FLASHCARDS: TO SUPPORT TEACHING AND LEARNING

GTT
Great Teaching Toolkit

Evidence Based Education

INTRODUCTION

Flashcards are a teaching and learning technique involving the use of paper or digital resources to support the consolidation of curriculum content and recall of information from long term memory. Retrieval practice refers to the act of recalling learned information from memory (with no or little support) and every time that information is retrieved, or an answer is generated, it changes that original memory to make it stronger. The benefits of retrieval practice for long-term learning are among the most secure findings in educational psychology (Brown, Roediger, & McDaniel, 2014) and flashcards are a student friendly method of providing regular retrieval practice opportunities for learners.

The Great Teaching Toolkit: Evidence Review (Coe et al., 2020) suggests that great teaching involves activating hard thinking. This can be achieved through the use of questioning to promote elaboration and connected, flexible thinking in addition to using questions to elicit student thinking and evidence of understanding or long-term learning as learners develop knowledge and expertise. Flashcards can be used to activate hard thinking, in a classroom, with peers or as part of independent study.

However, as with most things in education it is important to take care when it comes to encouraging students to use flashcards, as this technique can be misunderstood and vulnerable to 'lethal mutation'. Flashcards can be an effective learning intervention but that depends on how students use them, when they are used by students and what content is included.

This eBook will cover the following:

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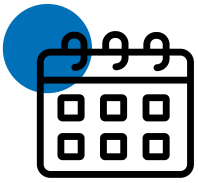

When to use flashcards?

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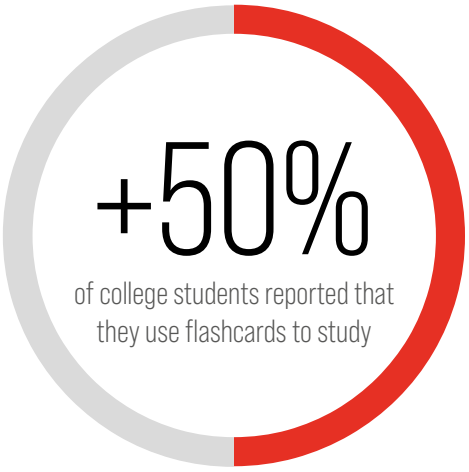
Why use flashcards?

Flashcards are versatile as they can be used inside and outside of the classroom, to provide opportunities for regular review, rehearsal, and retrieval practice. Flashcards can be adopted across different subjects, topics, ages, and key stages. They are low cost to create and there is the option for digital or paper versions (either way they can be portable).

Flashcards have flexibility as they can promote the recall of key facts, dates, quotes, definitions and more. In addition to effectiveness, flashcards are also popular with students.

In a survey carried out in 2018 (Miyatsu T, Nguyen K, McDaniel MA. Five Popular Study Strategies: Their Pitfalls and Optimal Implementations) more than 50% of college students reported that they use flashcards to study.



How to use flashcards?

Flashcard design and creation is the first hurdle to overcome to ensure flashcards are used efficiently and effectively by students. Creating flashcards can be a very time consuming and workload heavy task (for the teacher or student). A question that is often asked and considered by teachers: should students create their own flashcards?

There are several errors students can make when creating flashcards, which are worth being aware of:

- Students might include questions that are not relevant to the material they need to learn
- Students may miss important content that needs to be learned
- The questions created by students might not be desirably difficult (for example, too easy or too challenging)
- Answers on the flip side of the flashcard must be accurate, mistakes can be made
- Students may transfer notes to flashcards to re-read, in contrast to questions or definitions for self-testing.

"I have known students to create bundles of beautiful and bright flashcards with detailed notes and illustrations filling each card. I have also known students to spend hours transferring information from a textbook to a flash card. This shows students are clearly investing time, effort, and energy into their studies but often they are simply copying their notes onto cards and re-reading - not the most effective study techniques!"

– **Kate Jones**, Senior Associate for Teaching and Learning

Naturally, younger learners will not be able to create their own flashcards (as they will not have developed the skills and abilities to do so) but it is possible for them to use flashcards (with a parent or teacher) to support learning. Context is key. There are arguments for and against students creating their own flashcards, in contrast to using pre-made flashcards (that are created by the teacher, an external provider or found online). There have been numerous investigations to find an answer to this question, with mixed and at times unclear results.

A study published in 2023 by Pan, S. C., Zung, I., Imundo, M. N., Zhang, X., & Qiu, Y. illustrated that premade flashcards are quicker and more convenient for learners, but is the use of premade flashcards more effective for learning than students creating their own? Six experiments were conducted, using both premade and student created (referred to as user generated) flashcards to learn content material followed by a 48-hour delayed test. The results showed that across experiments user-generated flashcards did improve memory relative to premade flashcards. The abstract states,

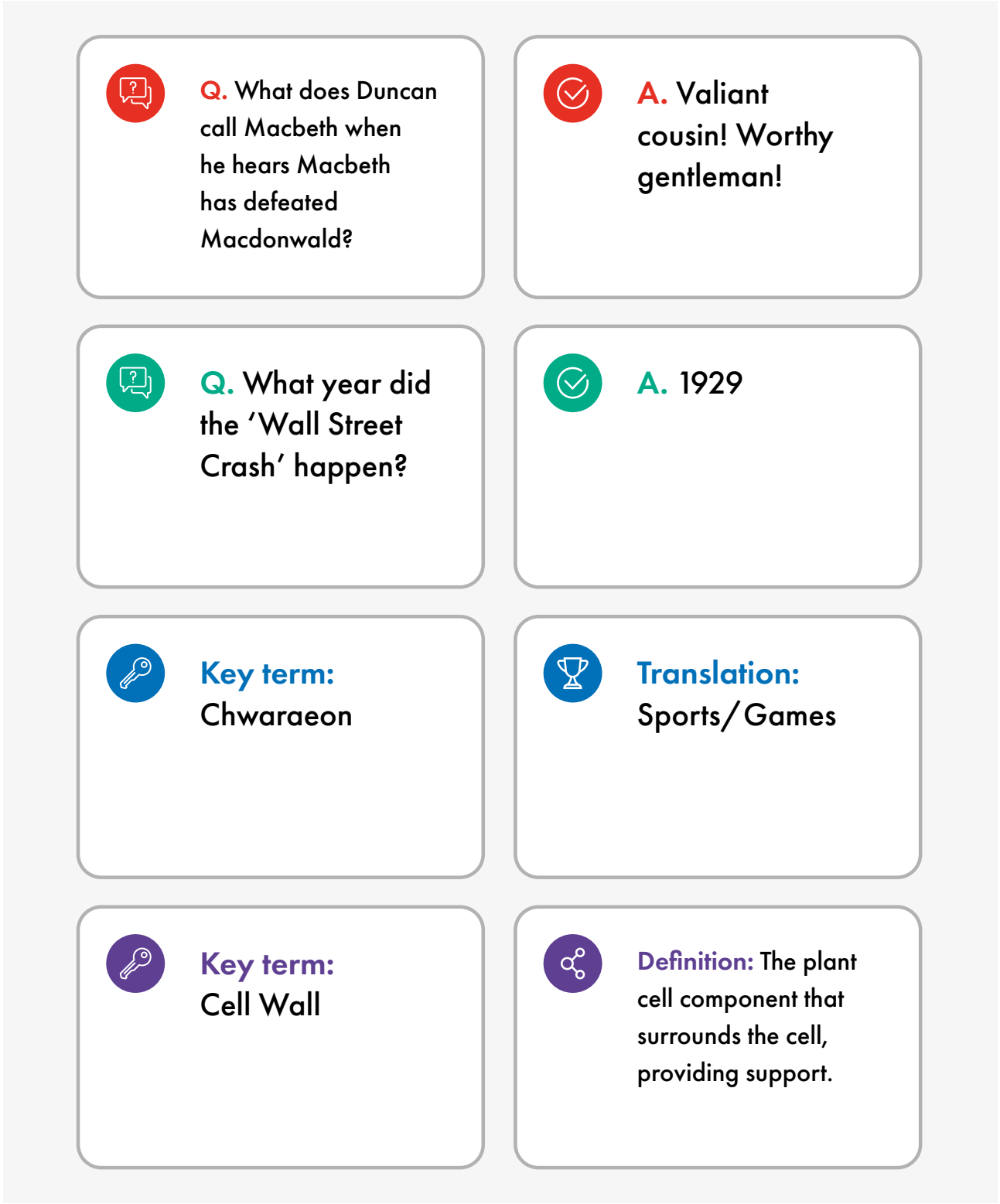
"These results suggest that generating one's own flashcards enables productive learning processes that enhance memory and comprehension. Accordingly, digital flashcard users may benefit from eschewing premade versions in favour of making their own."

These findings offer valuable insight for teachers and students. However, it is important to remember that students are often **novices** in terms of question design and flashcard creation, therefore they will require explicit guidance and support from the teacher. The teacher can model to the class how to create flashcards with examples (and highlighting bad or non-examples). Teachers should monitor and quality assure the flashcards, this can be carried out with a quick check and review during a lesson.

When creating flashcards students should use existing resources to ensure the content included is relevant and answers are accurate. This can include referring to knowledge organisers, question banks provided by the teacher, class books and/or textbooks. Creating flashcards for several subjects (and topics within each subject) can take a significant amount of time and become a workload issue for students. They should aim to devise flashcards each week (or on a regular basis) to help consolidate new material and spread the creation of flashcards over time.

For paper flashcards colours can be used for different subjects, such as green for science and pink for history, or the use of colours for various categories or topics. Colour coding is purely to help with organisation, not recall. Students should be aware that extended questions should be used for practice essays or exam questions, but not all questions are suitable for flashcards.

Flashcards should contain a question on one side and answer on the other (or keywords and definitions on the back), as shown below with a selection of examples:

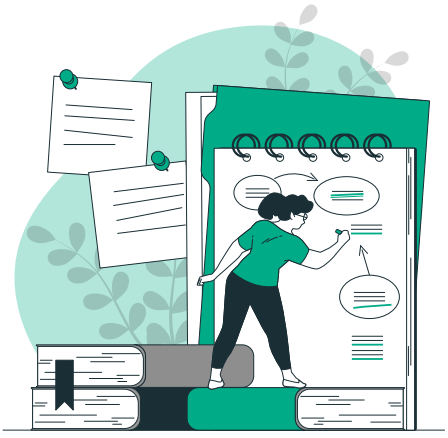


The argument for not including more questions or key terms per card is to help students monitor their progress by placing cards in an incorrect or correct pile. For example, if there are five questions per card and a student were to answer three correctly, there are still two incorrect answers that need to be revisited (not added to the correct pile). It is vital students include the answers when creating flash cards because this provides the necessary instant feedback and guidance to progress forward. This feedback also informs students as to what they need to return to and focus on. **Using flashcards for quizzing is the best way to use flash cards.**

> *"The advice and mantra I shared with my students (and their parents/carers) is that 'flashcards don't need to be flashy '."*
>
> – **Kate Jones**, Senior Associate for Teaching and Learning

Digital flashcards can be used as a form of in class quizzing and homework. They can be created by the teacher and/or student and there are existing premade digital flashcards available across a wide range of websites, apps and platforms. Digital flashcards can include features that paper versions cannot including the following:

- The use of visual images as retrieval cues and prompts
- The inclusion of audio (for use in Modern Foreign Languages or to help learners with Special Educational Needs and Disabilities or English as an additional language).
- Hyperlinks to guide students to further resources and content materials
- Digital tracking and recording of progress
- A shared storage space to hold vast amounts of questions/ question banks



In terms of teacher created flashcards, digital versions offer a better alternative in regard to workload as no printing, cutting or laminating will be required. Digital tools can help the teacher to monitor student engagement and progress with greater ease and speed.

Students will require a digital device and internet to access flashcards online, unlike like paper cards but both can be used in a variety of locations and 'on the go' to support regular revision. A disadvantage of using digital flashcards can be an increase in student screen time and there is the potential for distractions online e.g. social media notifications. Nevertheless, distractions also exist when using paper flashcards, so the learner will need to be able to demonstrate focus, attention and self-regulation.

A study published in 2024 by Ingebrigtsen, M., Miland, Å.O., Bastesen, J. and Sæle, R.G. (involving 799 first-year nursing students across 19 Norwegian campuses) investigated the effectiveness of teacher-made digital flashcards as an intervention to improve learning. This study highlighted the advantages of digital flashcards,

"Digital flashcards are ideal for spaced retrieval practice for two reasons. Firstly, the material is presented in a question-answer format. Second, the digital application can present the material at intervals that are optimized by a spacing algorithm (Dunlosky & O'Brien, 2022). This tailors the repetition intervals to each individual student in a way that is unattainable with classroom quizzes, which is the more typical form of classroom application (Trumble et al., 2023). Moreover, these applications are already popular among students (Gilbert et al., 2023; Zung et al.,2022), which combined with their superior smartphone accessibility, makes regular use more likely."

As with all decisions in the classroom the teacher can draw on evidence and combine that with their professional knowledge, expertise, and judgement. There can still be benefits for students using premade flashcards, harnessing the benefits provided through regular spaced retrieval practice. Some learners, for example students with special educational needs and disabilities (SEND) or English as an additional language (EAL), or younger learners may struggle with the creation of flashcards and find it difficult, but they may benefit from using premade flashcards. However, if students can understand and develop the skills to create flashcards to enhance learning they will be able to do so to support lifelong learning and study.

The creation of flashcards should not become the main task or focus with flashcards. The main purpose of flash cards should be self-testing (quizzing) to strengthen information in long term memory and provide instant feedback to identify gaps in students' knowledge, alternatively they can be used for rehearsal if later followed by active recall. Unfortunately, flashcards are not always used this way by students.

"Lots of students use flash cards. But using flash cards doesn't guarantee they're using retrieval. In fact, students could be wasting their time. "

– Dr Pooja K. Agarwal
Cognitive scientist & founder of retrievalpractice.org.

Professor John Dunlosky (2013) ranked different study strategies in order of how effective they are. Retrieval and spaced practices were the most effective strategies, while less effective strategies included re-reading, highlighting and summarisation. In 2021 John Hattie and Gregory Donoghue published, *A Meta-Analysis of Ten Learning Techniques*. This focused on the ten learning techniques originally highlighted by Dunlosky in 2013, whilst reviewing recently published evidence. The meta-analysis is based on 242 studies, 1,619 effects, 169,179 unique participants. The conclusion replicated the findings of the Dunlosky report, stating,

"The most effective techniques are Distributed Practice and Practice Testing and the least effective (but still with relatively high effects) are Underlining and Summarization."

This is relevant for understanding how flashcards should and shouldn't be used. Flashcards should be used for quizzing and providing regular opportunities for retrieval practice, not for re-reading class notes and materials. Students must consciously recall the answer to the question on their flashcards, either verbally, through writing down their answer or selecting an option if using digital flashcards. The reason for this is that students can struggle to self-test. They may see a question and think (or assume) they know the answer and, before consciously recalling it, they have turned over to read the answer and told themselves they knew it. They just recognised the answer instead of going through the retrieval process. This approach to using flashcards effectively requires self-discipline from students.

Flashcards can be used independently for self-quizzing, but they can also be used for pair quizzing with a peer, friend, or family member. The pair quizzing can take place within a lesson or outside of the classroom. A study published in October 2024 entitled, 'When Two Learners Are Better Than One: Using Flashcards with a Partner Improves Metacognitive Accuracy', explored the benefits of using flashcards to facilitate retrieval practice alone versus with a partner. The paper highlighted that although flashcards have many benefits to support long-term learning students do not always use them effectively and efficiently.

"Although flashcards can facilitate retrieval practice, the conditions under which they are most effective remains to be fully established, and there is evidence that students use flashcards ineffectively and remain susceptible to illusions of competence when doing so."

During the three experiments, undergraduate students were tasked with learning word-definition pairs using flashcards alone or with another student to compare individual and paired conditions. The participants undertook a cued recall test after a short delay and a 24-hour delay. The abstract below summarises the findings,

"... findings suggest that although performing retrieval practice with flashcards alone versus with a partner yields comparable amounts of learning, doing so with a partner can increase metacognitive accuracy, a benefit driven by the facilitation of overt retrieval. Overall, these findings have implications for self-regulated learning and effective exam preparation."

Teachers and students can encourage parents or peers to get involved with flashcards by asking the questions and checking the answers. Often parents are keen to support their child with revision and this is a straightforward way they can do so. This will ensure retrieval practice is taking place with students verbally answering questions and receiving feedback.

When to use flashcards?

When is a suitable time to start using flashcards? Obviously, students can only create and use flashcards after the content material has been taught and covered by the teacher, but in terms of when, the sooner the better.

Creating and using flashcards close to an exam or assessment is not harnessing the full benefits that flashcards can offer. Flashcards should not be crammed as a method of intense and last-minute revision, but instead used little and often, regularly over time.

A strategy to ensure spaced or distributed practice is known as the **Leitner System**, named after Sebastian Leitner, who developed this method in the 1970s. The focus of this approach is to help students revisit the flashcards they have previously struggled with, until they can retrieve that information with ease and confidence. There are different variations of the Leitner System, but a commonly used method promoted by teachers involves the use of three boxes (or any item to store the flashcards). This system does rely on students using their flashcards on a regular basis for self-quizzing, commitment is required but effective long-term learning does require effort!

The following day students will repeat the process. If they still cannot answer the flashcards from box one, they remain there, but if they have now answered that flashcard accurately it will move to box two. If students answer a question from box two incorrectly then it goes back to box one. When students are able to correctly answer the questions in box two, they will be moved to box three, only to be revisited on Friday. This process will continually be repeated, either with the same flashcards or for different subjects and topics. The Leitner System identifies gaps in knowledge and ensures that those knowledge gaps are revisited and closed with regular opportunities for repeated retrieval practice.

Students will need to recognise when to 'drop' the flashcards and move onto another study method (one which enables extended answers and practice under timed and exam conditions). Students should only drop the flashcards and progress onto other study strategies once the flashcards have been mastered and students are able to recall answers and information correctly, confidently, and quickly. Once the content from flashcards is secure and recallable students can then apply that knowledge by completing exam questions and papers.

Research has revealed that students often drop flashcards as a study method too soon. A study entitled, 'Optimising self-regulated study: The benefits—and costs—of dropping flashcards '(2008) published by Nate Kornell and Robert A. Bjork found that students dropping flashcards is common after just one correct retrieval attempt, resulting in reduced learning in contrast to conditions were dropping was disallowed. The authors of the publication note,

"Dropping items has the possible drawback that it decreases the spacing of the repetitions of the remaining items."

It can be difficult for learners to self-regulate and monitor their own progress, they should revisit flashcards to maintain retrieval strength, therefore ensuring content remains easy to recall from long term memory. Kornell and Bjork also warn,

"A student who focuses too much on learning the most difficult flashcards is in danger of dropping easier items too soon ... students who believe they can master all the to-be learned materials typically focus on the most difficult materials. A strong focus on difficult flashcards translates to a strong desire to drop easy flashcards—even if doing so means jeopardising one's ability to recall the easy ones later."

Teachers can use lesson time to provide opportunities for self or pair quizzing with flashcards, although this can be difficult with the demands of curriculum content to cover. Homework tasks can be set where students are expected to spend a specific amount of time using flashcards, if using a digital platform this can be monitored and tracked, or students can record their progress. The Education Endowment Foundation (EEF) published key findings and guidance about the use of homework to support teaching and learning. The EEF advises that homework that is linked to classroom work tends to be more effective and that it is important to make the purpose of homework clear to learners (e.g. to increase a specific area of knowledge, or to develop fluency in a particular area). Flashcards should be clearly linked to curriculum content covered in class and students should understand the value and purpose of using flashcards outside of the classroom to support their learning.

"Students tend not to understand the value of the homework they do, and assume it is just a part of day-to-day school life. Teachers set it because it's a policy, and students do it because they have to. As such, the only incentive to do it is either the natural inclination to do what we are supposed to do, or the deterrent effects of a consequence like a detention. Rare is the student who truly appreciates the learning value of their homework and is grateful that it has been set. It is therefore imperative that we explain to students why we set certain homework. Telling students that doing homework is important is one thing but showing them is quite another. The more you can feed the work students do at home into the work they do in class the better, and the more they will mutually reinforce each other. Students who can see that the work they do at home makes them better in class will grow not just in their knowledge, but also in their confidence and surety that homework really helps."

– Adam Boxer, Science teacher and Co-founder at Carousel Learning

The goal (especially for older students) should eventually lead to flashcards being used appropriately and accurately to support independent study and preparation. They can do so when they know and understand why, how and when to use flashcards. Flashcards can be used beyond the classroom, in further and higher education, to learn a new language or to develop knowledge and expertise in the workplace.

To find out more about the 'Science of Learning' you can complete the Science of Learning Programme as part of the Great Teaching Toolkit. You can also download our free eBooks 'Understanding Memory and Learning' and 'Retrieval Practice: Myths, Mutations and Mistakes' from the Evidence Based Education resource library, to learn more about the research and theory supporting evidence-based practices.

REFERENCES:

- Brown, P. C., Roediger III, H. L., & McDaniel, M. A. (2014). Make it stick: The science of successful learning. Cambridge, MA: Belknap Press.
- Coe, R., Rauch, C. J., Kime, S., & Singleton, D. (2020). Great teaching toolkit: Evidence Review. Evidence Based Education
- Miyatsu T, Nguyen K, McDaniel MA. Five Popular Study Strategies: Their Pitfalls and Optimal Implementations. Perspect Psychol Sci. 2018 May;13(3):390-407. doi: 10.1177/1745691617710510. PMID: 29716455.
- Pan, S. C., Zung, I., Imundo, M. N., Zhang, X., & Qiu, Y. (2023). User-generated digital flashcards yield better learning than premade flashcards. Journal of Applied Research in Memory and Cognition, 12(4), 574–588.
- Ingebrigtsen, M., Miland, Å.O., Bastesen, J. and Sæle, R.G., Effective, scalable and low-cost: The use of teacher-made digital flashcards improves student learning. (2024)
- https://www.retrievalpractice.org/strategies/2019/11/18/flashcards
- Dunlosky, J. (2013) 'Strengthening the Student Toolbox: Study Strategies to Boost Learning', American Educator.
- Hattie, J. Donoghue, G. (March 2021) A Meta-Analysis of Ten Learning Techniques.
- Imundo, Megan & Zung, Inez & Whatley, Mary & Pan, Steven. (2024). When Two Learners are Better Than One: Using Flashcards with a Partner Improves Metacognitive Accuracy. 10.31234/osf.io/xaysc.
- Kornell, N., & Bjork, R. A. (2008). Optimising self-regulated study: The benefits—and costs— of dropping flashcards. Memory.
- https://educationendowmentfoundation.org.uk/education-evidence/teaching-learning-toolkit/homework
- https://www.carousel-learning.com/teaching-and-learning/blog/the-four-planks-of-an-effective-homework-policy

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