
- c) Concrete examples- giving precise examples

Now turn into 4's and compare

Do you want to combine your ideas? Adapt them?

Lesson 15:

How do we learn- revisited...

What was Elizabeth's religious settlement?

Lesson Objectives:

Be able to describe the Religious Settlement of 1559

Explain the impact of the Religious settlement of 1559

Evaluate the consequences of the Religious settlement of 1559

Discuss research about the process of learning

Starter: How does the brain remember things?

<https://www.youtube.com/watch?v=U1s0dWp4Q>

Willingham supports the idea maintenance rehearsal, repeating material, which keeps the information in the 'articulatory loop of working memory' (p187 Willingham 2004) is a way of retaining the memory he does point out this technique doesn't move the information in the long-term memory

Why do researchers say elaboration is helpful?

Brown (2014) says to retain learning engaging in elaboration could be a key method as this gives 'new material meaning by expressing it in your own words and connecting it with what you already know' (p5 Brown 2014) connecting the newly acquired information with your pre-existing schema.

Elaborative interrogation has promise, allowing the student to self-explain encouraging 'students to actively process the content they are focusing on' (Dunlosky 2012 p 18).

Why do researchers say concrete examples are helpful?

Brown says (p11) learning is stronger when it matters, when the abstract is made concrete and personal.

Heath's claims that a bicycle is more memorable than justice (p106 Heath 2008), arguing the use of concrete ideas allows memory more 'hooks' for an idea.

Why do researchers say dual coding is helpful?

Dual coding, the idea of presenting information in more than one way (Fordham 2017) seems to have support, this could be via presenting information with text and visuals.

'Pictures are better remembered than words' (Medin 2001) suggests that use of large simple visuals could help students retain information over a longer period.

How did Elizabeth resolve the religious problem?

In pairs: Read p21/22

What are the key aspects of the religious settlement?

In pairs write:

Describe **two** features of the Elizabethan religious settlement (4 marks)

Act of Supremacy 1534	Act of Uniformity 1534	Thomas Cromwell 1534
Established the King as the Supreme Head of the Church of England, replacing the Pope.	The Act of Uniformity 1534 required all clergy to swear an oath of loyalty to the King as the Supreme Head of the Church of England.	Thomas Cromwell was a key figure in the English Reformation, responsible for the Act of Supremacy and the Act of Uniformity.
Established the King as the Supreme Head of the Church of England, replacing the Pope.	The Act of Uniformity 1534 required all clergy to swear an oath of loyalty to the King as the Supreme Head of the Church of England.	Thomas Cromwell was a key figure in the English Reformation, responsible for the Act of Supremacy and the Act of Uniformity.
Established the King as the Supreme Head of the Church of England, replacing the Pope.	The Act of Uniformity 1534 required all clergy to swear an oath of loyalty to the King as the Supreme Head of the Church of England.	Thomas Cromwell was a key figure in the English Reformation, responsible for the Act of Supremacy and the Act of Uniformity.

What was the impact of the new Church of England?

MATCH to the elements of the Religious Settlement:

- A. Most people accepted Elizabeth as the head of the Church
- B. The fact there was no mass in Latin was unacceptable to Catholics
- C. Ordinary Catholics accepted the title, Governor, so they could tell themselves the Pope was still the head of the Church
- D. Many Catholics went to the new Church on Sundays but practices made in Latin in secret
- E. All but one of Henry's Catholic bishops resigned
- F. Most churchmen took the oath of loyalty to the new Church
- G. By not changing the look of the Church most people were won over
- H. 200 out of 3,000 priests refused to take the oath of loyalty and lost their job
- I. Puritan bishops complained the new Church looked too Catholic
- J. Elizabeth turned a blind eye when the fines for recusancy were not collected
- K. Every Sunday the people would say prayers for the Queen's safety and give thanks for the blessings of her reign

How to remember this?

Create a method for remembering

The Religious Settlement:

You can use any of these 3 ideas

- a) Elaboration- explaining in detail
- b) Dual coding- using images with words
- c) Concrete examples- giving precise examples

Homework: retrieval practice

Techniques research suggests helps remembering learning

Concrete Examples

This means: using specific examples to understand abstract ideas

E.g. A specific example of appeasement was when Britain did not react to Hitler breaking the treaty of Versailles by building up his army.

E.g. A specific example about why people wanted the vote was because there were 0 MPs for Birmingham

Dual Coding

This means: using combining words and visuals

E.g.



Revision Hint



LAMB

- **LAND** – Lost their overseas Empire which was divided amongst the victorious allies.
- **ARMY** – reduced to 100,000 men, no air force and only 6 battleships.
- **MONEY** - reparations set at £6600 million to be paid to the allies.
- **BLAME**: Germany had to accept guilt for starting the war.

Elaboration

This means: explaining and describing ideas with many details

E.g. if you write down the phrase: Causes of WW1 you can elaborate by adding

- the assassination of the Archduke Franz Ferdinand

-the alliances- the triple alliance-Germany- Italy- Austria Hungary- the triple entente- Britain- France- Russia (you could add more ideas and elaborate further..)



LEARN TO STUDY USING...

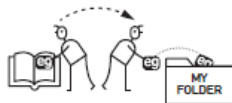
Concrete Examples

USE SPECIFIC EXAMPLES TO UNDERSTAND ABSTRACT IDEAS



HOW TO DO IT

Collect examples your teacher has used, and look in your class materials for as many examples as you can find.



Make the link between the idea you are studying and each example, so that you understand how the example applies to the idea.



Share examples with friends, and explain them to each other for added benefits.





LEARN TO STUDY USING...

Interleaving

SWITCH BETWEEN IDEAS WHILE YOU STUDY



HOW TO DO IT

Switch between ideas during a study session. Don't study one idea for too long.





LEARN TO STUDY USING...

Dual Coding

COMBINE WORDS AND VISUALS



HOW TO DO IT



Look at your class materials and find visuals. Look over the visuals and compare to the words.



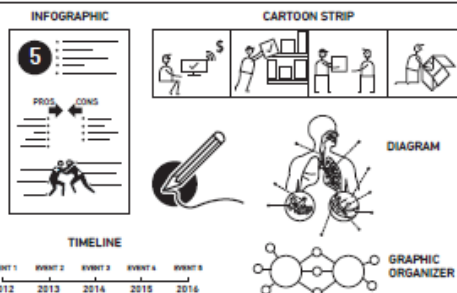
Look at visuals, and explain in your own words what they mean.



Take information that you are trying to learn, and draw visuals to go along with it.

HOLD ON!

Try to come up with different ways to represent the information visually, for example an infographic, a timeline, a cartoon strip, or a diagram of parts that work together.



Work your way up to drawing what you know from memory.



Content by Yana Weinstein (University of Massachusetts Lowell) & Megan Smith (Rhode Island College) | Illustrations by Oliver Caviglioli (@teachingwithaowl.com/cogsci)
Funding provided by the APS Fund for Teaching and Public Understanding of Psychological Science

Appendix E: Examples of student created learning summaries

