2021 cohort

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What is the impact of retrieval practice homework in Science?

Introduction

There are lots of facts and key words to be learned in Science curriculum. Retrieval practice is set as home learning through an online quiz programme called Educake. The questions are chosen by the teacher to consolidate the learning in the lessons, to aid embedding of the key scientific facts and thinking skills. These questions can be considered as pre-made Leitner flashcards that are adaptable and available on demand. The answers are shown after the student response has been submitted, and students are encouraged to repeat the questions until the threshold success limit of 80% correct has been achieved.

This study reviews the statistics from Educake science retrieval practice homework and compares these results to the subsequent summative assessment, GCSE, outcome. The impact of homework completion is compared to repeated access versus singular access. This study uses the data from the year 11 cohort of 2021-2022 to compare the use of Educake to the GCSE results and incorporates information from approximately 80 students.

Literature Review

There are four key pedagogic approaches to teaching and learning that all contribute to a student's educational success; behaviourism, cognitivism, constructivism and connectivism. Each highlights a beneficial habit for life to enable students to be lifelong learners, such as the act of training and performing new behaviours, mental processes such as thinking, memory, knowing, and problem-solving, meaningful activities and the ability to see connections between fields, ideas, and concepts [Woollard (2010), Bates (2016), Pritchard (2018), Siemens (2017)]. Each theory works well alone, but when combined they can constructively interact and become greater than the sum of their parts. In my teaching practice so far, I have found it important to consider the holistic approach rather than just focus on one pedagogy.

Setting the habits for learning starts at an early age and is reinforced throughout student education [EEF Guidance Report (2019)]. The Teacher Toolkit simplifies it down to a simple four step process - explain, question, practice, feedback [Morrison McGill (2021)]. Assessment is a critical part of the process of collecting feedback to respond to the students' needs [Fletcher-Wood (2018)]. The science summative assessments are split into three main objectives: content, application, and analysis. These skills need to be practiced and challenged, through frequent informal assessment and the subsequent feedback for improvement [EEF Guidance Report (2021)]. Feedback and improvement time has become an integral part of lesson planning, which I feel supports this aim.

Thinking skills, such as those required for summative assessments, need metacognition and memory management skills. This can be achieved by interleaved, spaced revision such as

discussed by Dunlosky (2013), Averell & Heathcote (2011) Leitner (1991), Loftus (1985), and Ebbinghaus (1885). Leitner (1991) proposed the widely used method of using flashcards for revision. This is a simple implementation of the principle of spaced repetition, where cards are reviewed at increasing intervals. Knowledge that can be easily retrieved is reviewed less frequently than that which is harder to retrieve or even absent.

This principle of frequent retrieval practice has been adopted by my placement school. Each lesson, regardless of subject, starts with retrieval fast start questions and homework is focussed on further retrieval exercises. This is achieved in Science by using an online quizzing website called Educake [Educake (2022)]. The questions are chosen by the teacher to consolidate the learning in the lessons, to aid embedding of the key scientific facts and thinking skills. These can be considered as pre-made Leitner flashcards that are adaptable and available on demand. The answers are shown after the student response has been submitted, and students are encouraged to repeat the questions until the threshold success limit of 80% correct has been achieved.

There has been much discussion about the pros and cons of homework [Drew C. (2022)]. It has been discussed by the EEF that homework can have a high impact for a low cost, but this is based on very limited evidence [EEF Guidance Report (2022)]. There is a concern about teacher workload as summarised in the UK government report [DfE Research Report (2018)]. The online nature of the Educake work minimises the marking of the homework, but it still requires teacher input to choose appropriate questions and monitor student progress.

The impact of homework has been shown to be beneficial for both high and low achievers [Eren and Henderson (2018)]. Whilst Magalhoes et al (2020) found only a weak relationship between the amount of homework assigned and the student achievement. A positive correlation between the amount of homework completed and the achievement was found, particularly for the older students. This will be interesting to investigate with the Educake data, to compare the assigned work and achievement compared to the completed work and achievement.

Rochelle et al (2016) investigated the benefits of additional online maths homework. The results showed that there was an increased student scores on an end-of-the-year standardized mathematics assessment. It will be interesting to compare this to online science homework with my investigation. The maths investigation showed particular benefit for low prior achievement students. The catchment area and special educational need profile of my placement school will hopefully produce results that will either confirm or contradict these findings.

The promotional information provided by Educake claims that the online questioning could improve the exam results of your students by 2-3 grades [Educake (2022)]. Educake have released one study of their data from a large academy in an urban area of Nottingham with high deprivation and 42% of students on pupil premium. Their analysis was based on the 2016 GCSE results of their 246 year 11 students and their use of Educake in the 2015-16 academic year [Educake (2022)].

The analysis concluded that the students who attempted more Educake questions achieved higher Progress 8 scores and higher GCSE grades. The investigation that I am planning will hopefully build on and extend these results. This study divided the students into three main categories; non-users who attempted less than 100 questions, occasional users who attempted between 100 and 500 questions and regular users who attempted more than 500 questions. I would like to look deeper into the data for different categories, such as quiz completion versus quiz repetition. I hope that my study will be able to confirm or refute these results, as well as extending the analysis to the benefits in a COVID world where there is a greater access to and familiarity with technology.

Methodology

There are lots of facts and key words to be learned in Science curriculum. Retrieval practice is set as home learning through an online quiz programme called Educake. The questions are chosen by the teacher to consolidate the learning in the lessons, to aid embedding of the key scientific facts and thinking skills. These can be considered as pre-made Leitner flashcards that are adaptable and available on demand. The answers are shown after the student response has been submitted, and students are encouraged to repeat the questions until the threshold success limit of 80% correct has been achieved.

This study uses the data from the year 11 cohort of 2021-2022 to compare the use of Educake to the GCSE results and incorporates information from approximately 80 students. The information is stored within the online Educake account and is accessible for the school. The GCSE results and Educake data can be combined and anonymised for further analysis. I intend to investigate this wealth of data to see if there is any significant correlation. The information required for this investigation was all freely available within the school and has be anonymised to remove any association with a specific student.

Homework is an interesting topic, because it has been stated that there is minimal impact if it is too easy or hard. Retrieval practice has been shown to improve remembering and recalling information from the long-term memory. The whole student population are stakeholders of the study if they can have justification for homework and the impact of going the extra mile over just doing the bare minimum.

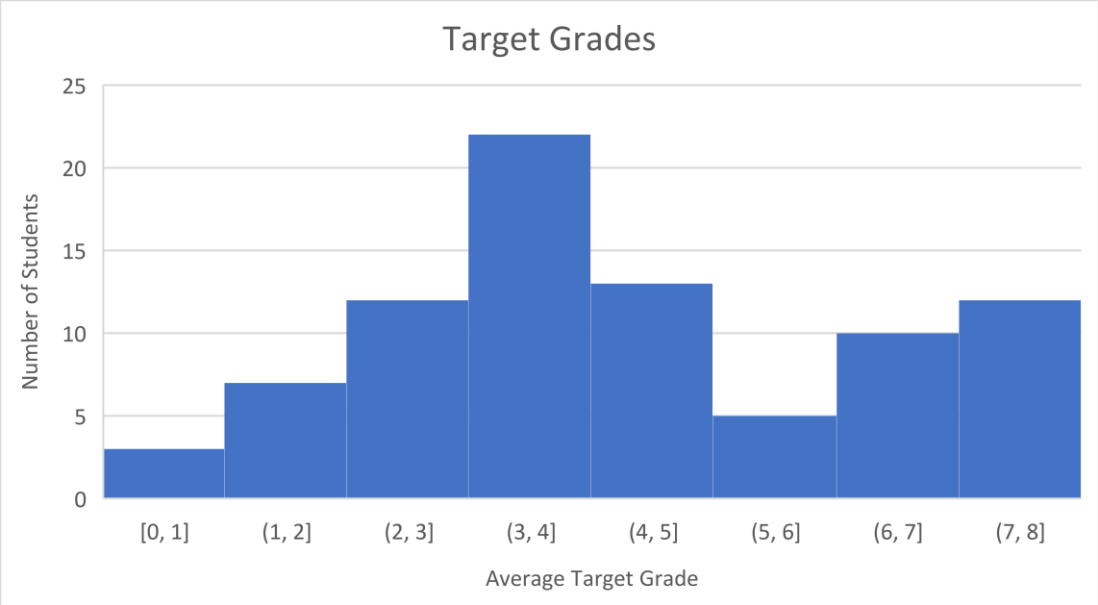
The main influential, advocate stakeholders were my placement school, particularly the Science department, and also the academy trust who manage the school. The study will hopefully provide further support for the importance of retrieval practice, which is a school focus currently, and concrete evidence to justify the money spent annually on the subscription to Educake. Educake themselves are another stakeholder, as the investigation will hopefully increase their evidence of the efficacy of the product. The main risks during this investigation included incomplete data, no correlation/other factors and overstretched outcomes.

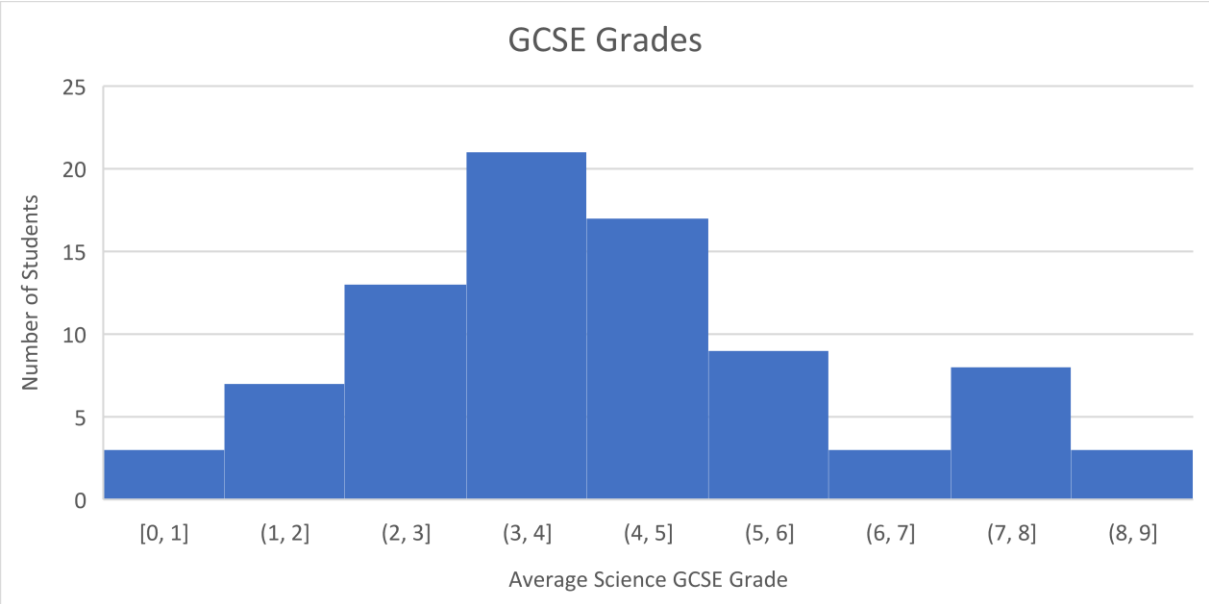
The first steps for the investigation were to download and access all of the data required, such as the Educake data and GCSE results, both of which will need to be collated and anonymised on a school secure location as a priority. The bulk of the work will be the data analysis of looking any correlation.

Results

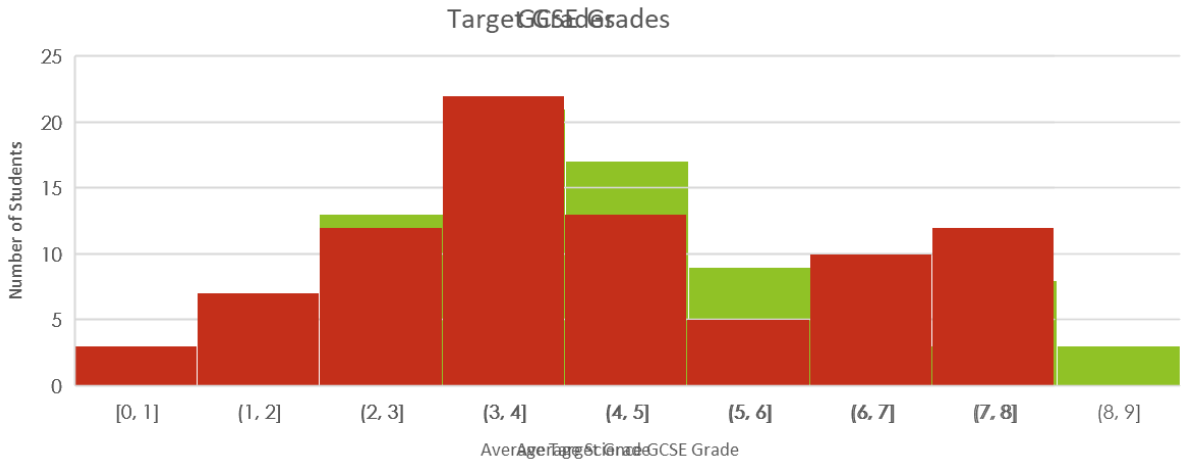
The GSCE data from the 2021 cohort of students at Oakbank School was analysed, a total number of 83 students. The data was anonymised so that only the student initials and GCSE targets and results remained. Within the 83 students with data, there were 12 English as a foreign language (EAL) students, 19 more able (MA) students, 19 pupil premium (PP) students and 14 students with a special educational need (SEN) either SEN support or a full educational health care plan (EHCP).

There was a distribution of students completing combined science, where 2 grades are awarded, and triple science, where 3 grades are awarded. For ease of comparison, the grades were averaged to allocate one figure for the results, e.g. a combined GCSE of 4-3 became a 3.5 and a triple GCSE of 7-7-8 became 7.67. This enabled the results to be analysed on the award scale from zero (representing U) to 9 (the highest grade). The data showed that there was generally an increase from their target grade to the grade achieved, as shown by the two graphs below:

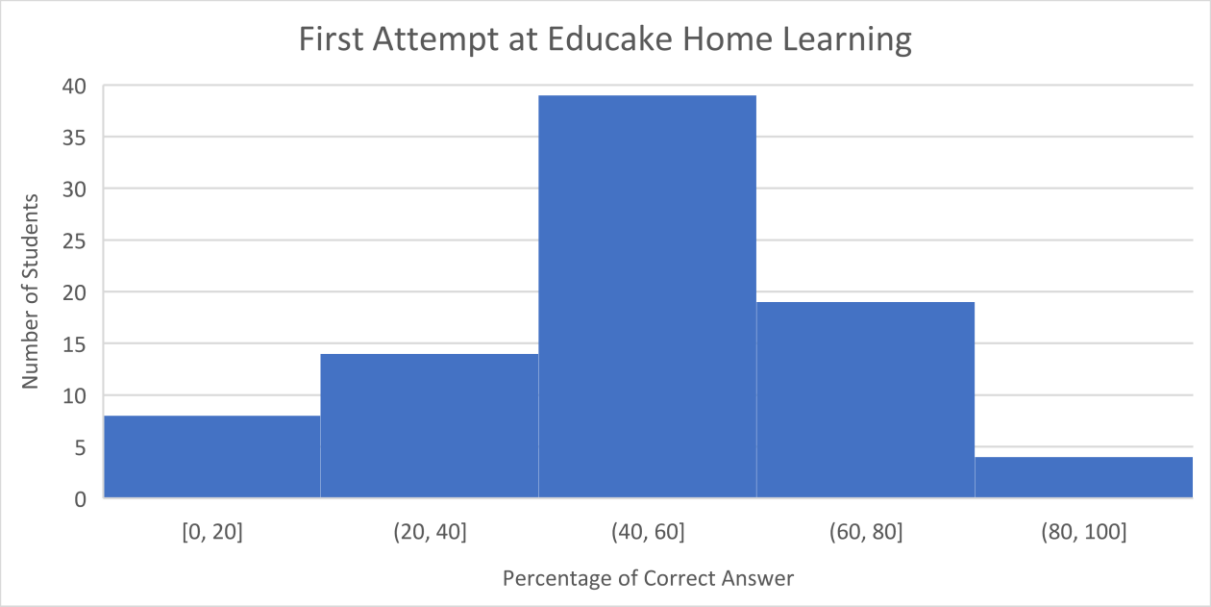


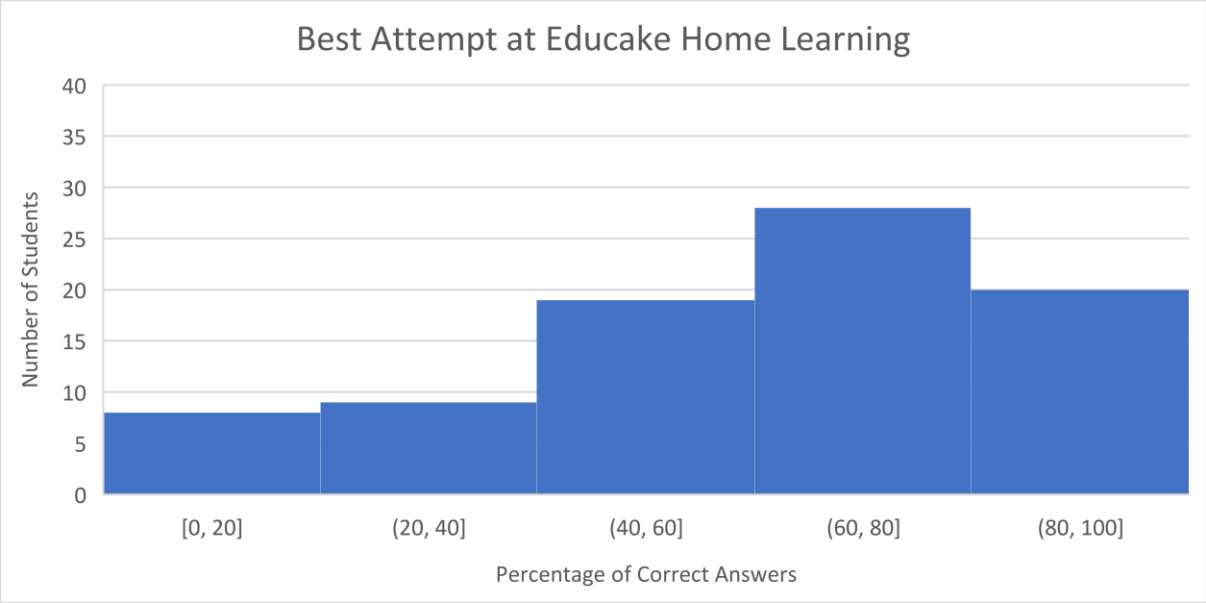


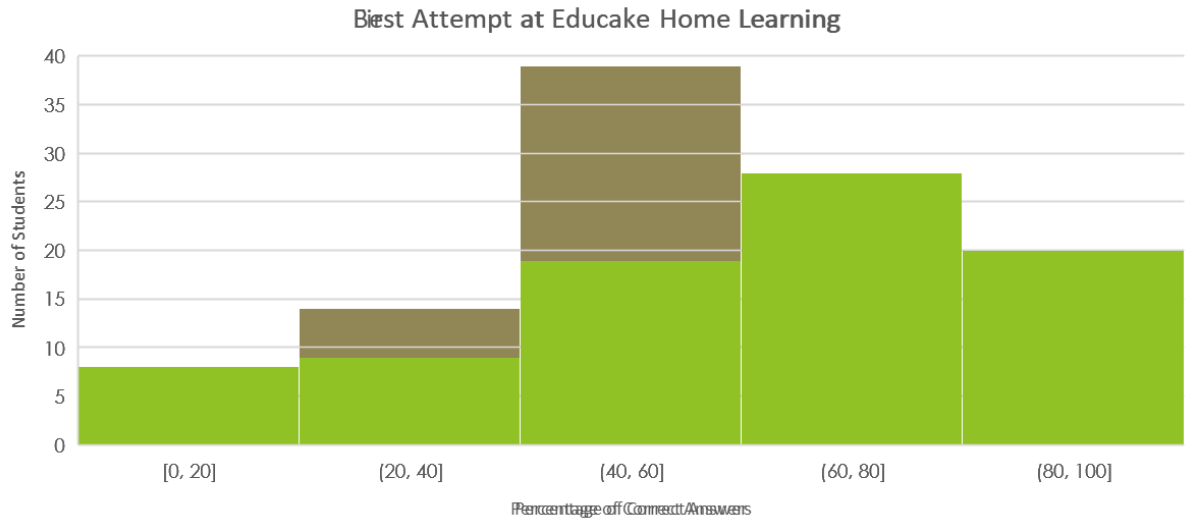
Students with an estimated target grade of 0 to 3 showed minimal difference between their target grade and the GCSE grade achieved. The larger difference in grades are in the target range of 6 to 9. This data is highly influenced by the choice of qualification attempted, for example the foundation candidates are limited to a 5-5, or 5 in the averaged data. Whereas at the higher end of the data, there is a discrepancy between taking the combined higher qualification and the triple sciences, which can be significantly affected by the averaging process applied to compare the data.



This information was then compared to the internal department data from Educake, an online science quiz based on a bank of thousands of science specification-mapped questions. This data included the percentage score correct from the first time they completed the quiz. Students are encouraged to repeat the quiz until they achieve a score of 80% correct, and this information is captured by their percentage score for their best attempt at completing the quiz.
The graphs below show that there is a significant increase in the percentage outcome from repeating the quiz. This is to be expected, as the answers to the questions are given after the first attempt so it should be easier to improve your score. It can be seen in the 0 to 20% bracket that there is a base line of 8 students that never attempt to improve their score.







The main null hypotheses for this study were:

1) Repeating online Educake homework has no effect on improving student grade on Educake.
2) Repeating online Educake homework has no effect on improving student

These hypotheses were tested using the t-test calculation of the p-value using Microsoft Excel. The data from the initial attempts at completing the Educake quiz, and the effect of repeating the Educake quiz gave a p-value of 4.03×10^{-15}, which disproves the null hypothesis that repeating the online quiz had no effect on improving the student grade on Educake.
The data from the difference in score between the first and best attempts at completing the Educake quiz was compared with the difference between the target grade and actual GCSE grade gave a p-value of 4.18×10^{-15}, which disproves the null hypothesis that repeating the online quiz had no effect on improving the student outcome at GCSE.

Discussion and Conclusion

It is no surprise to see that these null hypotheses are disproved. It shows that the hard work that a student puts into their study aids their progress. There is no evidence to prove that there is any

causality between the findings, but it would be nice to explore the evidence over a number of years.
The study was limited in Educake data for students that had graduated from Oakbank, because only the basic data has been saved/archived. For active students there is greater resolution of data, including any additional, self-driven study from access to the quiz data at their fingertips. Additional data would also enable a deeper investigation into any significant improvements for specific groups of students such as pupil premium, English as a second language or with special educational needs.
As a teacher, I feel the study justifies the additional workload on both the student and teacher to set these recall questions to aid the knowledge and basic understanding of the Science curriculum. The study is limited in positive hypotheses because conscientious students are more likely to complete their homework, and repeat their homework, and succeed in hitting or improving their GCSE grades without the intervention of Educake learning. This study is also not able to determine access to or skills with the online format of the Educake learning.

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