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The Use of Digital Technology as Part of the Consolidation of Lexical Memorization in Languages: The Ankara University Private Foundation & Anatolian High School (ANKU) in Ankara

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Abstract

Through this study of the lexicon in learning English as a foreign language, we see that learning the lexicon is a sine qua non for learners since it is thanks to it that they will access effective communication. Also, the integration of digital technology in the teaching-learning of languages is not new, but the web and the great diversity of tools that are increasingly easy to use seem to have had an accelerating effect. So, this research took place in The Ankara University Private Foundation & Anatolian High School (ANKU) in Ankara for the use of digital technology in the context of consolidating lexical memorization in languages. Based on this research, we will ask the question of the effectiveness of memory replays via digital technology in the context of a consolidation of lexical memorization in the medium term versus the use of paper supports. The experiment was carried out in an establishment whose students mainly have a relatively high socio-economic profile. This is a Secondary class, with heterogeneous levels. We will highlight here the fact that in English lessons, students have used the Socrative online exerciser on several occasions since the start of the year on a computer in the computer room for formative assessments (as training and self -evaluation) preceding summative evaluations on paper and that they were therefore accustomed to this digital medium during the experience.

Keywords: Digital Technology, Lexical Memorization, Ankara University Private, Anatolian High School, Ankara

Introduction

While the school was previously perceived by students and families as possessing digital tools and the knowledge to use them, it is clear that learners today seem more in touch with digital technology in their personal lives than in the school setting and that they develop uses of increasingly sophisticated tools. Some consider this development as a "revolution", like the philosopher Michel Serres who goes so far as to describe this advent of digital technology as the third "anthropological rupture" following the invention of writing and communication. Printing which also led to a change in perception of space and time and a necessary re-evaluation of the act of teaching (Assailly, 2022, pp. 10-12).

While a significant number of language teachers underline the difficulty of students acquiring a "minimal" vocabulary allowing them to express themselves, (some going so far as to admit to having abandoned any evaluation of learning vocabulary following the poor results of past attempts and the students' perception of memorizing items as boring), we are allowed to wonder about the possible contribution of the use of digital technology in the teaching of lexicon (Bin Saran, 2024). While the computer equipment available in establishments often appears insufficient given the number of students and the needs of teachers, we are led to a second question: students who are widely equipped with connected mobile phones or "smartphones", could they make this tool an asset for their language learning?

After looking at the contributions of cognitive sciences concerning the functioning of memory and what the term "digital" covers, we will consider what a work environment integrating these new tools connected via BYOD (Bring Your Own) can be. Device or use of learners' personal equipment). Based on this research, we will ask the question of the effectiveness of memory replays via digital technology in the context of a consolidation of lexical memorization in the medium term versus the use of paper supports. To this initial question will be added that of knowing whether the tool used – computer provided by the establishment or BYOD (that is to say in this case, the student's mobile phone) – can have an influence on memorization. To try to answer this question, we will present the results of the experiment carried out this year with a Secondary class. Finally, we will compare the results and the nuances that must be brought to them due to the experimental conditions while raising the questions which seem to us to be the most relevant and which in our view deserve broader investigations.

Literature Review

The sources, namely books, articles, journals, theses and dissertations, used in this research are all linked to the exploration of the use of digital technology in the context of the consolidation of lexical memorization in languages. Here, some of the most important

research is detailed.

According to Kosharna et al. (2023) digital and multimedia technologies are a key element in the effectiveness of learning a foreign language, as they contribute to the acquisition of innovative knowledge and the realization of educational ideas. Digital technologies improve students' philological and communicative skills. Learning a foreign language should be based on the use of an individual approach to learning, which affects the personal development of students. Emphasis should be placed on speaking, listening, writing and reading, taking into account specific trends in the development of digital technologies.

In "*reviewing and exploring innovative and ubiquitous learning tools in higher education*" (2020) Aljawarneh study that there is a negative aspect associated with the use of these applications described. For example, there is concern that by engaging students with portable devices with Internet access, they may become distracted by unrelated topics, ultimately compromising the effectiveness of such learning. Over-reliance on mobile devices can hinder students' cognitive activation. Since students have constant access to information on their smartphones, they may not make an effort to memorize the necessary material. Additionally, students are often distracted by social media conversations and browsing non-academic websites, impacting their engagement during classes. Antufi Eva et al. (2023) concluded that the use of digital technologies in learning a foreign language contributes to the development of professional skills. The digitalization of learning also improves the organization of the learning process. Reading skills develop during the first year of study, therefore it is necessary to ensure the possibility of meaningful perception of information. Digital technologies provide syntagmatic segmentation of sentences, which contributes to the formation of correct intonation when reading.

In *the recognition of coordinative compound words by learners of Chinese as a foreign language: A mixed methods study* (2021), Jing Sun, Hye K. and Haiyang Ai insisted that learning Chinese as a foreign language requires coordination work, which can be implemented using digital technologies. The identification of words and their written pronunciation must be ensured during the learning process. For this, the study of inter-symbolic orthographic and semantic relationships is necessary, which excludes confusion with individual words. Digital technologies contribute to the study of semantic similarities between words and to the study of orthographic similarities. This promotes the development of students' thinking through the search for logical connections between words.

Problem

The process of semantic memorization revealed by cognitive sciences demonstrates the importance of frequent memory repetitions for the consolidation of

memorization of “essentials” via active approaches such as testing. Therefore, it seems interesting to question the place of digital technology in this process and the opportunity it represents when it is integrated into an approach demonstrating global coherence between methods, tools and educational objectives. This question can be coupled with a second question linked to the tools used and the possible place of Bring Your Own Device in class. We will therefore be led to question the effectiveness of memory recovery via digital technology (and more precisely via the Socrative exerciser) as part of a consolidation of lexical memorization versus the use of paper supports. To this initial question will be added that of knowing whether the digital tool used – computer provided by the establishment or BYOD (that is to say in this case, the student's personal mobile phone) – can have an influence on this memorization. We will start from the following hypotheses to compare them with our experience:

1. The use of digital technology has no impact on the consolidation of memorization of the lexicon via memory repetitions; the use of digital technology via the use of the Socrative exerciser would only constitute, according to Puentedura's SAMR model, a Simple substitution for paper exercises.

2. The use of digital technology via the Socrative exerciser constitutes an Improvement or even a Modification in particular due to the motivation generated by the tool but also due to the immediate feedback which reinforces the understanding of the error and memorization among the student. pupil. The use of digital technology has a positive impact compared to the use of paper. The fact of using computer or BYOD does not impact the results.

3. The use of Socrative via BYOD, in addition to presenting advantages in organizational terms for the teacher and the establishment, leads to better results due to the systematics acquired by the students with the tool as well as the affect linked to the object.

Method

In order to refute or confirm these hypotheses, the following experiment was set up within the Ankara University Private Foundation & Anatolian High School (ANKU) in Ankara.

Participants

The experiment was carried out in an establishment whose students mainly have a relatively high socio-economic profile. This is a Secondary class of 26 students, at heterogeneous levels (from A1+ to B2), mixed with a majority of boys (9 girls, 16 boys). We will highlight here the fact that in English lessons, students have used the Socrative online exerciser on a computer in the computer room on several occasions since the beginning of the year for formative assessments (as training and self-assessment -

evaluation) preceding summative evaluations on paper and that they were therefore accustomed to this digital medium during the experience.

Material and Procedure

The Ankara University Private Foundation & Anatolian High School (ANKU) in Ankara, which accommodates nearly 300 students, has three computer rooms, two with 18 stations, a third room made up of two distinct spaces with limited visibility between the two (room little used and currently under construction) offering 15 computers. The rooms can be reserved by teachers via an online platform and are rarely available. No Wi-Fi connection is available in the establishment. As part of this experiment, we used the computer room for one session (first session) as well as the following equipment.

Questionnaire

Before carrying out the experiment, a questionnaire approved by the management of the establishment was submitted to the students (appendix 2); it had to be completed individually by the students, at home, within a week. It focused on their relationship with digital technology (in class and at home, on different tools, linked to their schooling or not). It aimed to first see what concrete experience it was possible to envisage with the class. It was also a question of seeing if it was possible to distinguish broad “typologies” of students in terms of level of equipment and appetite for digital technology. The analysis of the responses to the questionnaire made it possible to identify several points (which we will develop in the section

"Analysis") including that of the inability to conduct the experiment using BYOD with the entire class (only a small number of students being both equipped with a smartphone with unlimited connection and wishing to use their telephone in class).

Vocabulary Discovery and Memorization Phase in Class

The entire class was required to work in the computer room (reservable by teachers but in high demand, with 18 stations available for 26 students and a space equipped with tables and chairs facing the blackboard). The first step was to discover and memorize new vocabulary. The memorization work at the start of the course in a frontal device (space in front of the board with tables and chairs) focused on a mind map (a tool frequently used throughout the year) bringing together 14 words in English. They came from a field not studied in class (so that appetite and work on the sequence do not impact the results) and considered close to their sphere of interest: music (appendix 3). The choice of 14 words resulted from a desire to avoid cognitive overload by working on two series of 7 words (corresponding to the memory span). The words themselves were chosen so as not to be

too close to Turkish or, when this was the case, to present a difference in terms of the spelling of the word (rythme / rhythm – rhyme / rhyme). Following a few minutes of personal work on the translation of Turkic words into English, a sharing phase took place on the board. The students completed and corrected their production then benefited from three minutes of silent memorization work. At the end of this time, the mind maps created by the students were given to the teacher. Another activity, linked to the current sequence, was then offered to the students.

Test 1: Training Phase on Differentiated Tools

At the end of the course, the students were divided into 3 groups determined based on the results of the questionnaire. We will distinguish here the supports (digital – here Socrative – and paper) and the tools (computer, smartphone, paper), the paper being in this experiment at the same time a distinct support (test not exactly identical to the digital support although it is as close as possible) and a tool different from the computer and the mobile phone.

- group 1: students equipped with smartphones with an unlimited plan and volunteering to use it in class, worked on their smartphone (on which they had downloaded the application beforehand at the teacher's request),
- group 2: students more or less equipped and more or less comfortable in the computer room (a fairly disparate group according to the results of the questionnaire) worked on paper,
- group 3: students interested in digital technology but not equipped with an unlimited plan worked on a computer.

The groups were heterogeneous in terms of the language level of the students. All were subjected to a test (combining cued recall and free knowledge recall) covering the 14 words studied at the start of the course, over eight minutes: group 2 doing it on paper, group 3 on computer and group 1 on personal mobile phone (Socrative test). The “paper” test was as faithful as possible, both in the wording of the questions and in their order, to that offered on the Socrative online software, the difference being mainly in the ability of the software to provide immediate feedback on the proposed answer. (True/false and explanation of the expected answer) and allowing those who wished to repeat the exercise several times within the allotted time (8 minutes). The test focused on understanding the meaning of the vocabulary as well as mastering its spelling. A correction to the board was made at the end of the exercise for students working on paper.

Test 2: On Paper

A week later, a second test (also combining free recall and cued knowledge recall) was offered on paper, in the “usual” class to all students. It was distinct from the first

although it included the 14 words studied on the mind map.

Test 3: On Paper

A month later, a third test (with free recall only to avoid the bias presented by cued recalls – see Limits and perspectives) was offered on paper, in the "usual" class to all students. It was distinct from the first two, although it included the 14 words studied on the mind map. It was proposed following two weeks of vacation.

The analysis concerns the comparison of the number of errors on 14 questions relating to the 14 words studied, on the three tests according to the medium used (digital or paper) and the tools used (telephone, computer, paper) during the training phase (test 1).

Lexical Memorization: Definition and Research

Scientific advances have revealed the fact that the term "memory" actually covers multiple and complementary "memories" differing in the nature of the elements to be remembered, the retention period and the quantity of information that can be maintained (Radvansky et al., 2022, pp. 1699-1700). Crystal Williams (2023) summarize the distinctions to be made between: sensory memory linked to the sense organs, working memory processing information for a few tens of seconds and so-called long-term memory (declarative memory bringing together "episodic memory" linked to personal history and "semantic memory" made up of facts and knowledge as well as "procedural memory" bringing together procedures and automatisms).

For our part, we will concentrate on dealing with lexical memory - and therefore the conscious memorization of usable knowledge - on semantic memory. However, if this is defined by an almost unlimited capacity, it appears subject to forgetting. As early as 1885, the German philosopher Hermann Ebbinghaus developed a hypothesis on the decline in memory retention over time which he schematized in the form of a "Forgetting Curve" demonstrating that humans tend to reduce more and more by half their memory of any new knowledge in the days or weeks following its acquisition, unless they consciously re-memorize this new learned knowledge (Wertheimer & Puente, 2021, pp. 77-82). Far from being a passive storage in the receptacle that would be the brain, semantic memory would therefore be subject to a cognitive process which would include several phases including the encoding of information, maintenance, phases of forgetting, and consolidation. Possible through storage and recall. This is what advances in so-called "cognitive" sciences tend to prove.

Semantic Memory According to Cognitive Sciences

Cognitive sciences, born in the 1950s in the United States, can be defined as "a set

of scientific disciplines aimed at the study and understanding of the mechanisms of human, animal or artificial thought, and more generally of any cognitive system, that is to say any complex information processing system capable of acquiring, retaining and transmitting knowledge" (Landi, 2020, pp. 1-2). These sciences would make it possible to better understand the functioning of memory by relying in particular on the Neuroscience and the development of brain imaging. In his course given on the cognitive foundations of school learning, Stanislas Dehaene (2014), professor at the College in France holding the chair of Cognitive Psychology, takes up one of the basic postulates of the discipline: if from the end of the 19th century, Ebbinghaus (1885) postulates that forgetting follows an exponential law as a function of time, he also indicates that forgetting depends on several factors. Loftus (1985), based on numerous data, shows that forgetting is (slightly) slower when the initial facts have been over-learned. It therefore seems possible to extend memory. The problem remains, however, that teachers and students alike do not necessarily have the metacognition necessary to optimize memorization. This metacognition is one of the objectives of cognitive sciences which aim to bring out from scientific experiments the phenomena which underlie memory in order not to rely solely on intuitions to optimize learning but on methods based on evidence.

Certainly, the debate exists on the interest of the meeting between educational sciences and cognitive neurosciences which are interested in the neurological bases of memory. Some authors (Maki, 2022) argue that the two must remain separate while others (Tardif & Doudin) are favorable to this transdisciplinary exchange. While being in favor of it, Tardif and Doudin raise the obstacles and limits of this interaction: an excessive fascination with neuroscience, abusive interpretations of research results as well as the development of false beliefs about the functioning of the brain (which have sometimes been able to penetrate the educational environment, such as the unfounded myths of the existence of a right and left hemisphere and the use of only 10% of the capacity of our brain) (Denet et al., 2022, pp. 21-22). On the other hand, neuroscience taken in isolation seems to contribute little to educational sciences. Having raised these reservations, it nevertheless seems interesting to the authors to establish a collaboration between neuroscience researchers, education researchers, teachers and psychologists in order to better uncover the complex links that unite pedagogy and the brain. We will follow this approach here and particularly to question the functioning of the consolidation of lexical memorization.

Patricia J. Bauer and Nicole L. Varga take up the idea that "The processes of transforming temporary patterns of activation into long-term mnemonic representations require that experiences are not only recorded in the brain but also consolidated and preserved for subsequent recovery. » (Varga, Cronin-Golomb, and Bauer, 2022). The question therefore arises of the contribution of cognitive sciences to the updating of the facilitative elements of memory consolidation.

Memory Recovery and Consolidation of Stored Data

If we take up the synthesis carried out by Stanislas Dehaene based on the results of research carried out on long-term memorization, we can establish a comparison between "distributed learning" ("spaced", repetition of an item after a certain delay empty or including other trials) and "massed learning", when one and the same item is presented without temporal interruption). Numerous studies demonstrate that distributed learning facilitates memory retention. This is particularly the case with regard to verbal memory (learning sentences, foreign words, etc.). And to conclude that distributing learning over several periods, spaced at least one day apart, considerably increases memory retention (Hernandez et al., 2018).

Not only does the acquisition and consolidation of memorized elements need to be distributed over time, but they require the combination of two time scales, short and long: "the more knowledge must be retained over a long period of time, the more the interval between two learning of this notion can be spaced out over time (from one to two months for retention of one year or more)" (Crystal, 2023). The brain's own rhythm of learning therefore involves thinking about "spiral" teaching using the same notions on a regular basis. The optimal interval of these repetitions will depend on various personal factors of the learner (knowledge already possessed, learning conditions and techniques) but also on the term that we envisage for retention (the longer we want a long-term recall of the information the greater the differences must be). The use of memorization software with an individualized path (such as Anki) would therefore be preferred. In the context of a class, if it seems difficult to adopt a personalized rhythm for each student, it remains possible to adopt a global schedule by taking up gaps in repeats at an expanded pace (for example, a gap double the previous one): question the students at 1 week of initial teaching, then at 2, at 4, 8, etc…). The main thing being, even without respecting the differences, to "regularly review the data" (Hernandez et al., 2018).

This memory recovery work cannot, however, relate to too extensive a mass of information and first underlies the selection of the elements to be memorized and retrieved. The "marking of the essentials" which consists of the selection and prioritization of data, is essential to enable the building of a strategy and supports for the consolidation work. It also implies that the essentials thus identified are the subject of a clear and explicit presentation to students (for example in the form of a memorization sheet or mind map). Finally, it should allow a differentiation between the "minimum" required for all students and the "recommended" for students who can and wish to go further.

Active Memory and Testing

When remembering the "essentials" previously described, several studies reveal

the preponderant role of an active rather than passive approach for better consolidation. As early as 1890, the American philosopher and psychologist William James wrote:

"A strange peculiarity of our memory is that facts are better imprinted there by active repetition than passive. By this I mean that during learning (by rote, for example), when we almost manage to remember something, it is better to wait and make the effort to try to remember, rather than rushing through a book. If we practice retrieving words in this way, we will probably know them next time; otherwise, we will most likely need to go look in a book again. Indeed, testing your memory makes it stronger. » (Hernandez et al., 2018). Testing yourself regularly maximizes long-term performance. The experiments carried out by Henry Roediger and his team of researchers in 2006 are enlightening on this point: doing memory tests rather than reading the same data several times improves long-term data retention. Testing indeed has several advantages: it has a beneficial effect on the student's concentration; provides metacognitive information on the quality of their learning (are the answers provided consistent with those expected or not) which allows them to return to concepts that are difficult to memorize; finally, introducing knowledge tests would also have positive effects on the amount of information retained in the course.

As part of a test or assessment (whether diagnostic, formative or summative), there are several methods of recalling knowledge: recall by recognition (which presents a list from which to choose the correct answer(s) , multiple choice type exercises: the success rate is normally high because the correct concept is already activated), cued recall (the student must find a piece of data but a clue is given to him, for example with a diagram to complete, support proposed visual…) and free recall (where knowledge must be mobilized without assistance, this type of very demanding recall presenting increased difficulty in mobilizing memorized data). To measure memorization, it is therefore indicated, in addition to using frequent tests, to add to an evaluation of knowledge by free recall, questions with cued recall or recognition (Denet et al., 2022, pp. 3-9).

Role of Interactivity and Immediate Feedback in Memory Consolidation

During the recall phases of facts memorized by testing, it is possible to use different methods of feedback to the learner. We can refer here to the learning theory which distinguishes three forms of learning (Hernandez et al., 2018):

- Unsupervised: no distinction is proposed between the desired inputs and outputs.
- Supervised: on each trial, the learner is informed of the answer that would have been correct.
- By reward: the learner only receives a scalar (degree of success: grade, percentage, etc.)

According to studies, supervised learning appears to be the most effective. This implies the fundamental role of feedback after each student proposal. However, the latter

often receives feedback on their errors several days or weeks after practicing (after the teacher's correction). The feeling of error, which can be more or less conscious (because many feel insecure about their attempt if they perceive it as potentially false), is therefore met with a lack of response over a long period of time. Proposing immediate feedback validating or invalidating the student's proposal therefore amounts to capitalizing on the feeling of the error and the doubt it generates by explaining the error. This allows testing to be included not in the evaluation of the student's level but in the extension of the learning and memorization processes. Crystal (2023) specify that ideally the return, in addition to being rapid, should be personalized, this last point, like that of expanded intervals, being able to clash with the pragmatic conditions for implementing the returns.

The Place of Digital at School

The Internet is above all a technical object: you must have the necessary equipment (network cards were not yet the norm; in Turkey, Wi-Fi was only used by a few handfuls of people), know how to use this equipment, know how to connect and, above all, know, according to the expression of the time, “surf online”. The Internet is a window open to the world, even if the creation of Wikipedia dates from January of the same year and will take a few years to gain momentum. It is also an expression tool allowing you to make your publication potentially accessible to any other connected person. Having this possibility, as a teacher in a high school, meant following paths of experimentation hitherto little taken: not only did it make it possible to discover or deepen the use of ‘Information and Communication Technologies’, but more importantly to share information, practices, feedback between teachers (Batista, 2021, pp. 1-2).

If we consider the term “digital” to describe anything that uses computer systems, the use of digital technology within Education is not without raising many questions. Sometimes vilified for the harmful effects it would have on students' ability to concentrate and their deleterious impact on their social relationships, its use has also been encouraged for several years to be part of the learning processes offered by Education. national.

Digital technology will make it possible to experiment with reinforced evaluation, based on better use of data and improved sharing capacities within educational communities. Students will be able to practice, self-assess, and participate in diagnostic moments based on content adapted to their levels and/or their needs. These devices will also help to relieve teachers of certain tedious correction tasks by providing them with the tools which enable them to further individualize their action with each student (Awang, 2021, pp.1-2).

“Digital humanities”, a notion that appeared in 2004, widely used in the academic world of research and which brings together, to use the definition used by Mounier and Dacos (2014) and borrowed from the Digital Humanities Manifesto written in 2010 in Paris

(co-signed by more than 250 researchers and 10 institutions): “a transdiscipline, carrying methods, devices and heuristic perspectives linked to digital technology in the field of human and social sciences” (Fiormonte et al., 2015, p. 212). We will focus more modestly on a very structured use of digital technology as an element that can potentially facilitate memorization based on memory repetitions with immediate feedback. It could at best be envisaged that the experiment presented here would enable students to understand the self-training process via digital technology, a fact which will not be measured and can only remain as a supposition.

Recent work identifies four key skills (critical thinking and problem-solving, creativity, communication, collaboration) and six qualities (curiosity, sense of initiative, tenacity, adaptability, leadership, social and cultural awareness) required for 21st century job market. Among these skills and qualities, some are already at the heart of the missions carried out by the Turkey school – training citizens equipped with a critical mind, for example –, others are traditionally less valued by our education system – such as promotion of creativity or a sense of initiative (Awang, 2021).

It turns out that the digital world is largely based on these skills or offers extraordinary opportunities to develop them:

• individualize teaching: individualized teaching, based on immediate adaptation of teaching to the progress and difficulties of each student;

• use Big Data to improve the performance of the education system: the continuous assessment of students' achievements and the difficulties they encounter constitutes a major management issue for educational policies. The collection of this data could also allow the detection of learning difficulties in early grades;

• promote autonomy and creativity: adapt to a constantly changing world; by encouraging the autonomy and experimentation of each student in particular (“learning by doing”).

Summary Presentation of the Different Phases of the Experiment

Experiment on the use of digital technology in interaction to evaluate the contribution of digital technology in the context of medium-term memorization, thanks to memory tests by testing. Question: are we according to the Puentedura model, within the framework of a Substitution (identical results), an Augmentation (improvement of results) or a Modification (transformation of the activity)? What effect does computer or smartphone use have on memorization?

Table 1: Summary of the different phases of the experiment

Phases of research	Population	Objective
Quiz	Treatment of 26 quizzes wearing on the use of digital by the students.	Understand the degree of family and personal equipment of students. Evaluate their willingness to use their own materials in English lessons. Evaluate the emotional relationship with their material. Identify the dominant behaviors in the learning/digital relationship.
Phase test 1	26 students divided into 3 groups determined according to the results of the questionnaire and heterogeneous in terms of language level: - GR 1: students equipped with smartphones with an unlimited plan and volunteers to use it in class: working on smartphones (Socrative software) - GR 2: more or less equipped and more or less comfortable in the computer room: work on paper - GR 3: students interested in digital technology, not equipped with unlimited package: computer work (Socrative software)	Work at the start of the session on vocabulary outside of class (14 words - 2 x 7 words - on mind map): - words proposed in French to translate - sharing, mind map completed/corrected by the students - 3 min of silent memorization - the teacher notes the mind maps, warning that there will be a second test the following week but without revision (no need for the mind map) Objective: memorization in class End of course: 8 min test on memorizing the meaning and spelling of words studied at the start of the course with 3 different tools: paper – computer – smartphone Objective: recall phase shortly after memorization phase serving as training
Phase test 2	Test of all 26 students	1 week later: evaluation of the whole class on a paper questionnaire

Phase test 3	Test of all 26 students	1 month later: evaluation of the entire class on a paper questionnaire
Analysis	Analysis relating only to the results of students present in the 3 phases of the test: 22 students	Comparison of the results (number of errors) of tests 1 (memorization + 45 min.), 2 (memorization + 1 week) and 3 (memorization + 1 month) according to the supports and tools proposed in phase 1 (test 1) in order to update the effect of the media (digital / paper) and tools (telephone, computer, paper) used in phase 1 on medium-term memorization (+ 1 week and + 1 month)

Data Analysis

The results of the questionnaire on students' digital uses in and outside of school revealed the following points in particular:

Table 2: The results of the questionnaire on students' digital

on 26 students	
Equipment staff	
26 students either **100%**	have either a personal computer or a family computer or a tablet
22 students either **84%**	use their personal or family computer as part of their studies
26 students either **100%**	have a smartphone-type cell phone
17 students either **65%**	chose it themselves
1 students either **3.8%**	smartphone is not connected to the internet
14 students either **54%**	are connected with limited plan
11 students either **42%**	are connected with unlimited plan
Use of digital has school	
14 students either **54%**	feel very comfortable in the IT room
10 students either **38%**	feel moderately comfortable in the IT room
1 pupil either **3.8%**	does not feel comfortable in the computer room
10 students either **38%**	have already used their smartphone in class
21 students either **80%**	would be ready to use their smartphone in class: 11 without conditions /

	10 depending on the context
3 students either **11%**	do not seem ready to use their smartphone in class, including 1 justified by the limited plan / 1 by the private aspect of the tool / 1 not motivated
12 students either **46%**	think it would be easier to use a smartphone rather than an institution computer: 10 are fully convinced, 2 are somewhat convinced
12 students either **46%**	think it would not be easier to use a smartphone rather than a computer
8 students either **31%**	students have both an unlimited plan and the desire to use their phone during class (+ a 9th grader would agree "depending on the context") > questioned, the 9 students confirm their desire to participate in the experiment of participate has experimentation
12 students either **46%**	think that there is not enough digital technology at school
14 students either **54%**	think there is a good balance between digital and paper media at school

We can note here some surprising aspects: if the equipment with digital tools appears very good (which could be expected according to the TNS Sofres studies seen previously and the high socio-economic profile of the class), we can be surprised the large number of phones not connected or connected with a limited plan. This decisive fact decided the continuation of the experiment because it was not allowed, as initially planned, to carry out an experiment on a smartphone with the entire class due to the absence of a Wi-Fi connection within the establishment and the need to go through the connection of students.

Test 1 presents the following results (note: the data from students who were absent from one of the three phases of the experiment were not retained in the analysis proposed here, the results therefore relate to 22 students).

Only the results of the test completed the first time by the students who had the opportunity to repeat the exercise on Socrative several times were taken into account here.

Table 3: Results of the test completed the first time

Test 1 - Summary of the number of errors according to tool	Total	Avg. By Student
Socrative - Computer - 7 students	21	3
Socrative - Smartphone - 8 students	36	4.5
Paper - 7 students	18	2.571428571

In this training phase, relatively similar results appear between work on computer and on paper, while we note a higher number of errors on smartphones. The greater number of errors on Smartphone is however to be linked to difficulties in using the tool (used for the first time in class) demonstrated by certain responses noted below (and which are not found with the use of Socrative on the computer, use to which the students were accustomed): Test 2 presents the following results:

Table 3: Test 2 presents the following results

Test 2 - Synthesis of number of errors depending on tool	Total	Avg. By Pupil
Socrative - Computer - 7 students	34	4.85
Socrative - Smartphone - 8 students	32	4
Paper - 7 students	28	4

Discussion

Context

In order to compare different methods of consolidating lexical memorization, we compared "training" work on two different media (paper/digital with Socrative software) and on three different tools (paper/computer/smartphone) in order to compare the following hypotheses to the experiment:

1. The use of digital technology has no impact on the consolidation of lexicon memorization; the use of the Socrative online exerciser would only constitute, according to the SAMR model, a simple replacement for paper exercises.

2. The use of digital technology via the Socrative exerciser constitutes an Improvement or even a Modification due to the motivation generated by the tool and the immediate feedback. The fact of using computer or BYOD does not impact the results.

3. The use of Socrative via BYOD, in addition to presenting advantages in organizational terms for the teacher and the establishment, leads to better results due to the students' habituation of the tool as well as the affect linked to the object.

Linking with Research

The use of digital technology would therefore seem slightly less efficient after one week but more efficient after one month; the rate of memory loss would seem less significant with the use of Socrative. The hypothesis according to which the use of digital technology has no impact on the consolidation of memorization would therefore seem invalidated. If we refer to the writings relating to cognitive sciences studied in the first part,

this could be explained in particular by the provision of immediate feedback which in addition to immediately specifying the correct answer, makes it possible to provide additional elements of understanding to the student.

As for our second hypothesis, the use of digital technology via the Socrative exerciser would here constitute an Improvement of the activity according to the SAMR model and not a Substitution (in which case the results would be identical). On the other hand, with regard to the second point of the hypothesis on the supposed homogeneity of the results according to the two numerical tools used, we can only invalidate the point. The differences between results on computer and smartphone prove to be significant in this experiment: the number of errors is higher in the training phase (test 1) with the smartphone (which can easily be explained due to the novelty of the process tested for the first time here by the students), at one week however, the results of the “smartphone” group seem slightly better but the retention at one month appears much less good (with an average of 8.1 mistakes out of 14 words compared to 6.4 with computer). It is possible to envisage that the cognitive load generated by the use of a new tool such as the smartphone has diverted the students' attention towards the functioning of the tool rather than towards the heart of the learning (frustration generated by the typos and errors mentioned above which can be a factor of decentralization). The motivation generated by the use of this new tool would therefore see its positive effect on memorization annihilated and the novelty would even have the effect of dispersing the attention of learners.

Finally, our third hypothesis seems to be refuted by experience. If in organizational terms, BYOD presents undeniable qualities for the teacher (no need for the coveted and rarely available computer rooms), it presents major disadvantages here. We see that many students are equipped with a limited package and that the need to connect for in-class exercises comes up against this limitation. On this subject, it is possible to hypothesize that it is a choice of parents linked more to the desire to restrict their child's "digital consumption" rather than to economic considerations (the same families which can also be very well equipped with digital tools – family computer, personal computer, tablet – and the cost of unlimited packages is now close to that of limited packages). One of the conclusions to be drawn regarding BYOD could be that it is necessary for the establishment to offer a WiFi connection if it wishes to develop work on this new tool, without which the organization, instead of being facilitated, is on the contrary made more complex or even prevented. As for medium-term memorization, it does not seem to have a positive impact despite the affect and motivation associated with the smartphone tool. On the contrary, its effects seem negative, whether due to the novelty of its use (the students being used to paper and in this case, to the computer exerciser), the practicality of the tool (size of the keys causing typos and potential frustration or at least too much concentration devoted to the use of the tool itself rather than to the digital medium and its content).

Conclusion

If it seems clear from this short study that digital technology and BYOD in particular are not to be favored for memorization phases as such, it could be a valuable ally for the recall and memory consolidation phases in class or even independently. Digital technology could be one of the means that allows us to move towards what researchers such as Stanislas Dehaene (2014) are calling for: "replacing grades with a precise, differentiated, rapid assessment, which can only progress with time. child (…) and promote the child's self-evaluation. ".

In my opinion, the use of digital media such as the Socrative exerciser has many advantages, including (which is perhaps the most important of all) that it allows the teacher to adapt his course: do a test of a few minutes on the phone at the start of the session would allow us to see if only two or three students have not integrated the necessary prerequisites to move forward (and to help them directly with individual remediation while the rest of the class works on another exercise) or if a majority of students did not know how to answer (and to make a collective reminder in order to avoid a blockage at the start of the course). Digital technology would therefore allow an improvement in formative assessment (as seen during our experience) but also in diagnostic assessment. We could therefore speak of Increased practice thanks to the digital tool which makes it possible to assess the knowledge of the entire class instantly and gives the teacher the ability to adapt his response (in order to being able to immediately and effectively differentiate one's teaching methods) which was impossible before. It is here the practice of teaching itself that is modified, "augmented".

Finally, the teacher reassured by the simplicity of using digital testing supports such as Socrative, may be led (as is my case) to want to go further in the use of digital technology and towards the transformation of their own teaching practices.

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