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Designing a Revision System: An Exploratory Qualitative Study to Identify the Needs of French Teachers and Students.

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Abstract. The design of interactive systems leveraging testing and spacing effects has been poorly studied in ecological contexts. This paper presents an exploratory qualitative study conducted with French middle school and high-school teachers and students to identify hypotheses to guide the design of this kind of system. The resulting hypotheses are: (1) students will access the interactive system with a variety of devices; (2) the presence of a revision system will induce more testing activity during revision but (3) still massively before exams. (4) Teachers would like to have access to nominative indicators to set up personalised monitoring. (5) Students and parents will consent to share personal data with teachers. These hypotheses will be tested with a quantitative study based on data collected through the first version of the revision tool.

Keywords. Testing effect · Spacing effect · Revision · Interactive system · Qualitative method

1 Introduction

According to the French national education program, as stated in its official bulletin N°27 of 2 July 2015, the "accompagnement personnalisé" ["personal support"] lessons aim to equip students with the necessary learning methods, including the practice of revision. To work on this revision activity, we propose the following definition provided by the Cambridge dictionary¹ : "study of work you have done, in order to prepare for an exam".

Different studies have shown that revising knowledge is more effective by testing oneself on that knowledge [17, 20], that is the testing effect. Furthermore, spacing out work sessions [7, 9, 19] is more effective than a massed effort in a single session, called the spacing effect. These effects are both beneficial for longer retention of information and could be used to help students throughout their revision.

¹ <https://dictionary.cambridge.org/fr/dictionnaire/anglais/revision>

We, therefore, ask how technology can support revisions by promoting the best use of these effects. The literature already questions the support of these effects through several digital tools [14, 21]. However, these tools are not designed in a school setting and have not been tested in middle-school or high-school ecological contexts, as highlighted in Latimier’s thesis [14]. Our research, therefore, focuses on the design of an interactive revision system that takes advantage of test and spacing effects in a high-school environment. This paper presents the exploratory qualitative study conducted with teachers and students to identify hypotheses to explore to design a tool adapted to their needs. We seek to answer the following research questions:

- RQ1. What hypotheses will help design a revision tool that meets teachers’ needs?
- RQ2. What hypotheses will help design a revision tool adapted to students’ needs?

This article is structured as follows. Section 2 presents the work on which our research is based. Section 3 describes the methodology of this study. Section 4 presents the study context. Section 5 presents the results obtained. Section 6 discusses the results. Finally, the last section summarises the study and how it fits in with further work on this system.

2 State of the Art

Several studies, such as that of Phelps [17] and Rowland et al. [20], show that it is more effective to test oneself than to simply reread the information one wishes to remember: this is the testing effect. More generally, the literature identifies an improvement in knowledge retention over the long term when this effect is used [18, 25]. Roediger et al. [18] have shown that the tests can be repeated several times for greater benefit.

Various studies have shown that spacing out revision sessions instead of concentrating them at the same time also has a beneficial effect on the memorisation of long-term information [9, 19]. This effect, called the spacing effect, has been studied in several disciplines such as language learning [7] or mathematics [15] and has shown that the more test sessions are spaced out, the more likely it is to remember the information for a longer period. Carpenter’s work in 2012 [9] confirms that the beneficial effect tends to have a longer impact as spacing is increased but warns that too much spacing should not be used as the learner may forget the knowledge. This work emphasises the need to tailor spacing to the learning conditions and objectives.

In her thesis, Latimier studied the articulation of the test and spacing effects and underlined that their effects are additional [14]. Thus, it seems relevant to apply these two effects jointly within the same tool to hope to maximise the results of school learning. To this end, the study carried out in Latimier’s thesis [14] underlines the interest in mobilising digital tools. Thus, in the literature, we find several tools that mention test and spacing effects, such as Anki or Didask,

which are essentially designed for language learning or simple knowledge [14, 21]. However, most of these tools have been tested with university students or adults [10, 14, 21], in a context that does not correspond to the ecological reality. In her experimental study with Didask [14], Latimier specifies on pages 144 to 147 that the experimental conditions do not correspond to an ecological context since the students were adults in perfect autonomy, essentially motivated by financial compensation and without interaction with a teacher or other students. Thus, Latimier [14] points out that younger populations are rarely tested in studies of test and spacing effects and that it would be interesting to do so.

Our work is in line with Biggs' constructivist alignment [6]. In order to align pedagogical objectives with learning activity and assessment activity, revisions aimed at preparing a summative assessment must be based on formatively assessed classroom activities. This is why we decided to build a tool based on Elaastic¹, formerly known as Tsaap-Notes. This tool has already been studied in ecological contexts in higher education [4, 22] and in secondary education [3]. The recycling of classroom activities with Elaastic to semi-automatically generate review tests has been the subject of previous work [4, 23]. This work, conducted in higher education only, highlighted the widespread use of review tests by students but did not explore in detail the modalities of review. For example, no data on test spacing is provided.

3 Research Method

In order to design a tool adapted to pedagogical needs and students, we wish to follow a human-centred design with teachers and students. Our work is part of design-based research [2, 16], and we approach each of our iterations through mixed methods to capitalise on the contributions of qualitative and quantitative results. For the first iteration of this research project, we follow the exploratory sequential model of Creswell and Clark [12]. In line with this model, we have therefore conducted a qualitative study with volunteer teachers and students to identify hypotheses that will help in the design of an interactive revision system adapted to the needs of teachers and students. The hypotheses identified will be investigated quantitatively through the collection of objective data through the first version of the tool.

4 The Qualitative Study

The qualitative study is based on interviews with teachers and students. These interviews focus on the first (RQ1) and second (RQ2) research questions, respectively. The study was conducted in French, with French participants. Therefore all materials and results shown in this paper are translated into English for a better understanding.

¹ <https://www.irit.fr/elaastic/>

4.1 Participants

For this study, we interviewed eight volunteer teachers from middle school and high school who had already been trained in the use of Elaastic. Despite the participation of 8 teachers in these interviews, only six valid recordings could be kept for this study. Indeed, one damaged recording, as well as an interview for which written permission to use the data was not given, had to be excluded from the results.

In the second phase, we were able to obtain four individual interviews with students who had recently completed their secondary education or were in their final year to ask them about their practices in secondary school.

4.2 Data Collection Procedure

The qualitative study that is the subject of this paper was based on semi-structured individual interviews with participants lasting approximately 45 minutes. They were based on questionnaires developed in team meetings, stating the purpose of each question for the current study, guided by UTAUT2 for some aspects regarding technology acceptance. Some closed questions aimed to only start the subject without giving any hints and leaving the door open for the participants to argue their answers freely. Sometimes, follow-up questions were asked to get more information on a specific subject if the participants didn't mention it themselves. Each of these interviews consisted of three phases. The first phase (about 20 min.) aimed to gain a better understanding of the participants' working environment. The second phase was the presentation (about 5 min.) of a prototype revision tool in order to make the subject concrete for the participants, helping them to imagine the tool and its potential uses. Finally, the last phase (about 20 min.) consisted in questioning the participants about the prototype presented and the various aspects that could impact the use of the target system positively or negatively.

A thematic analysis was carried out on each of the interviews, the results of which are detailed below. The encoding of the themes was carried out by only one person, the same one that conducted the interviews. However, each theme has been reviewed by the team to ensure the relevance of the coding done. Then, the formulation of hypotheses has been done as a group while analysing the results of the encoded transcriptions.

Data on the teachers' profiles were collected in advance by online survey and is summarised in **Table 1**. We gathered in **Table 2** the results of the teachers' feeling of proficiency with different technologies, asked through the online survey with a 5-point Likert scale going from "Pas à l'aise du tout" ["Not at ease at all"] to "Très à l'aise" ["Very at ease"]. The interview used the questionnaire presented in **Table 3**. Information on the students was collected in interviews with the questionnaire in **Table 4** and their profiles are summarised in **Table 5**. The original data in French are accessible in an Open Science Framework repository⁴, with the questionnaires, and full transcriptions of the interviews.

⁴ https://osf.io/cz7fe/?view_only=cc64c8417d184a9298efc638a54cde34

Table 1. Profile of teachers participating in the study

Identity			Professional experience			
Id	Age	Gen.	Years	Disciplines	Grade taught	Nb stud.
T1	44	F	18	Biology	7th, 8th, 9th	315
T2	48	F	23	History, MEC, Geography	6th, 7th, 8th, 9th, 10th	170
T4	59	M	38	Mathematics, IT	6th, 7th, 8th, 9th, 10th, 1re, 12th.	150
T5	35	M	12	Mathematics, IT	6th, 7th, 8th, 9th, 10th, 11th, 12th.	150
T6	43	F	20	Mathematics, IT	6th, 7th, 8th, 10th, 1re, 12th	150
T8	49	M	23	Physics-Chemistry	6th, 7th, 8th, 9th, 10th	300

Table 2. Technological proficiency declared by teachers

Id	Internet	Computer	Smartphone	Electrical tablet
T1	at ease	neither at ease nor uncomfortable	uncomfortable	at ease
T2	at ease	at ease	very uncomfortable	neither at ease nor uncomfortable
T4	at ease	at ease	at ease	at ease
T5	very at ease	very at ease	at ease	at ease
T6	at ease	at ease	neither at ease nor uncomfortable	neither at ease nor uncomfortable
T8	very at ease	very at ease	at ease	at ease

Table 3. Questionnaire used with teachers

Questions asked
Among your teaching practices, do you use one more frequently than the others?
Do you provide out-of-class work for your students? If so, in what form?
How do you ask students to prepare a summative assessment?
Are you comfortable using digital tools for teaching? Which ones do you use?
Do you use social networks to share with students? And to share with other teachers?
<i>— Presentation of prototype —</i>
Do you think that such an application is pedagogically relevant for students? For the teachers?
Would you have any reservations about using such a tool? With regard to teachers? With regard to the students?
What indicators could be useful in such an application?
Would you like to intervene before such an application? How would you do that?

Table 4. Questionnaire used with students

Questions asked
How old are you?
What gender do you identify with?
What course of study and/or specialisation did you pursue in high school?
During the past school year, did you have access to the following tools at home in the evening?
How did you interact with your teachers last year?
With your classmates?
How do you use technology?
Of the school uses, do you use it directly in the classroom as well?
If so, have you ever used any particular tools that you recall?
Do you already use a revision application? If so, which one?
Can you describe it? If not, can you see what it looks like?
What should a revision app look like for you?
What tools would you expect it to offer?
— <i>Presentation of prototype</i> —
Do you think a revision application like this would be useful in your work?
If you were to use a revision application, do you think you would get better grades?
On average, how much time per week would you use such an application?
What elements might slow you down in using the presented application?
What elements would you like to see in such an application? To help you work better?
To appreciate the tool / be motivated to use it?
Would you like your parents to be able to see the work done on this application?
Do you feel more motivated to use the app if you can interact with other students on it?
What role do you think teachers should have around this application?
What information would you be willing to share with the teacher?
Automatically or on demand (with action on your part)? Nominally or anonymously?

Table 5. Profile of students participating in the study

Students	Age	Gender	Specialisation
S1	17	M	Physics, Biology
S2	17	F	Maths, Physics
S3	17	M	Maths, IT
S4	17	F	Arts, Literature

The non-functional, high-fidelity-looking prototype presented in **Fig. 1** was designed with the idea of offering content already worked on in the classroom through the use of the online tool Elaastic [4]. The prototype was first envisaged with a mobile-first approach, assuming that this was a suitable format for students. It takes the form of 9 static screens (4 main, 5 altered states), inspired by the functioning and shape of Elaastic. The interviews were analysed by coding theme to group the common elements mentioned by the participants.

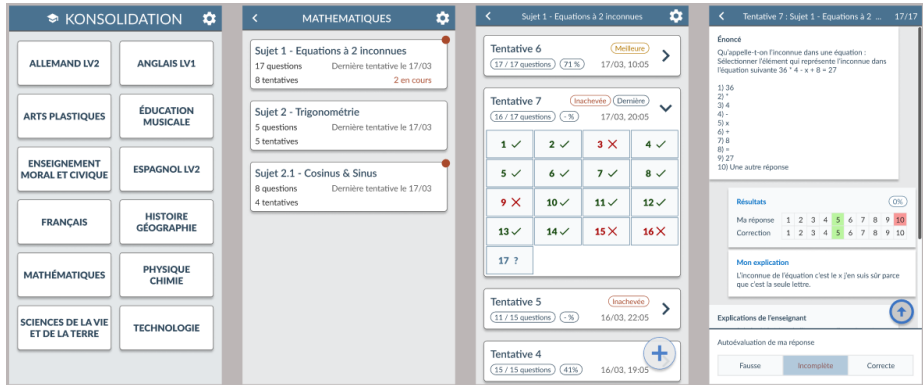


Fig. 1. 4 main screens of the prototype presented during the interview

5 Results

The result of this analysis is a fairly large number of themes that cannot all be mentioned here. Therefore, the elements presented here will be those that were most mentioned in the interviews or considered relevant for the formulation of hypotheses that could guide the design of a first version of the target system.

5.1 Having the tool available on devices other than the smartphone.

First of all, when teachers were asked about their eventual reservation regarding the tool and mentioned it could concern the tool itself or the device it was presented on, it emerged that there was a need to access the tool via various devices. This idea was expressed by several teachers, sometimes in opposition to the mobile: T1- "... [the tool should be accessible on different devices because they don't have smartphones but they may have an electronic tablet or access to a computer at home]", and on the other hand, sometimes in favour of the mobile: T4- "We would have said it's on the computer necessarily it would have been difficult, but strangely the pupils know how to use the computer less today than the tablet or the phone". The interviews with the students brought out the same need for other reasons. While teachers were worried about fairness and material issues, some students simply stated they prefer the computer to the mobile when it comes to working: S3- "So frankly it depends on the students I know that some are much more likely to work with their phone, others with their computer. As a student I mainly use the computer, after that both platforms are good I think."

5.2 Regulating the use of smartphones in the context of education.

To further delve into the topic of the use of smartphones in education, two teachers emphasised the need to remain vigilant about the use of digital tools because of the abuses that can arise from them: T4- "I agree less and less with

the use of smartphones in high school regarding the damages that it may bring", but they consider that the problem is not the tool in itself but the control we can have on it: T5-"And for me there is a real need for support ... to explain that it is a pedagogical tool and that it must therefore be supervised". While the students may appear not as concerned as the teachers regarding the use of smartphones to work, one of them still mentioned some limits regarding eventual distractions that may come out while using smartphones, which caught our attention : S1-"If it's ever going to be an application that's going to be on the phone, what would be good is that it's usable without the internet because I know that ... if I get a notification, it will make me want to get out of the application to check, to see what it is."

5.3 The motivation around digital and the use of the tool.

However, even though some limits are highlighted, some teachers stated that using digital tools motivates students, which influences their teaching methods: T2-"All my lessons are systematically illustrated by a slide show . . . I know that they appreciate it very much; every year at the end of the year, I check with my students", T1-"... I know they like it when there are little videos or extra things, or LearningApps for example...". While this intrinsic motivation with digital tools has been observed by the teachers, the presentation of the prototype was intended to allow the pupils to imagine the possible functionalities of the tool and to project themselves into its possible use. Thus, the pupils expressed a certain enthusiasm specifically toward the tool : S2-"So I find it very interesting, especially the fact that the pupils can progress by seeing the arguments of their classmates; I really find it very interesting", S1-"... [I think that it could be very interesting to have an application of this kind, yeah frankly, it's cool".

5.4 Staying cautious with the eventual need for extrinsic motivation.

Nonetheless, some teachers stressed that such a tool might not be sufficient if it is not accompanied by a grade as extrinsic motivation: T4- "... at first perhaps we will have to find a carrot to make them want to go spontaneously...". In opposition, when the students were asked specifically about the possibility of integrating a grade into the tool, they all expressed the negative feeling that the grade would be perceived as a hindrance: S4-"Erm, I would see it more as a percentage like there was on the model rather than a grade. It's true that a mark can demoralise the pupil depending on the type, and he can say to himself, 'I'm stuck at such and such a mark,' and that can be particularly frustrating".

5.5 Supervising students' revision with indicators.

Finally, after the presentation of the prototype, when teachers were asked about the indicators they would find relevant, many expressed an interest in indicators

on the use of the tool by pupils. These indicators were mentioned as relevant tools for generating individual monitoring: En5-"So what could be interesting is to know the rate of use of the application during the sequence and up to the evaluation in fact ... to help them better distribute their workload". However, one teacher emphasised that this possibility can lead to a workload that needs to be considered: T8"The time or workload I think, is really on the analysis of the feedback, which is done more or less individually, where there can be a workload that is indeed substantial." These needs echoed the students' statements when we asked them about the role they think the teachers should have regarding the revision tool; it first appeared that a supervisory role was expected: S2-"At the high school, we are always very sheltered, so we refer a lot to the teachers, to what they really tell us to do, so I think that encouraging them is the most important thing". On the other hand, by specifically mentioning the possibility of having indicators, the students also mention the interest in taking advantage of it to make a personalised follow-up: S4-"I think that it could help the teacher to see what the student produces to try to correct it afterwards in addition to the corrections with the arguments and to see where the student is and to see his progress".

6 Discussion

The purpose of the individual interviews in this study was to identify hypotheses to guide the design of a teacher and student-friendly revision system. Each hypothesis will be accompanied by the implications it brings to the conception of the first version of the revision system. All hypotheses are regrouped in the **Table 6** at the end of the discussion.

6.1 Access the Tool Via Different Devices

First, understanding the context and the devices used refers to UTAUT2 Model and the facilitating conditions, which is a prerequisite for us: the first step to help students benefit from the testing and spacing effect through our system is for them to use it. The interviews helped us hypothesise that **(H1)** the students will access the system through a variety of devices, as opposed to our first assumption about smartphone being a sufficient device considering that literature shows that it is a motivational source for students [5, 11]. However, even if teachers observed the same effect, they argued in favour of multi-device accessibility, as students in early high school (6th to 9th grade) may not have a smartphone but access to another device at home. In addition, a good number of students stressed that the use could vary and stated some inconveniences related to smartphone use while revising. Referring to others' research [1, 13], it seems relevant to us to develop a first version accessible on several types of devices. We then need to set up appropriate markers, which will allow us to identify the devices used by the students in a revision context. The system should also be developed keeping in mind the regulation that could be needed to help the student avoid the

distractions that could occur while using digital tools. Even though no specific feature will be implemented at first, the structure of the tool must already be done considering such evolution.

6.2 Making a Testing Tool Available Encourages Students to Test Themselves More to Revise

Ensuring the accessibility to the tool was a prerequisite to benefit from students' enthusiasm. Teachers' observations and students' reactions to the tool presented indicate that the introduction of a digital tool seems to have a positive impact on student's motivation. Using this motivation as a starting point, we hypothesise that **(H2)** providing students with a digital revision tool that exploits the testing effect will already have a beneficial effect on their use of the test as a revision method. This hypothesis will be investigated by comparing the uses of the first version of the revision system with the use of Elaastic as a revision tool by students. This hypothesis also implies that we will not try to incite the students through any other means than providing the application and the eventual initial formation to use it, as we want to observe their behaviour with as less solicitation as possible.

6.3 Pupils Revise Especially in the Run-Up to Evaluations

Despite the motivation highlighted, it was pointed out by some teachers that it might not be sufficient for use in the absence of marking. Considering the opinion of students who said marking the revision could harm the activity, we would like to add none. Then, we can refer to some studies of students' attitudes towards revision, which show a tendency for students to revise massively in the run-up to evaluations [8]. It can therefore be hypothesised that **(H3)** the use of the revision system will be particularly marked in the vicinity of evaluations, and this hypothesis will be studied with the data collected via the system. The system should therefore make it possible to collect the dates of students' work and the dates of students' exams in the subjects worked on. With the system gathering these data, we shall then study the question of regulation through the scope of the planning of the students' revision. Echoing the previous hypothesis, the same parameter of no solicitation is needed here to observe the students' behaviour without further action from the system.

6.4 Nominal Indicators on Student Activity

When asked about the kind of indicators teachers would like to see if they find any relevant ones, many of them responded positively to the idea of using the tool to set up personalised monitoring, even though they did not provide many different indicators ideas. However, a need to remain vigilant regarding the time that such monitoring can cost was highlighted. We, therefore, assume that **(H4)** teachers will use the nominative data on pupils' work to improve individualised

monitoring despite the workload involved if we provide some relevant indicators to do so. The workload mentioned seems quite important, so we will try to verify this hypothesis by proposing different depths of indicators and tracing how teachers use them.

Such data collection to build indicators brings our attention toward privacy and ethics [24] regarding the students. Given the students' expressed need for monitoring, we are confident in assuming that **(H5)** students and their parents will agree to the collection of personal data to build indicators for teachers. However, to test that hypothesis, we will ensure the system implements privacy by design, allowing students and their parents to choose at any time which nominative data they transmit or not to teachers and to trace these choices.

6.5 A Perspective on Out-of-Class regulation

Finally, when we summarise the elements that emerge from these interviews, both students and teachers seem to think that secondary school students are not able to fully regulate themselves. Thus, we think it would be interesting to work on this tool from the perspective of teacher regulation of out-of-class work. By seriously studying the literature about self-regulation as well as teacher-directed learning, we believe that we could reconsider this tool as an assistance to the regulation of students' revisions. We, therefore, intend to explore further the idea of a tool that helps teachers to regulate students' out-of-class work in the first instance and which could evolve in the longer term into a tool that simplifies the transition to self-regulated learning for students.

6.6 Limits

In the context of this study, some limitations must be pointed out concerning the lack of diversity among the participants. Indeed, the teachers interviewed have rather similar profiles, with more than ten years of teaching experience, generally scientific disciplines, and a marked technological fluency. This first approach with a voluntary audience allows us to guide our reflections, but it is necessary to gather more various data to obtain more representative ones. On the other hand, students showed some difficulty in developing ideas on open questions. The limited spectrum of the interrogated audience is an issue that we will correct through the gathering of data with the first version of the tool with the quantitative study following this one.

Another limit regarding our method shall be mentioned. The transcriptions and thematic encoding being done by the same person that interviewed the participants may raise issues regarding eventual bias during the study. However, as we conducted an exploratory study, our aim was solely to identify hypotheses for later verification through a quantitative study, so the eventual bias seemed acceptable, considering these resulting hypotheses will be tested with objective data.

Table 6. Hypotheses identified through the interviews

	Hypotheses
H1	The students will access the system through a variety of devices (smartphones, computers, tablets)
H2	Providing students with a digital revision tool that exploits the testing effect will already have a beneficial effect on their use of the test as a revision method
H3	The use of the revision system will be particularly marked in the vicinity of evaluations
H4	The teachers will use the nominative data on pupils' work to improve individualised monitoring despite the workload involved
H5	The students and their parents will agree to the collection of personal data to build indicators for teachers

7 Conclusion

In our research, we are asking ourselves how to design an interactive system adapted to the revision activity, taking advantage of the test and spacing effects. We decided to interview teachers and students to identify the hypotheses that will guide the quantitative study that will allow the design of a relevant tool. As a result of these interviews, we assume that students will naturally test themselves more (**H2**) with a multi-platform tool at their disposal (**H1**), but still massively before exams (**H3**). We also assume that by providing teachers with dashboards, they will work to improve individualised monitoring despite the workload involved (**H4**). As these dashboards imply the collection of students' personal data, we finally assume that the students and their parents will accept to show the students' nominative data to build more precise individual indicators for teachers (**H5**). According to the exploratory sequential method, this qualitative study helped us design the tool for it to be adapted to test the different assumptions made with this study. Through the tool, we will collect objective data and analysis of these results will serve as a basis for reflection in the development of future versions of the tool, which should ultimately lead to the identification of recommendations for the design of revision tools adapted to the needs of students and teachers.

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