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Spread the word! BaLex, a gamified lexical database for collaborative vocabulary learning

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Abstract: Many tools have shown positive effects on vocabulary learning. They can enable learners to work autonomously, both inside and outside the classroom. However, learning the few thousand words needed to master a language takes time, and maintaining learners' motivation over long periods is a key issue. Moreover, Technology-Assisted Vocabulary Learning (TAVL) tools rarely offer features to involve teachers in the learners' vocabulary learning process, although this type of guidance has been shown to be effective. In this context, we propose a gamified lexical database for collaborative learning named BaLex, designed according to an iterative design process, intended to (1) improve vocabulary learning, (2) keep learners motivated over the long term (months and years of learning), (3) support collaboration between learners, and (4) involve teachers in the learning process carried out autonomously. Learners have access to individual and group lexicons with learning features, collaborative features and gamified indicators, the latter thought to enhance learners' motivation and provide feedback. We conclude by discussing the possibilities offered by the generic architecture of BaLex and the applications that can be added to enrich vocabulary learning.

1 INTRODUCTION

Vocabulary learning is an essential dimension of foreign language learning, like grammar, phonology or culture (Nation, 1999). However, it is rarely addressed explicitly, neither in the classroom nor through out of class activities (Oxford and Crookall, 1990). In French higher education for instance, language classes for non specialists are typically granted around 20 hours each semester. In this context, the mastery of the necessary few thousands words¹ has to be acquired in a large part autonomously, outside the classroom, while classroom time is dedicated to interaction and production tasks (Freund, 2016). Many studies highlight the need to foster independent and autonomous learning (Ginanjar Anjaniputra and Salsabila, 2018; Farangi et al., 2015).

Numerous Technology-Assisted Vocabulary Learning (TAVL) tools² have been developed and have shown positive impact on learning processes, particularly for acquiring and practicing new vocabulary (Hao et al., 2021). However, these tools have also shown certain limitations when used autonomously by learners. Based on a review study on TAVL, (Klimova, 2021) suggested such applications should be used in a guided and controlled context to lead to an effective learning process. Therefore, implicating the teacher in the learning process appears as a key element to ensure that students learn vocabulary efficiently. Furthermore, vocabulary learning is a complex, multi-skilled task (Tremblay and Anttil, 2020) that can prove taxing for learners, and thus likely to demotivate them (Tseng and Schmitt, 2008). Maintaining motivation over long periods of time is

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¹Some 3000 families of words, at least, are required to communicate in a foreign language (Laufer, 1992).

²Although the acronym TAVL is still not widely used, we believe it makes a logical addition to Mobile-Assisted Vocabulary Learning (MAVL) (Ye et al., 2023; Ma, 2017) and Computer-Assisted Vocabulary Learning (CAVL) (A. Al-Jasir, 2019). It is noteworthy that the expression "Technology-Assisted Vocabulary Learning" has already been used in (Hao et al., 2021).

a key component in vocabulary learning and can be supported by TAVL.

In this context, we propose BaLex, a personalized digital vocabulary learning environment ensuring continuity outside the classroom. Its features were designed using an iterative and participatory design process. We first conducted a survey to identify teachers' and students' expectations regarding such a tool. Based on the results of this study, and on a theoretical background on vocabulary learning, BaLex has been developed as a gamified vocabulary notebook that encourages collaboration between students. Learners are provided with both individual and group lexicons, as well as outside resources. Teachers can also interact with the learners and share lists of words with their groups of students.

In this paper, we first delve into the theoretical background on vocabulary learning and identify the specific challenges that arise, particularly when it comes to learner motivation. We also review existing TAVL tools to identify the relevant functionalities they propose, but also limitations in the field. We then present the results of our preliminary study conducted with language teachers and students. Finally, we present the features and the architecture of the BaLex software. In conclusion, we outline the research avenues offered by such a vocabulary learning environment and present the upcoming improvements that will complete the lexical database BaLex.

2 THEORETICAL BACKGROUND

Learning and teaching vocabulary constitutes a part of any foreign language studying program. Therefore, it is important to place vocabulary in proper perspective. Nation's "four strands" (Nation, 2013, pp.2–3) offer a comprehensive model for characterizing language learning activities. According to Nation, each strand should receive the same attention. The first two strands are meaning-focused: (1.) "comprehensible meaning-focused input" (2.) "meaning-focused output". In both strands, the focus of the learner is centered on the information conveyed to/by them. The third strand concerns activities focusing on form, or accuracy. In the context of vocabulary learning, this strand implies that "a course should involve the direct teaching of vocabulary and the direct learning and study of vocabulary" (Nation, 2013, p. 2). The last strand (4.) is fluency development *i.e.* the learners become more fluent with what they already know.

In this perspective, vocabulary learning, present in all four strands, plays a fundamental role in the language learning process. Studies indicate that profi-

ciency in vocabulary plays a crucial role for second language readers, and the lack thereof constitutes the most significant challenge for Second language (L2) readers to surmount (Alqahtani, 2015).

Mastering vocabulary requires the synthesis of many different cognitive elements (Tremblay and Anttil, 2020). Tremblay et al. (2016) propose to characterize lexical competence through three components: knowledge, skills and attitudes. They refer to attitudes towards vocabulary as "lexical sensitivity". Among many examples of such manifestations proposed in their work, we can highlight the following: (1.) be enthusiastic about learning new words and phrases; (2.) be motivated to learn new words; (3.) enjoy sharing their lexical discoveries with others; (4.) show an interest in learning the meaning of a new word encountered in a text and understanding its subtleties.

This underlines the importance of motivation in vocabulary learning, and maintaining learners' motivation over a long period emerges as a key feature (Tseng and Schmitt, 2008). The notion of "lexical sensitivity" also involves teachers and is echoed by Manzo and Sherk (1971) who highlight that teachers communicating excitement about word learning and the ideas being developed facilitate vocabulary learning. Therefore, another essential element in enhancing student vocabulary learning includes the teacher's attitude on said learning (Rausch, 1969).

Digital learning environments offer tools and solutions to equip teachers and learners for the challenges of vocabulary learning. We review in next section the potential of such resources to foster learners' autonomy and motivation for vocabulary learning. Existing studies indicate that the computer-assisted setting has the potential to enhance students' linguistic awareness, facilitate peer interaction and collaboration, and promote learner autonomy within a learner-centered learning environment (Benson, 2013, p. 146).

3 TECHNOLOGY ASSISTED LEARNING ENVIRONMENTS

Many TAVL tools have been developed over the past two decades. Yu and Trainin (2022) analysed 34 studies with 2,511 participants yielding 49 separate effect sizes and identified a moderate overall positive effect size for using technology to learn L2 vocabulary. On a similar scope, Hao et al. (2021) made a meta-analysis of 45 studies conducted between 2012 and 2018 on TAVL for English as a Foreign Language (EFL) learners and found an overall large positive effect of TAVL, compared to traditional instructional methods. Fi-

nally, Lin and Lin (2019) conducted a meta-analysis examining more particularly the effectiveness of L2 Mobile-Assisted Vocabulary Learning (MAVL) in 33 studies carried out between 2005 and 2018, and found a positive and large effect size on L2 word retention. These 3 meta-reviews all agree on the positive effect of TAVL for vocabulary learning and point out that these tools need to support learners' motivation and guide them through the learning process.

Games and gameful tools are widely used for vocabulary learning. They can take various forms, such as role playing games like RPG Story (Hwang and Wang, 2016), virtual reality games like House of Languages (Alfadil, 2020) or gamified tools like IdiomsTube (Lin, 2022). Various game elements (virtual money, points, badges, trophies) are used to reward learners' actions that benefit their learning. The impact of games and gamification are studied in several literature reviews on TAVL (Wang et al., 2021; Lin and Lin, 2019; Zou et al., 2021) as approaches to increase learners' motivation and vocabulary knowledge.

Another way to enhance learning in vocabulary tasks is to offer collaboration opportunities (Trim, 2002). Zou et al. (2021) showed in their review that collaborative vocabulary learning embedded in game environments could tend to produce effective learning outcomes. For instance, Quizlet (Bueno-Alastuey and Nemeth, 2020) and Linguarium (Chukharev-Hudilainen and Klepikova, 2016) offer the possibility to share vocabulary lists with other users and both were successfully used in a way that improved vocabulary learning among learners. However, we observe that few collaborative functionalities are integrated into existing TAVL (Wang et al., 2021; Lin and Lin, 2019).

Finally, we observe that only few tools specifically address the concern of including the teacher in the learning process, thus limiting their ability to guide learners and ensure that they learn vocabulary efficiently outside the classroom. One rare example of such inclusion can be found in Moodle in which learners and teachers can communicate directly via chat messaging while implementing a vocabulary learning activity (Barcomb and Cardoso, 2020). Other examples include Vocabulary.com (Nishioka, 2020), which enables learners' progress to be tracked, and IdiomsTube (Lin, 2022), which provides an interface for teachers to automatically compile reports on the learning progress of students and classes.

4 Research objectives

In summary, previous studies on the field of TAVL highlighted the effectiveness of technology-assisted approaches in enhancing vocabulary learning for second language (L2) learners, most often in the context of EFL. The studies identified various types of digital tools used for vocabulary learning, emphasizing their impact on vocabulary retention, motivation, attitudes, and perceptions. Additionally, they highlighted several key factors influencing the effectiveness of TAVL, such as learner motivation and enjoyment, and teacher involvement in the process of using the tool to guide learners outside the classroom (Teng, 2014). Based on these findings, and to address gaps in existing research, we identified three research objectives to guide the development of the BaLex lexical database:

1. Improving vocabulary learning and keeping learners motivated on the long term;
2. Supporting collaboration between learners;
3. Involving teachers in the learning process, to guide the learning task carried out in autonomy.

5 Preliminary study on teachers' and students' practices and expectations

5.1 Methodology and participants

We conducted a preliminary study on lexicon learning practices in the context of language classes for non-specialists. This study involved two separate questionnaires — one for learners and one for teachers —, followed by semi-structured interviews with teachers. It was mainly carried out at the University Lyon 2. The aim was to confront the literature with field data: actual practices and in a user-driven approach, concrete needs and associated features.

The teacher questionnaire gathered 70 complete responses. After regular demographic questions, we asked them about 3 main themes: 1) importance granted to, and class time spent on vocabulary teaching; 2) useful features for vocabulary learning tools, both for them and their students; 3) means to motivate students when using the tools. The semi-structured interviews were conducted to allow the teachers to explain more thoroughly their practice and expectations. The learner questionnaire gathered 124 complete answers. After demographic questions, we asked them about the features they would like in a vocabulary

learning tool that would be linked to the language course.

5.2 Results

5.2.1 Vocabulary teaching practices and teachers' expectations

The survey brought insights into vocabulary teaching practices and teachers' perceptions on the subject. To the question "How important do you think lexical skills are in language learning?", on a 5 degrees Likert scale, the mean result was 4.4, showing the importance of vocabulary learning for teachers. They declared spending on average 11 hours (with a median of 6 hours) every semester on explicit vocabulary learning with a class. Most of them were enthusiastic about having tools allowing autonomous vocabulary learning on the students' part.

5.2.2 Students' motivation for vocabulary learning tools

In exploring the motivations behind learners using new vocabulary learning tools, our focus was on identifying the factors influencing their choice. By analyzing teachers' responses to the questionnaire, we uncovered two aspects: the "game" aspect, emphasizing pleasure and entertainment, and the "serious" aspect, highlighting the learning facet hidden within the activities.

Games and playing emerged as key elements bringing pleasure to learners. Terms such as "fun" ("learning different from classes is fun"), "attractiveness," "gadget" (a new and amusing object), and "playful" are recurrent, emphasizing the enjoyment derived from games. Some teachers linked games to digital technologies and attributed the playful effect to the digital support itself. They encouraged making these tools accessible on mobile phones and tablets, allowing for autonomous learning outside the classroom. Conditions for creating a playful atmosphere include usability (ease of use), affordances, and interface attractiveness. Moreover, the possibility of remote group play was identified as a way to foster interaction, socialization, and the formation of friendships among learners.

Regarding the didactic aspect, teachers enumerated characteristics essential for achieving learning objectives. Feedback, either in the form of grades, bonus points, or visualizing learners' progress, was deemed crucial. Visualizing learning steps was emphasized, with teachers proposing graphic representations to make progress and learning evolution visible.

Multiple requirements for lexicons were also considered essential: customizable, adapted to learners' levels, contextualized, anchored in learning situations. The ideal scenario is inline with Nation's strands and involves production task for learners to create utterances involving newly learned words. Teachers advocated for vocabulary to be linked to the course, allowing learners and teachers to create their own word lists. To ensure regular tool use, some teachers proposed introducing these tools in class, integrating them into assignments, and dedicating time to these activities during lessons.

5.2.3 TAVL features

The option of sharing a common vocabulary across the entire class was the most demanded feature (31% of teacher respondents). Teachers expressed a desire to share word lists with their students. Following closely, 26% of instructors voted for feedback, acknowledging its crucial role in the learning process. The possibility of having a personal vocabulary notebook reached 24%, while direct messaging received the lowest percentage at 17%. It is noteworthy that in the "other" category, teachers proposed additional features such as creating a collaborative and exportable glossary — which not unlike the shared common vocabulary — and access digital resources like corpora and selected usage examples.

On the students' side, we found a similar interest for the vocabulary notebook as 74% of the students found it useful in a vocabulary learning tool. Among the other most required features, the ability to monitor their own progression was highlighted by 92% of them and a feature for exchanging with other learners reached 62%.

6 BaLex

This preliminary study was the first step of the design and development of a collaborative vocabulary learning tool using a user-centered approach (Norman, 2013; Bastien and Scapin, 2004). After the analysis of the results of the preliminary study, we conducted a meeting with several teachers during which a functioning prototype was presented to them. This allowed us to gather remarks and suggestions in order to adapt the tool to their pedagogical practices.

Headwords				Labels		
Order	<input type="checkbox"/>	$\frac{1}{2}$		General	Deadline	Définitions
1	<input type="checkbox"/>	love		Family	Next class 12/01/2024	
2	<input type="checkbox"/>	cat		Animal	Next class 12/01/2024	
3	<input type="checkbox"/>	apple		Food		
4	<input type="checkbox"/>	cook		Food Family Job Activity	Next class 12/01/2024	
5	<input type="checkbox"/>	mother		Family Job		
6	<input type="checkbox"/>	reindeer		Family Holiday	Next class 12/01/2024	

Figure 1: An example of shared lexicon. At the top, the bar allows users to search for words inside the lexicon and, if not found, in the Wiktionary. Words can be sorted by addition date (order), alphabetically, randomly, by label or by deadline. Toggle buttons allow quick display of definitions without having to change pages. The button at bottom left allows users to add word lists (batch mode).

6.1 Main features

6.1.1 Individual and group lexicons

Learners have access to various vocabulary notebooks, which we refer to as a “lexicons”. BaLex defines three distinct levels for organizing lexical data. The primary lexical database encompasses reliable information extracted from the Wiktionary in the target language. Second, at the group level collections are dynamically managed by a student group (e.g. a whole class or just a work group), with or without a supervising teacher. To share a collaborative lexicon with other learners, anyone can create a group and invite new members into the group. The group will automatically have a lexicon available to all its members. The collaborative lexicons each contain a discussion zone enabling members to interact and each entry page provides a “comment” feature. Both features are meant to encourage discussion. Finally, each user has their own personal lexicon.

The features on the lexicon’s main page (see Fig. 1) allow teachers and learners to sort, organize and manipulate large lexicons, displayed as lists of words. Users can sort the words (by alphabetical order, order of added date, or random order), have a quick view of the words definition, select some words and perform specific actions on the selection. They can export a selection of words into a different lexicon, delete them, mark them as known or unknown, and apply labels and deadlines.

Labels enable users to list headwords according to various criteria, in the form of tags attached to a word and providing information about it (e.g. the labels Animal, Travel, Feeling, etc.). Labels thus serve both

an organizational and a learning purpose. Indeed, in order to create their own labels and apply them to words, learners need knowledge about the meanings of the words they are labelling. Therefore, they might gain some understanding of the concept of polysemia. Labels consist of several parameters: a name, a type (general or milestone), a category of users that can access it (personal, group or public).

The general labels are added by users, they can have a “universal” scope (e.g., Sport, Animal), a scope specific to the label’s creator (e.g., Summer 2020, Words that sound good) or a scope specific to a group (e.g., Words we laughed about). The deadlines operate similarly to general labels, but they also require a date (e.g. Next class, 05/01/2024 or Final exam, 20/03/2024). When the date is reached, a dialog prompts the label creator whether to delete or renew the milestone (in which case, a new date is requested).

The owner parameter determines the label access rights. There are 3 modes: **Personal Labels** belong to a unique user who has exclusive access to it (i.e. view, modify, use³, delete). **Group Labels** are accessible to a unique group and only group members can access them. This type of labels can allow teachers to mark some words with useful and contextual information for the students, with labels such as “False friend” or “For the project”. **Public Labels** are available to all BaLex users and everyone has access to them. For critical actions, such as deleting or renaming the label, an “approval” vote is required before making the change. Every BaLex user can participate and vote

³By “use” we mean applying the label to an entry or removing it from an entry.

”In favour” or ”Against” the action.

On the lexicon main page, users can look up words in the search bar. It searches if the word is already in the lexicon, if not it proposes to add it. Batch addition of a list of words is also available to users, especially teachers who might want to share a list of objectives in one single step. For every word in the list, the software looks up an existing entry and, if needed, imports lexical information. The lexical information is extracted from the Wiktionary and a copy is stored in the application database using Python scripts that automatically retrieve and structure it. Each language has its own Wiktionary with its own structure and templates (we currently process the French and English wiktionaries). Users can then consult the entry and modify all the information: add, remove and re-order pronunciations, parts of speeches, definitions, examples, sub-definitions and sub-examples.

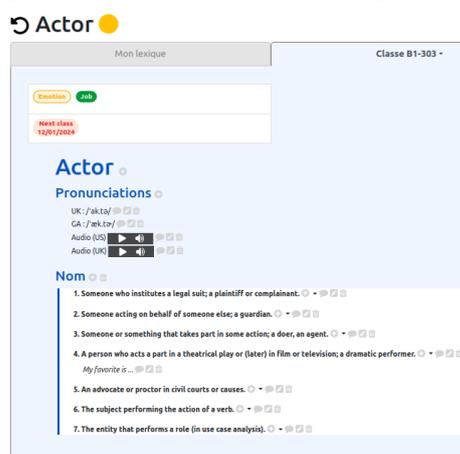


Figure 2: An example of entry. In the top left, the arrow takes the user back to the lexicon. Learners can click on the orange dot to turn it green, indicating that they know the word. Labels are displayed above pronunciations, then parts of speech with their definitions and examples. Each element can be modified, commented, deleted or created.

6.1.2 Gamified indicators

As discussed in section 3, keeping learners motivated is one of the main challenges for vocabulary learning and encouraging learners to collaborate is one way to motivate them. Another approach consists in gamifying the learning process, which can also provide feedback to learners on their activities and progress (Lavoué et al., 2019). According to Deterding, ”gamification is an informal umbrella term for the use of video game elements in non-gaming systems to improve user experience (UX) and user engagement” (Deterding et al., 2011). Examples of game elements include completing quests or earning rewards, scores,

badges, trophies (Dumas Reyssier et al., 2023).

We relied on the methodology proposed by Hallifax et al. (2018) to design and implement game elements in BaLex. We first listed the activities available in BaLex and then identified the users’ expected behavior in particular regarding vocabulary learning and collaboration. Finally, we selected the game elements best suited to these behaviors. This process aims to create game elements that, in addition to being motivating, guide learners by giving them positive feedback and showing them a methodology for learning vocabulary.

We propose 8 different types of badges, a daily quest and a point system that applies to all game elements. The daily quest requires to complete 3 tasks: adding a word to one of their lexicons, modifying the information on an entry and applying a label to an entry. Once they complete the 3 tasks in a 24 hours span, they complete the quest and are rewarded 10 points. This element is meant to encourage regularity and daily training.

The 8 types of badges are the following: **Vocabulary** rewards the number of words added by learners in all their lexicons. It relates to vocabulary width (number of known words) as it encourages learners to add new words; **Labellicist** rewards the number of labels applied by learners. This badge is related to vocabulary depth (meaning, polysemy): learners have to understand the meaning(s) of a word in order to label it; **Knowledge Guardian** rewards the number of views on all learners’ entries pages. It is also related to vocabulary depth as it encourages learners to consult frequently the lexical information; **Time Master** rewards the number of consecutive days learners completed the daily quest. It encourages learners to memorize words by emphasizing regularity and repetition. **Altruist** rewards the number of headwords added to a public label by learners. Steps: [1, 5, 10, 20, 35]. With the use of public labels, this badge incites learner collaboration on shared lexicons, and targets word depth (like the labellicist). **Acolyte Anonymous** rewards the number of entries modified by learners in a group lexicon. This badge encourages learners to collaborate to enrich the group’s lexicon. It also targets word depth, since modifying an entry requires an understanding of the lexical information it contains; **Do not Shoot the Messenger** rewards the number of messages posted by learners in a group lexicon. This badge promotes social exchanges between learners, facilitating collaboration on the group’s lexicon; **Mighty Commentator** rewards the number of comments posted by learners in a group lexicon. As comments are linked to the content of an entry, this badge favors collaborative work.

All these elements are displayed on the homepage of the application in a summarized version (see Fig. 3) and the details are available on a dashboard.



Figure 3: Summarized game elements displayed on the homepage.

These game elements are meant to maintain motivation and engagement in a vocabulary notebook type of task, and to give cues regarding vocabulary learning methodology, by drawing attention to various ways in which the learner can deepen their knowledge of one given word.

7 CONCLUSION

In this paper, we propose the gamified vocabulary notebook BaLex. It was designed to promote vocabulary learning by supporting collaboration among learners, enhancing their motivation and favouring autonomous learning. This software provides lexical information from the Wiktionary and lets users adapt the content of their different notebooks according to their learning curriculum.

Features such as managing labels, deadlines and word sorting are designed to facilitate the organization and learning of word lists. Group lexicons provide group chats and allow to comment every block in entry pages. Both features are intended to foster collaboration, and we hypothesize it will have a positive effect on both learner motivation and vocabulary learning. Game elements are also implemented to enhance learner motivation and provide methodological guidance regarding vocabulary learning.

Teachers can easily monitor their students by creating groups for their classes. Their role as administrator in the group allows them to view the work carried out in individual and group lexicons, as well as give instructions and feedback. As literature suggests it, we expect it to improve learners' vocabulary

skills. Indeed, vocabulary learning requires methodology and strategies on the part of learners (Nation, 2013), and the presence of the teacher will foster continuity between learning in the classroom and outside, on their own. In this way, the tool can be integrated into the school curriculum, providing a link between classroom teaching practices and the autonomous learning of vocabulary expected.

BaLex is meant to be integrated more closely in a workflow involving various applications. We provide a dedicated Application Programming Interface (API) that allows to extend the learners' vocabulary outside of the notebook application. As part of our future works, we will plug BaLex with external tools such as vocabulary learning games, flashcards applications, reader assistants, or other vocabulary learning application. Connecting more deeply the different applications via the BaLex API will contribute to creating a complete learning ecosystem organised around the vocabulary notebooks. We will also enrich the gamified indicators with more information on the learners' activities carried out in the different applications to provide a deep feedback on their progress and relevant rewards. Finally, another perspective is the integration of new languages in BaLex, which currently only operate with the English words from the English Wiktionary.

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