

The Role of Quizlet in Vocabulary Acquisition

Hans Platzer

(hans.platzer@fhwn.ac.at)

University of Applied Sciences Wiener Neustadt, Austria

Abstract

Quizlet is a widely used online vocabulary learning tool comprising seven different self-study modes, viz. Match, Learn, Test, Write, Spell, Gravity, and Flashcard. This study explores the following aspects of Quizlet use among a sample of 165 first-year business students: (a) the degree of voluntary uptake of Quizlet, (b) its effectiveness for vocabulary retention (both overall and of its individual study activities), and (c) the impact of the use of PC vs. smartphone on the choice of self-study activity. In this context, a regression analysis confirms that overall Quizlet made a significant contribution to students' vocabulary acquisition. In fact, Quizlet use had a slightly greater impact on students' vocabulary scores than their underlying English competence did. However, despite its potential to support vocabulary learning, over a third of students (35.2%) did not use Quizlet even once. In addition, a single study mode, i.e. Match, was responsible for half of overall Quizlet use. This is problematic as the Match activity is unchallenging, being exclusively based on word recognition, and accordingly a further regression analysis confirmed that Match did not make a significant contribution to vocabulary growth. On the other hand, the other six activities made significant contributions to vocabulary learning being either partly or exclusively based on more challenging recall tasks, rather than mere recognition. However, these more effective recall-based tasks require typing the correct answer, and this invariably proves cumbersome on mobile phones, which were unfortunately the preferred device among the subjects studied.

1 Introduction

1.1 Background

Technology-enhanced language learning can look back on a long - albeit somewhat chequered - history spanning half a century. Early manifestations of CALL (Computer-Aided Language Learning) were already on the scene in the mid-1960ies and early 70ies, with systems such as PLATO and TICCIT (Kohn, 2009, 576), and then morphed - via the personal computer in the 80ies and the didactic promise of the CD-ROM in the 90ies (Kohn, 2009, 757-578) - into web-based e-learning as we now know it. Each of those stages tended to be accompanied by predictions of breakthroughs in language learning. But despite the reputation of CALL for its effectiveness (Hirschel and Fritz, 2013; Nakata, 2011), its benefits have rarely materialised to the extent envisaged (Fryer and Bovee, 2018; Kumar and Tammelin, 2008), and accordingly institutional uptake of e-learning has also been lagging behind expectations (Tondeur et al., 2017; Kumar and Tammelin, 2008; Coryell and Chlup, 2007).

Nonetheless, a number of e-learning tools have been developed, many with a focus on vocabulary acquisition, such as *My Word Coach* discussed by Cobb and Horst (2011), *Study Stack* (studystack.com/) and *Cram* (cram.com) described by Chien (2015), *Word Engine* (wordengine.jp) reviewed by Browne and Culligan (2008), and *Google's Word Coach*. However, one of the most

widely used vocabulary learning tools is *Quizlet* (quizlet.com) with 50 million monthly users (Quizlet, 2019). In this context, the current study examines the effectiveness of Quizlet and patterns of its use among a sample of first-year students enrolled at a tertiary business college.

1.2 Design characteristics of Quizlet in the context of previous research

Quizlet is an easy-to-use vocabulary learning tool, accessed either on the web or via a mobile app. Users (both, teachers and learners) may upload wordlists containing L2 lexemes and their L1 translations (or definitions), and on the basis of these wordlists, Quizlet generates seven different self-study activities or self-tests. An eighth activity, Quizlet Live, is described by Wolff (2016). However, as this activity needs to be initiated via a teacher account, it is not available for self-study and will thus not be discussed below.

The seven self-study activities comprise a mix of multiple-choice or multiple matching items, true/false exercises, flashcards and recall tasks, which require typing the appropriate answer. (For a detailed description, see Table 1.) In principle, these options are examples of paired-associate vocabulary learning, which is considered valuable in acquiring meaning-form relationships (Elgort 2011). And despite didactic reservations about such decontextualised L1/L2 lexical relationships, paired-associate vocabulary learning has proved to be an efficient measure to increase vocabulary size (Fitzpatrick, Al-Qarni, and Meara, 2008; Webb, 2007). In this context, Fryer and Bovee (2016, 22) maintain "that [such] drill-and-practice e-learning can be instrumental, ensuring that all students acquire and operationalize foundational knowledge". Indeed, Quizlet's mix of seven different activities may prove to be a boon in this respect as previous research underlined that mixed-modality instruction (Tight, 2010) and "a greater range of study options" may lead to better retention (Fryer, Bovee, and Nakao, 2014, 32).

Table 1. Quizlet's self-study activities

Quizlet activity	Description	Recall vs. recognition	Answer requires typing	Mobile App
Learn	Three task types: (a) flashcards, (b) multiple choice items, and (c) typing the required answer. Users can customise this activity and de-select any of the three choices.	Mixed	Custom	Yes
Flash-card	Self-explanatory.	Recall	No	Yes
Write	Requires the user to type the relevant translation.	Recall	Yes	Yes
Spell	User listens to lexical entry being read and is then required to type the word correctly.	Recall	Yes	No
Test	Includes four test methods: (a) typing the answer, (b) matching, (c) multiple-choice, and (d) true/false. Users can customise this activity and de-select any of these choices.	Mixed	Custom	Yes
Match	Multiple matching task. Users drag and drop the definition or translation to the matching lexeme, or vice versa.	Recognition	No	Yes
Gravity	Requires typing the correct answer while working against the clock. (See Fig. 1)	Recall	Yes	No

At the most basic level, the activities listed in Table 1 can be characterised as either recall-based or recognition-based tasks, or a mix of both types. "Recall requires learners to produce L2 word forms or their meanings, whereas recognition asks learners to choose L2 word forms or their meanings from a number of options as in a multiple-choice question." (Nakata and Webb, 2016, 129) This difference has been investigated widely (cf. Nakata, 2011; Laufer, Elder, and Congdon 2004) and

most research agrees that recognition-based tasks (such as multiple choice, matching and true/false) are less challenging (McLean, Hogg, and Rush, 2013) and therefore less effective for long-term retention. By contrast, recall-based exercises tend to generate better results in terms of retention (Butler and Roediger, 2007; Kang, McDermott, and Roediger, 2007) and are therefore widely regarded as the mode of choice in language learning.

Irrespective of such questions of task type, one important strand in vocabulary research highlights the need to facilitate the necessary number of repetitions to ensure reliable acquisition (Xue et al., 2010; Webb, 2007; Waring and Takaki, 2003). Arguably, e-learning environments, and particularly mobile assisted language learning (MALL), are ideally placed to provide maximum access to learning materials to enable such repetition. As five of Quizlet's seven activities are also available as a mobile app, such ready access ensures one of the key benefits ascribed to e-learning, viz. its ubiquity (Kukulka-Hulme and Shield, 2008), whose positive impact is obvious. Fryer, Bovee, and Nakao (2014, 33) argue that "making the online tasks accessible from mobile devices may encourage students to engage with the content more frequently". This is echoed by Kukulka-Hulme (2018, 2), who argues that MALL "can multiply the possibilities for learning on the move", and this extends "the language learning process beyond the classroom" (Shadiey, Hwang, and Liu 2018, 894). In fact, Wu (2015) reports higher vocabulary retention rates among students who had access to her mobile learning app, and she credits their better performance to the fact that these students "probably spent a longer accumulated time [on these tasks] because of the convenient access they had to the material" (Wu, 2015, 177). A similar point is made by Kukulka-Hulme (2018, 4), who assumes that additional learning may well take place "in different settings (on the bus, in a café, in a queue)". Accordingly, the discussion in section 3.2 explores whether students indeed used mobile devices more frequently than stationary PCs, and it also outlines the effect this had on the type of activity selected and its impact on vocabulary growth.

A further characteristic of e-learning, which is crucial to its effectiveness, involves the feedback provided to learners. According to Fryer and Bovee (2016, 22), e-learning "instantly provides feedback to the learner", and this fact "lends itself to the memorization of basic linguistic elements", i.e. it should be particularly effective in vocabulary acquisition. Such feedback allows learners to self-assess their performance, which in turn leads to "better learning effectiveness" (Wang, 2014, 201). The positive effects of self-assessment have also been shown by Deutsch et al. (2012) and Hwang and Chang (2011). Conveniently, all of Quizlet's seven activities include instant feedback on the correctness of the answers provided. However, some researchers warn that learners' abilities to apply such meta-cognitive strategies should not be taken for granted (Winters, Greene, and Costich 2008) as not all students are "ready to learn from a technology-integrated" approach (Tondeur et al., 2017, 563-564).

Apart from feedback, e-learning tools such as Quizlet share several other characteristics of serious gaming, defined by Sandberg, Maris, and Hoogendoorn (2014, 120) as "games that serve some other primary purpose than mere entertainment". Garris, Ahlers, and Driskell (2002) compiled a number of central game characteristics, which were further augmented by Sandberg, Maris, and Hoogendoorn (2014), the final list comprising: *fantasy, rules and goals, sensory stimuli and feedback* (see discussion above), *challenges, control, mystery and storyline, rewards, competition and cooperation*, and lastly *adaptivity*. However, the precise contribution made by gamified exercises is still subject to debate. On the one hand, Smith et al. (2013, 276) conclude that "educational computer games can increase learners' motivation" (cf. also Chen and Yang, 2013; Dickey, 2011). On the other hand, Sandberg, Maris, and Hoogendoorn (2014, 120) second-guess such observations and argue that we still lack "conclusive results" on the effectiveness of gamed learning tasks (cf. also Connolly et al., 2012; Girard, Ecalle, and Magnan, 2012; Wouters et al., 2013). Indeed, their own research implies that "the gaming aspect does not motivate the children to spend more time on the learning material" (Sandberg, Maris, and Hoogendoorn, 2014, 129).

In the context of Quizlet, apart from feedback, gamification has been incorporated fairly selectively, with only the Gravity activity having been comprehensively gamified (see Fig. 1). This activity requires learners to type the appropriate answer while an asteroid descends on a planet (cf. *fantasy, sensory stimuli* above) and hits it if the correct answer is not provided in time (cf. *rules and goals* above). If the planet is struck twice, it is destroyed (cf. *storyline* above).

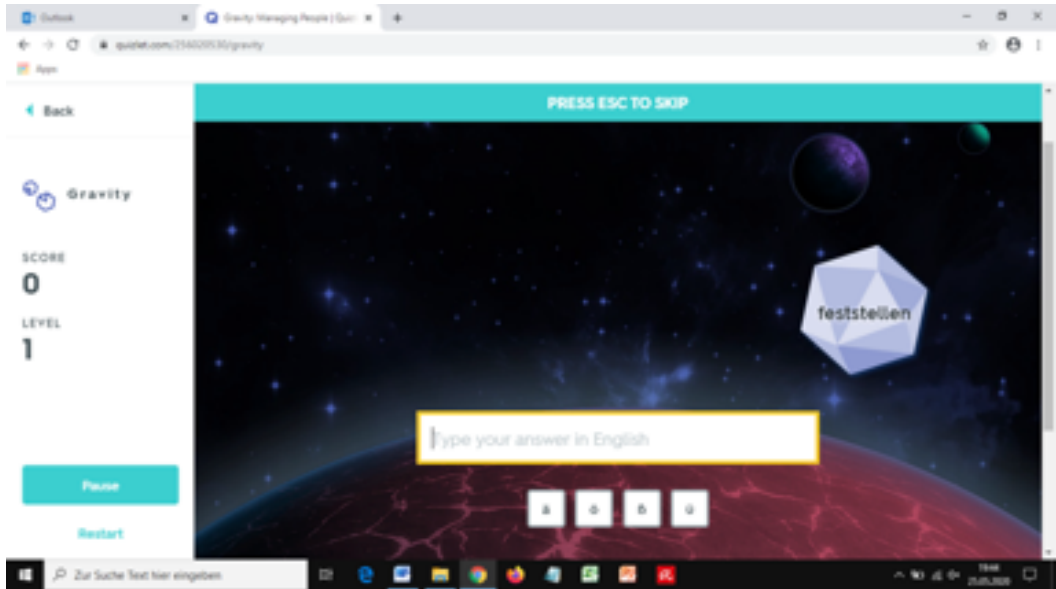


Fig. 1. Quizlet's 'Gravity' activity

A second activity, Match, contains only a single, but arguably very distinctive gamified feature, viz. *competition*. In this study mode, the speed is timed with which learners provide the correct answers and this result is entered on a leader board, which effectively allows learners to compete against each other. Otherwise, however, Quizlet tasks are not substantially gamified, and we will see in section 3.2 that the degree of gamification may not be a decisive feature in learners' choice of a specific activity.

Finally, Quizlet does, however, provide some aspects of *control, adaptivity and collaboration* (cf. above): e.g. learners may compile and upload their own wordlists; the direction of study (L1 \leftrightarrow L2 or L2 \leftrightarrow L1) is up to them and they may, of course, select from the various activities, i.e. some form of control is definitely offered. In addition, the ability to upload their own wordlists also implies that learners may share their lists with other users. Quizlet, therefore, creates an incipient form of learning community, which has proved positive for learning outcomes (Thompson and MacDonald, 2005). On the other hand, this is clearly still a far cry from proper knowledge sharing and negotiation of content, which is usually regarded as the gold standard of "effective collaborative learning" (Wang and Chiu, 2011, 1792). One should, consequently, not expect Quizlet to provide the full benefits typically associated with collaborative learning.

1.3 Quizlet-specific research

Studies focusing on the use of Quizlet itself have so far been mainly exploratory. Its implementation into classroom practice was described by Ismailova et al. (2017), Wright (2016), Xerou, Papadima-Sophocleous, and Parmaxi (2016), Wolff (2016) and Robertson (2015). However, what is

of greater interest for present purposes are papers discussing Quizlet's effectiveness and the impact of student attitudes on its use.

In terms of effectiveness, Dizon and Tang (2017), Kalecky (2016), and Davie and Hilber (2015) do not report any differences between vocabulary growth due to Quizlet or an alternative intervention. By contrast, Barr (2016) and Vargas (2011) found significant differences between students using Quizlet and a control group. But in both cases, this was likely due to the fact that subjects simply spent more time revising with Quizlet than to any inherent benefits of Quizlet over an alternative intervention. Similar positive findings on the effectiveness of Quizlet were reported by Chaikovska and Zbaravska (2020), Thanh, Ngoc, and Linh (2018), and Dizon (2016), who found Quizlet to lead to statistically significant vocabulary growth in a pre-test/post-test scenario. This finding was based on a sample of nine subjects and did not compare the effectiveness of Quizlet with an alternative intervention or control group.

Regarding student attitudes to Quizlet, most research reported that learners were keen on using it (Anjaniputra and Salsabila, 2018; Tran, 2018; Lander, 2016; Dizon, 2016; Davie and Hilber, 2015; Chien, 2015), especially when contrasted with analogue materials, such as notebooks, pen-and-paper flashcards or traditional textbooks (Dizon and Tang, 2017; Kalecky, 2016; Stroud, 2014; Vargas, 2011). However, it remains contentious whether this positive attitude readily translates into more frequent vocabulary revision (Tran, 2018).

1.4 Aims

Against this background, the current study analyses the use of Quizlet among a sample of first-year business students focusing on the following aspects:

Section 3.1 explores Quizlet uptake in the sample studied and analyses its effectiveness for vocabulary acquisition. Some studies treat mobile learning as a panacea to boost learner involvement, often based on the assumption that giving students the option to revise in a wider range of environments will invariably increase their willingness to do so (cf. Kukulska-Hulme 2018; Shadiey, Hwang, and Liu 2018; Wu 2015; Kukulska-Hulme and Shield, 2008). On the other hand, other studies report less promising findings concerning student engagement with e-learning (Fryer and Bovee, 2018; Clark and Mayer, 2016; Sanberg, Maris, and Hoogendoorn, 2014; Fryer, Bovee, and Nakao, 2014). As the appeal of e-learning can, consequently, not be regarded as a given, it is therefore useful to gauge the uptake of Quizlet among our sample in order to take remedial action in case of poor engagement (see section 3.1).

Unfortunately, the effectiveness of Quizlet might be similarly unclear with Dizon and Tang (2017), Kalecky (2016), and Davie and Hilber (2015) finding no significant impact of Quizlet on vocabulary learning. By contrast, Barr (2016), Vargas (2011), Dizon (2016), Thanh, Ngoc, and Linh (2018), and Chaikovska and Zbaravska (2020) report higher vocabulary scores among Quizlet users. However, Dizon's (2016) results are based on nine subjects, while Thanh, Ngoc, and Linh (2018), and Chaikovska and Zbaravska (2020) do not provide any inferential statistics which could clarify whether the reported differences are actually statistically significant. A further look at the impact of Quizlet on vocabulary retention on the basis of inferential statistics as envisaged for section 3.1 is therefore in order.

Section 3.2 tracks differences in the use of Quizlet's seven activities, relates their choice to the context in which they are used ('on the go' vs. stationary), and discusses the efficacy of the various activities for vocabulary retention. As mentioned above, a number of studies have already examined the impact of Quizlet on vocabulary retention (cf. Dizon and Tang, 2017; Kalecky, 2016; Davie and Hilber, 2015; Barr, 2016; Vargas, 2011; Dizon, 2016; Thanh, Ngoc, and Linh, 2018; Chaikovska and Zbaravska, 2020). However, they treated Quizlet as a monolithic tool, ignoring the possibility that the different self-study activities may show different levels of effectiveness. This contention is not implausible as recall-based and recognition-based tasks are involved to varying extents, with recall being linked to higher levels of mental processing than recognition (cf. Nakata and Webb,

2016; Nakata, 2011; Laufer, Elder, and Congdon 2004; McLean, Hogg, and Rush, 2013; Butler and Roediger, 2007; Kang, McDermott, and Roediger, 2007). It may therefore be useful to follow up on this aspect in the current study (see section 3.2).

In a similar vein, previous research has neglected the fact that Quizlet may be accessed either via a PC or mobile app. However, studies abound which confirm that physical PC keyboards are vastly preferred over onscreen ones in tablets and mobiles phones (cf. Chaparro et al., 2014; Kim et al., 2013; Findlater, Wobbrock, and Wigdor, 2011; Ozok et al., 2008). Consequently, the choice of PC vs. mobile phone may trigger the choice of different Quizlet activities depending on the extent of typing involved. However, if the various activities show different levels of effectiveness as hypothesised, the pragmatic factors governing these choices (such as the type of keyboard) are a worthwhile target of research (see section 3.2).

The final section, 3.3, identifies differences in the use of Quizlet among higher vs. lower competence learners. In fact, previous research has already confirmed that poor learners tend to make ineffective study choices (cf. Eklund and Sinclair, 2000; Yang and Wu, 2015; Wang, 2014), and this observation may plausibly extend to the choice of potentially less effective Quizlet activities. If this is found to be the case, then remedial action could be taken to steer weaker students towards activities which generate better learning outcomes. The focus of section 3.3 on the behaviour of strong vs. weak learners in regard to Quizlet might therefore prove didactically profitable.

2 Method

2.1 *Setting and subjects*

A sample of 165 first-year business students participated in the research, which was carried out at an Austrian tertiary business college in the academic year 2018/19. The background of the subjects is comparatively homogeneous: the vast majority attended 8-9 years of English instruction in the Austrian secondary school system. In the context of this study, several data sources were exploited, viz. (a) students' English competence on entering the study programme, (b) their use of the Quizlet e-learning tool, (c) the total score on three vocabulary check-ups administered during a 14-week Business English course, and (d) a questionnaire survey conducted after their first term of studies.

2.2 *Oxford Online Placement Test (OOPT)*

In the first week of their studies, subjects took the Oxford Online Placement Test (OOPT) to ascertain their underlying English competence. The constructs include grammatical knowledge (i.e. knowledge of grammatical forms and semantic meaning) and pragmatic ability. The test covers the domains of reading and listening (Purpura, no date). Results are reported as a point score and a corresponding assessment based on the six CEF levels (A1-C2) (Pollitt, no date). This test was taken by the whole sample of 165 students.

2.3 *Vocabulary check-ups*

Over the course of a 14-week Business English class, 119 students took three vocabulary check-ups, which contributed to their final grade. In total, students were presented with 24 items consisting of simplex lexemes, compounds and collocations. Two of those tests involved online quizzes, which took place in weeks 6 and 12. The third test was a pen-and-paper check-up, administered in class as part of an end-of-term exam. A test of internal reliability of this 24-item instrument resulted in a Cronbach's alpha of 0.88, which is satisfactory in terms of scoring validity (Green, 2013, 38). The test items were sampled from a set of 276 lexemes or collocations from two subject areas, viz. managing people (170 entries) and business organisations (106 entries). In terms of content validity, the 24 test items represent a coverage of 8.7% of the original 276 lexical entries.

2.4 Quizlet use

Based on the 276 entries mentioned above, two study sets were set up on Quizlet. Subsequently, all students received a hyperlink by email to those two study sets and were encouraged to use Quizlet's activities for self-study. In addition, they were reminded by their lecturers in class that the relevant vocabulary would form the basis of three graded vocabulary tests over the course of the term (cf. section 2.3). However, students' Quizlet use itself was not monitored during the term and did not contribute towards their final grade. After the 14-week Business English course, frequency data were available on how often each student had used the various activities. In addition, a sum total of these individual frequencies was calculated for each student to determine how often Quizlet was used overall, irrespective of activity.

Two further aggregate variables were computed, which were assumed to have an impact on the popularity and efficacy of the various Quizlet activities. The first variable is based on whether typing is inherently required in answering the item (Write, Spell, Gravity), not required (Flashcard, Match) or whether typing as an answer mode can be deselected (Learn, Test) (see Table 1). The need for extended typing presumably affects the user-friendliness of the respective activities, especially when used with mobile devices. A second variable involves the concept of recall- vs. recognition-based tasks. Based on the discussion in section 1.2, the classification of the various Quizlet activities as recall-based, recognition-based or a mix of both types is illustrated in Table 2 below. To recap, it is hypothesised that recall-based tasks should be associated with greater effectiveness than recognition-based ones. This proposition is tested in section 3.2.

Table 2. Recognition- vs. recall-based Quizlet activities

Recognition vs. recall	Quizlet activity
Recognition only:	Match
Mixed recognition/recall:	Learn, Test
Recall only:	Flashcard, Write, Spell*, Gravity*

(*Note: Both of these are not found on Quizlet's mobile app)

2.5 Questionnaire data

After administering the three vocabulary tests and collecting data on students' Quizlet usage, a questionnaire survey was conducted in which the subjects were quizzed on a number of environmental factors impacting on their use of Quizlet. Two sets of questions are analysed below, viz.

(a) how often students used a smartphone vs. tablet vs. personal computer/notebook when accessing Quizlet, and (b) how often they used Quizlet 'on the hoof' vs. in a stationary context (such as at home or in a library setting).

Response options were presented on a 5-point Likert scale, anchored only at the end points: to the left *never* and to the right *very often*, with three undefined intermediate frequency points. One hundred questionnaires were returned.

3 Results and discussion

3.1 Overall Quizlet use

The first question which needs addressing is whether Quizlet actually had a positive impact on vocabulary acquisition. For this purpose, a multiple regression analysis was conducted to assess the impact of two independent variables, i.e. aggregate Quizlet use and students' underlying English competence (as measured by the Oxford Online Placement Test/OOPT), on a dependent variable, viz. students' vocabulary scores. In fact, the regression model manages to predict the vocabulary scores significantly well, $r^2 = 0.118$, $F(2, 119) = 7.773$, $p = 0.001$. Both independent variables, i.e.

2nd Quartile	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.00
3rd Quartile	1.00	1.00	0.00	0.00	2.00	9.00	0.00	27.00

(*Note: Both of these are not found on Quizlet's mobile app)

This comparatively small number of - sometimes excessive - users tallies with anecdotal observations by teaching staff. As reported by their lecturers, a handful of students mentioned - unprompted - that they were keen users of Quizlet and they actively requested further study sets, including vocabulary for their upcoming semesters. For these respondents, learner autonomy and empowerment obviously work. However, it is tempting to confuse this - at times - keen and committed feedback from a relatively small number of users with engagement from the whole sample. In fact, Kumar and Tammelin (2008, 31) warn against the impression that learners "automatically know how to study in online learning environments, which requires a high degree of learner autonomy". Unfortunately, a good number of learners apparently lack the required skills (Coryell and Chlup, 2007). Indeed, this problem seems to be borne out by Figure 2 above, which shows that engagement with Quizlet was fairly unreliable among at least half of the respondents. The next section discusses which task characteristics appear to be associated with variations in the frequency of Quizlet use.

3.2 Individual activities and task characteristics

As soon as we look at Quizlet's seven activities individually, things become less transparent as the aggregate frequency presented in Figure 2 is spread over seven activities in Figure 3 (see also Table 3). In fact individual frequencies are so low that all medians (except the aggregate total) are zero meaning that at least half the respondents do not use the relevant activities at all. The three most frequently used activities are Match (mean = 8.32), Test (mean = 4.04) and Flashcard (mean = 2.99). The least popular are - unsurprisingly - Gravity (mean = 0.04) and Spelling (mean = 0.03) as these two activities are not available on the mobile app. Due to these generally low frequencies of use, it will be necessary to aggregate some of the figures to allow meaningful observations. In this context, a throwaway remark by one of the users may shed some light on a potential task feature impacting on frequency of use.

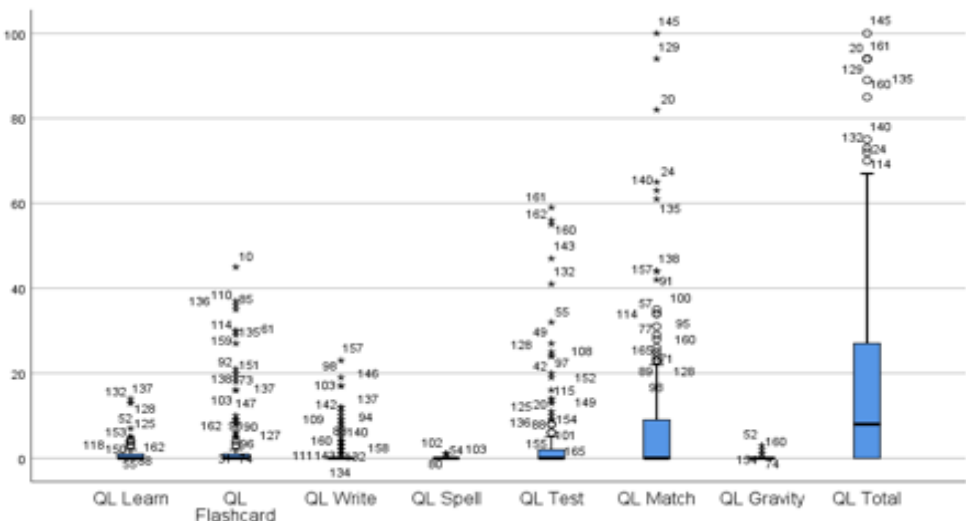


Fig. 3. Frequency of Quizlet (QL) use by activity (n = 165)

In fact, one student observed that he found Quizlet particularly useful when accessed 'on the hoof', such as waiting at the bus stop. Indeed, previous research highlighted the potential of e-learning to take place "in different settings (on the bus, in a café, in a queue)" (Kukulka-Hulme, 2018,

2), taking advantage of 'dead time' (Ballance, 2012). However, if this is indeed the case, it implies the use of Quizlet with mobile devices, most likely a smartphone, and suggests that tasks which involve typing may be quite cumbersome in such circumstances. Taking the requirement for extensive typing as a cue, the seven Quizlet activities can be classified as follows: Two of the exercises require no typing at all, viz. Flashcards and Match. Another two tasks, i.e. Learn and Test, require typing only in some instances, and in addition, these two tasks may also be customised in such a way that typing can be deselected completely. And finally, three tasks inherently involve typing the required answers, viz. Spell, Write and Gravity. Aggregate frequencies were calculated for each of these three categories, i.e. (a) typing not required, (b) typing customised, and (c) typing required (see Figure 4).

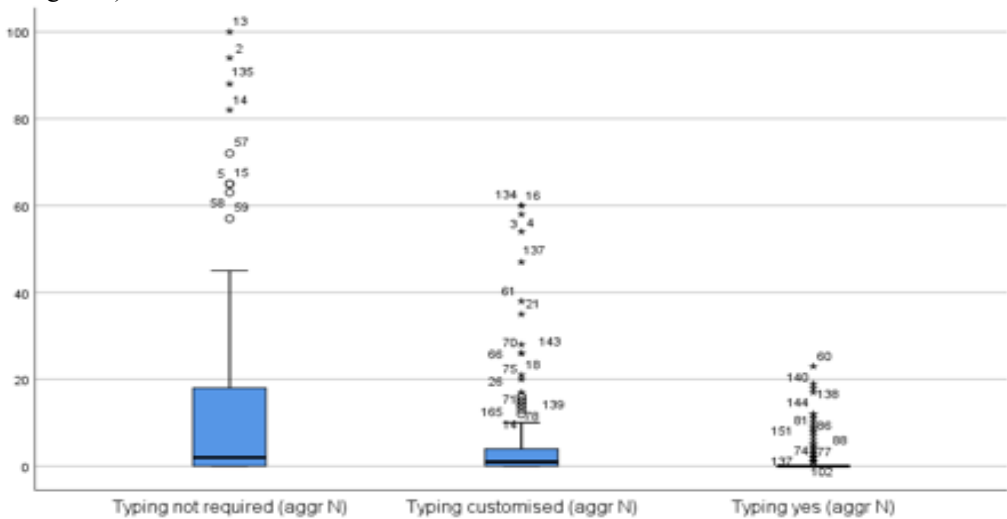


Fig. 4. Frequency of Quizlet use based on need for typing (n = 165)

Figure 4 reveals that the activity which does not involve typing (Match) is used most frequently (Typing not required: median = 2), followed by those which only require some typing or with the option to deselect the need for typing (Typing customised: median = 1). And apparently, tasks which always need a typed answer are least popular of all (Typing yes: median = 0). A Friedman test indicates that these differences are statistically significant, ($\chi^2(2, 165) = 62.716, p = 0.000$), i.e. the frequency of Quizlet use drops the more typing is required.

This finding also tallies with the questionnaire results exploring which types of device are used to access Quizlet. Figure 5 clearly shows significantly higher smartphone- than computer use, with tablet use being practically non-existent. Based on a Wilcoxon Signed Ranks Test, the difference between computer use (median = 2) and smartphone use (median = 5) is statistically significant ($Z = -5.403, p = 0.000$). This finding is clearly consistent with students' reluctance to access tasks which require extensive typing, as observed in Figure 4.

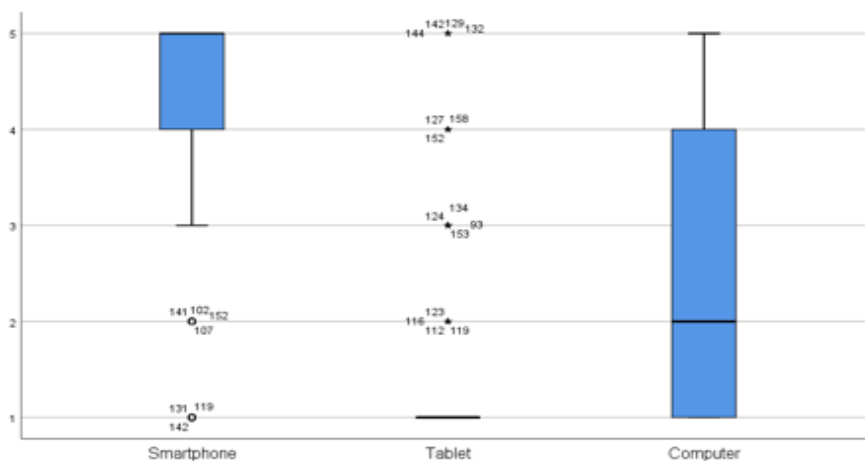


Fig. 5. Devices used for Quizlet (n = 97) (1 = never; 5 = very often)

This marked reluctance towards typing automatically implies a preference for matching, multiple-choice and true-false response options, which represent recognition-based tasks. And indeed, Match proves to be the single most frequent Quizlet activity (mean = 8.32, see Table 4). Two further activities, viz. Learn and Test, contain a mix of recognition-based tasks (matching, multiple-choice, true-false) and recall tasks resulting in less frequent use (mean = 4.95), while pure recall-based activities (Flashcard, Write, Spell, Gravity) are least frequent (mean = 4.41).

Table 4. Recognition- vs. recall-based Quizlet activities (n = 165)

	Recognition only	Mixed	Recall only
Activities	Match	Learn, Test	Flashcard, Write, Spell*, Gravity*
Mean	8.32	4.95	4.41
Median	0.00	1.00	0.00
Std deviation	17.005	11.160	9.256

(*Note: Both of these are not found on Quizlet's mobile app)

In order to assess whether the difference between recognition and recall has an impact on vocabulary retention, a further multiple regression analysis was conducted with students' vocabulary score as the dependent variable and three independent variables, viz. aggregate Quizlet use of (a) recall-based tasks (Flashcard, Spell, Write, Gravity), (b) mixed tasks (Learn, Test) and (c) the sole recognition-based activity (Match). The regression model explains 19.2% of the score variance ($r^2 = 0.192$, $F(3, 119) = 9.107$, $p = 0.000$). As suspected, the recognition-based task (Match), does not make a significant contribution to vocabulary scores ($\beta = -0.038$, $p = 0.651$, **not significant**). Along these lines, Barr (2016) also reported a lower performance for students who had used the Match activity. However, in his case the performance gap did not reach statistical significance. On the other hand, recall-based and mixed activities each make a significant unique contribution to vocabulary scores, with a β -value of 0.372 ($p = 0.000$) for recall tasks, and $\beta = 0.248$ ($p = 0.004$) for mixed activities. This means that the most frequently used activity (Match) is the one which does not seem to have any positive impact on vocabulary scores.

The unfortunate popularity of Match probably derives from a mix of at least three factors. First, the absence of a need for typing is likely a key element. Research on touchscreen keyboards has consistently reported major deficiencies of this text input option (Kim et al., 2013; Findlater, Wobbrock, and Wigdor, 2011; Ozok et al., 2008) and substantial dissatisfaction among users, especially when contrasted with physical keyboards (Chaparro et al., 2014). These results are clearly consistent with the observation that users of the Quizlet smartphone app opt for activities which allow them to

avoid cumbersome onscreen keyboards. And it is equally consistent to assume that PC users are more likely to use Quizlet activities which require typing due to the comparative ease of typing on a physical keyboard. Second, the fact that recognition tasks are regarded as easier and less challenging (McLean, Hogg, and Rush, 2013) may account for the comparative popularity of the Match activity over recall-based tasks. And finally, Match features an attractive element of gamification, viz. the option to compete against other players through the use of a scoreboard. This unique mix of features should go some way to explaining its popularity - despite its ineffectiveness as a revision task.

Two didactic approaches may remedy this dilemma. First, smartphone use is clearly inevitable when learners access Quizlet 'on the go', and in these circumstances, it is unreasonable to expect the use of typing-based activities. Nonetheless, this does not make Match the only option. Instead, it is more profitable to steer learners toward the Flashcard activity, which does not require typing either, but has the advantage of demanding greater attention and effort, and should therefore prove more effective.

Secondly, while smartphone use is significantly more prevalent than computer use (see Figure 5), this is not to say that mobile phones are invariably used 'on the go'. Figure 6 reveals that Quizlet is accessed less frequently 'on the hoof' than in a stationary environment, e.g. at home or in a library. However, in these environments the use of a mobile device is not necessary as a personal computer with a decent keyboard should be available. In such stationary environments, it would, therefore, make sense to recommend the use of a computer for recall-based tasks, which involve typing, i.e. Learn, Test, Write, Spell and Gravity, as these tasks are more conducive to effective learning outcomes.

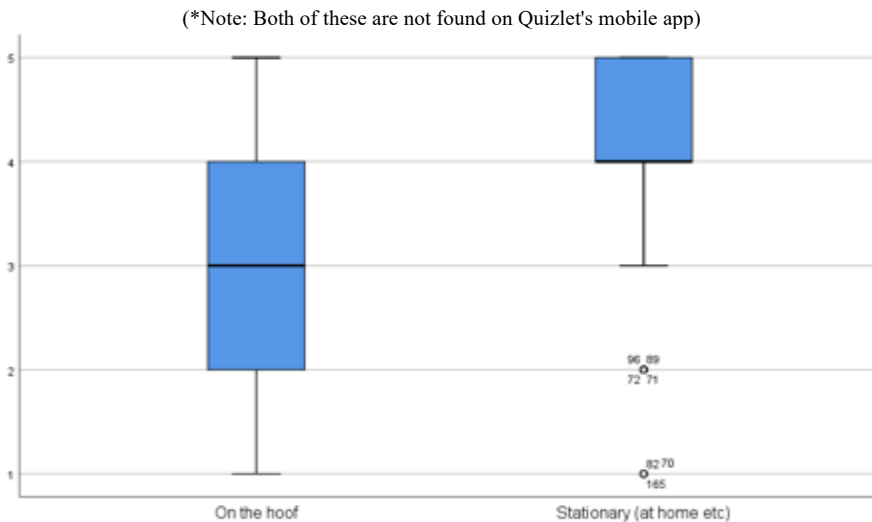


Fig. 6. Context of Quizlet use (n = 100) (1 = never, 5 = very often)

3.3 Learner characteristics

In addition to the task features discussed above, it is plausible to assume that learner characteristics may have an additional impact on Quizlet uptake. Hence, Figure 7 presents the aggregate frequency of overall Quizlet use (QL Total) among respondents classified according to four CEF-based competence bands, i.e. A1/A2 (n = 12), B1 (n = 44), B2 (n = 77) and C1/C2 (n = 32).

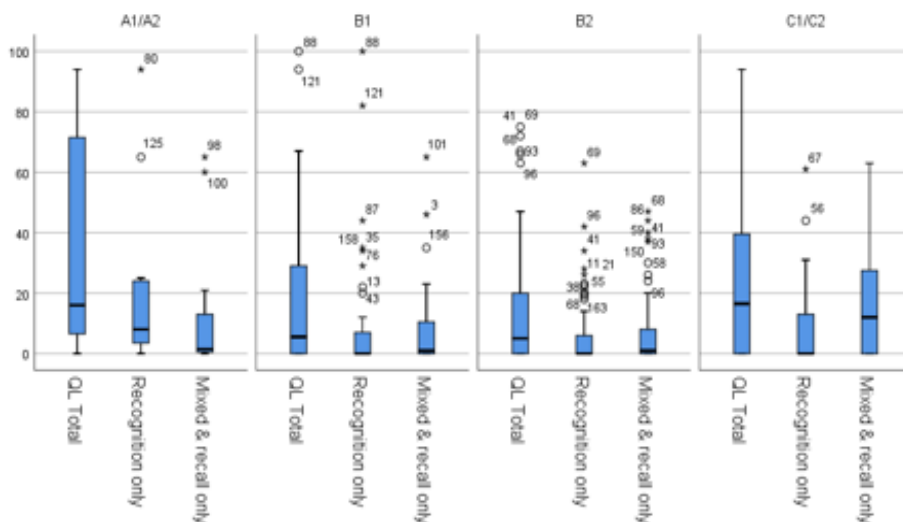


Fig. 7. Aggregate Quizlet use by CEF band (n = 165)

Interestingly, the output suggests that Quizlet overall (see QL Total in Figure 7) is more popular at both ends of the competence scale, i.e. with A1/A2 students (median = 16) and C1/C2 students (median = 16.5), but seems to be used less often by B1 (median = 5.5) and B2 (median = 5) respondents. Indeed, a Kruskal-Wallis test confirms a significant difference in frequency across the four competence bands ($H(3, 165) = 8.198, p = 0.042$). In addition, a set of post-hoc Mann-Whitney tests was conducted to follow up on this finding. Two of these revealed significant differences between individual groups. Thus, both, A1/A2 students ($U = 267.500, p = 0.017$) and C1/C2 students ($U = 931.000, p = 0.040$) used Quizlet significantly more frequently than B2 respondents.

Superficially, this looks like a positive result, as it is tempting to assume weaker students are aware that they need to balance out their skills issues with more vocabulary revision. Unfortunately, Figure 7 reveals that A1/A2 students are the only group which uses the ineffective, recognition-based Match activity more frequently than the effective activities based on recall. In fact, median use of Match is 8 times among the A1/A2 group, whereas in all other groups median frequency is zero (see Figure 7 and Table 5). A Kruskal-Wallis test ($H(3, 165) = 8.548, p = 0.036$) confirms that these differences are statistically significant, and it is plausible to assume that this is due to the prevalence of the Match activity among A1/A2 learners. Crucially, we also saw in section 3.2 that this is the one type of task which does not make a positive contribution to vocabulary scores, i.e. the effort invested here is unlikely to yield positive results in terms of vocabulary acquisition. This association of weaker learners and poor study choices echoes previous research. Yang and Wu (2015, 319) found that "poor learners tended to use [...] the easiest [learning] strategy" rather than the most effective one. And e-learning in particular seems to be implicated in learners selecting superficially stimulating, rather than effective, material (Eklund and Sinclair, 2000). Accordingly, Wang (2014, 192) suggests that "learners with low-level prior knowledge need to be provided with relatively greater guidance and assistance" in their e-learning endeavours, and Quizlet does not seem to be an exception in this respect.

Table 5. Median frequency of Quizlet use by activity type

CEF levels	Recognition only	Mixed & recall only
A1/A2 (n = 12)	8.00	1.50
B1 (n = 44)	0.00	1.00
B2 (n = 77)	0.00	1.00
C1/C2 (n = 32)	0.00	12.00

Conversely, the top competence group (C1/C2) uses recall-based or mixed activities much more frequently (median = 12.00, see Table 5), while the other groups access these less often, with median frequencies between 1.00 and 1.50. This suggests that higher competence learners seem to gravitate - consciously or unconsciously - towards the more effective learning tools. The contrast in Quizlet-usage between high and low performing learners is, therefore, consistent with Fryer and Bovee's (2018, 237) observation that "online contexts can encourage substantial movement of students away from the middle, driving them to the polar ends of subgroup distributions".

However, two caveats are in order at this point: First of all, the more frequent use of recall-based and mixed activities by C1/C2 students is only a tendency and merely approaches statistical significance (Kruskal Wallis $H(3, 165) = 7.311$, $p = 0.063$). This observation, therefore, still requires further corroboration. Secondly, while it is true that A1/A2 students' overuse of the Match task is statistically significant, this observation is based on a sub-sample of only twelve subjects. Again, care needs to be taken in generalising this to other contexts. Nonetheless, this apparently contrasting use of Quizlet activities by high and low competence learners should be a promising target for further research.

4 Conclusion

4.1 Key findings

This paper explored the effectiveness of Quizlet in terms of its uptake, impact on vocabulary retention and patterns of usage among first-year business students.

1. In this context, it was found that about a third of the sample did not engage with the e-learning tool at all.
2. A regression analysis showed that using Quizlet for vocabulary learning had a slightly higher impact on test scores than students' prior English competence.
3. The figures also revealed that Quizlet's recognition-based Match activity did not make a positive contribution to vocabulary growth. By contrast, Quizlet activities which are - at least to some extent - based on recall tasks have been shown to positively impact vocabulary acquisition.
4. Some tentative findings confirmed Fryer and Bovee's (2018) observation that e-learning may cause weaker and stronger learners to diverge even further. The current study suggests that A1/A2 learners tend to overuse the superficially attractive, but ineffective, Match activity, while C1/C2 students were more likely to use the more effective, recall-based tasks.

4.2 Recommendations

Based on the findings above, the following recommendations can be made:

1. The fact that a substantial proportion of students did not use Quizlet suggests that it is not sufficient to assume that digital natives are automatically comfortable with e-learning or motivated to use it. In order to ensure that as many students as possible benefit from technology-enhanced language learning, teacher intervention is imperative in motivating students to engage with online learning activities. Fryer and Bovee (2018, 229) suggest that this may be "as simple as teachers' emphasising the relevance of the e-learning component of the course during the first

two classes", and accordingly "teachers should see this as being an essential part of their role in the classroom" (Fryer and Bovee, 2016, 28).

2. Because of their efficacy for vocabulary retention, the use of recall-based tasks should be encouraged. Depending on the device used, a two-pronged approach is advisable. First, mobile phones are clearly the technology of choice as long as learners are genuinely 'on the go' as this "can multiply the possibilities for learning" (Kukulska-Hulme, 2018, 2). However, under these circumstances the Flashcard activity is to be recommended as it engages learners' language competence more deeply without the need for typing. On the other hand, as soon as students have access to a personal computer, cell phone use should be discouraged and learners instead steered towards recall-based tasks requiring typing, as these are more effective for lexical acquisition.
3. Due to the tendency of lower competence learners to overuse the recognition-based Match activity, particularly these language users should receive clear guidance steering them towards more effective recall-based activities (cf. previous point).

4.3 Limitations

This study is subject to a number of limitations discussed below. First, this research is based on a fairly homogeneous sample of first-year students who already experienced 8-9 years of English instruction. The findings should therefore generalise well to populations with a similar profile. However, for the results to reliably apply to other populations, a larger and more heterogeneous sample would be required. Secondly, the number of subjects (n=165) was large enough to make comparatively robust observations about the sample as a whole. Unfortunately, as soon as the subjects were divided into sub-samples based on their CEF level, especially the groups of A1/A2 and C1/C2 learners turned out to be fairly small. Hence, the study choices attributed to these groups are not based on particularly robust figures, and it would require a larger sample to confirm the tendencies stipulated here. Finally, the data situation in Quizlet generates its own limitations as Quizlet does not provide information about the type of device used to access a given self-study activity. Consequently, all research attempting to associate the choice of electronic device with a specific vocabulary activity requires parallel surveys among users, which, however, yields merely aggregate data, and this in turn introduces substantial uncertainty as to the relevant findings.

References

- Anjaniputra, A., & Salsabila, V. (2018). The Merits of Quizlet for Vocabulary Learning at Tertiary Level. *Indonesian EFL Journal*, 4(2), 1–11.
- Ballance, O. (2012). Mobile Language Learning: More Than Just "The Platform" - A Commentary on Glenn Stockwell's "Using Mobile Phones for Vocabulary Activities: Examining the Effect of the Platform". *Language Learning & Technology*, 14(2), 21–23. Retrieved May 15, 2018, from <http://llt.msu.edu/issues/october2012/ballance.pdf>
- Barr, B. (2016). Checking the Effectiveness of Quizlet as a Tool for Vocabulary Learning. *The Center for ELF Journal* 31, 36–48. Retrieved May 13, 2019, from <https://pdfs.semanticscholar.org/9ce3/35781dee4292083a046040f97898bcd526ff.pdf>
- Browne, C., & Culligan, B. (2008). Combining Technology and IRT Testing to Build Student Knowledge of High Frequency Vocabulary. *The JALT CALL Journal*, 4(2), 3–16
- Butler, A., Roediger, H. (2007). Testing Improves Long-Term Retention in a Simulated Classroom Setting. *European Journal of Cognitive Psychology*, 19(4/5), 514–527.
- Chaikovska, O., & Zbaravska, L. (2020). The efficiency of Quizlet-based EFL vocabulary learning on preparing undergraduates for state English exam. *Advanced Education*, 14, 84–90.
- Chaparro, B., Phan, M., Siu, C., & Jardina, J. (2014). User Performance and Satisfaction of Tablet Physical Keyboards. *Journal of Usability Studies*, 9(2), 70–80.
- Chen, H., & Yang, T. (2013). The impact of Adventure Video Games on Foreign Language Learning and the Perceptions of Learners. *Interactive Learning Environments*, 21(2), 129–141.
- Chien, C.-W. (2015). Analysis [sic] the Effectiveness of Three Online Vocabulary Flashcard Websites on L2 Learners' Level of Lexical Knowledge. *English Language Teacher*, 8(5), 111–121.

- Clark, R., & Mayer, R. (2016). *E-Learning and the Science of Instruction: Proven Guidelines for Consumers and Designers of Multimedia Learning*. Hoboken, N.J.: John Wiley & Sons.
- Cobb, T., & Horst, M. (2011). Does Word Coach Coach Words? *CALICO Journal*, 28(3), 639–661.
- Connolly, T., Boyle, E., MacArthur, E., Hailey, T., & Boyle, J. (2012). A Systematic Literature Review of Empirical Evidence on Computer Games and Serious Games. *Computers & Education*, 59(2), 661–686.
- Coryell, J., & Chlup, D. (2007). Implementing E-Learning Components with Adult English Language Learners: Vital Factors and Lessons Learned. *Computer Assisted Language Learning*, 20(3), 263–278.
- Davie, N., Hilber, T. (2015). Mobile-Assisted Language Learning: Student Attitudes to Using Smartphones to Learn English Vocabulary. *Proceedings of the 11th International Conference on Mobile Learning 2015*, 70–78. Retrieved August, 26, 2019, from https://www.researchgate.net/publication/270550041_Mobile-assisted_Language_Learning_Student_Attitudes_to_using_Smartphones_to_learn_English_Vocabulary
- Deutsch, T., Herrmann, K., Frese, T., & Sandholzer, H. (2012). Implementing Computer-Based Assessment - A Web-Based Mock Examination Changes Attitudes. *Computers & Education*, 58(4), 1068–1075.
- Dickey, M. (2011). Murder on Grimm Isle: The Impact of Game Narrative Design in an Educational Game-Based Learning Environment. *British Journal of Educational Technology*, 42(3), 456–469.
- Dizon, G. (2016). Quizlet in the EFL Classroom: Enhancing Academic Vocabulary Acquisition of Japanese University Students. *Teaching English with Technology*, 16(2), 40–56.
- Dizon, G., & Tang, D. (2017). Comparing the Efficacy of Digital Flashcards versus Paper Flashcards to Improve Receptive and Productive L2 Vocabulary." *The EUROCALL Review*, 25(1), 3–15.
- Eklund, J., & Sinclair, K. (2000). An Empirical Appraisal of the Effectiveness of Adaptive Interfaces for Instructional Systems. *Educational Technology & Society*, 3, 165–177.
- Elgort, I. (2011). Deliberate Learning and Vocabulary Acquisition in a Second Language. *Language Learning*, 61(2), 367–413.
- Findlater, L., Wobbrock, J., & Wigdor, D. (2011). Typing on flat glass: Examining ten-finger expert typing patterns on touch surfaces. In *Proceedings of CHI 2011*, May 7–12, 2011, Vancouver, Canada. 2453–2462.
- Fitzpatrick, T., Al-Qarni, I., & Meara, P. (2008). Intensive Vocabulary Learning: A Case Study. *Language Learning Journal*, 36(2), 239–248.
- Fryer, L., & Bovee, H. (2016). Supporting Students' Motivation for E-Learning: Teachers Matter On and Off-line." *Internet and Higher Education*, 30, 21–29.
- Fryer, L., & Bovee, H. (2018). Staying Motivated to E-Learn: Person- and Variable-Centred Perspectives on the Longitudinal Risks and Support. *Computers & Education*, 120, 227–240.
- Fryer, L., Bovee, N., & Nakao, K. (2014). E-Learning: Reasons Students in Language Learning Courses Don't Want To." *Computers & Education*, 74, 26–36.
- Garris, R., Ahlers, R., & Driskell, J. (2002). Games, Motivation and Learning: A Research and Practice Model. *Simulation and Gaming*, 33, 441–467.
- Girard, C., Ecalle, J., & Magnan, A. (2012). Serious Games as New Educational Tools: How Effective Are They? A Meta-Analysis of Recent Studies. *Journal of Computer Assisted Learning*, 28(6), 1–13.
- Green, R. (2013). *Statistical Analyses for Language Testers*. Houndmills, New York: Palgrave Macmillan.
- Hirschel, R., & Fritz, E. (2013). Learning Vocabulary: CALL Program versus Vocabulary Notebook. *System*, 41, 639–653.
- Hwang, G.-J., & Chang, H.-F. (2011). A Formative Assessment-Based Mobile Learning Approach to Improving the Learning Attitudes and Achievements of Students. *Computers & Education*, 56(4), 1023–1031.
- Ismailova, K., Gleason, K., Provotorova, P., & Matukhin, P. (2017). The Use of Online Quizlet.com Resource Tools to Support Native English Speaking Students of Engineering and Medical Departments in Accelerated RFL Teaching and Learning. *Mechanics, Materials Science, Engineering Journal*, 7, no pages. Retrieved August 2, 2019, from <https://hal.archives-ouvertes.fr/hal-01508618/document>
- Kalecky, R. (2016). *Quizlet vs. Vocabulary Notebook: The Impact of Different Methods of Storing and Revising Vocabulary on Students' Progress, Retention and Autonomy*. Unpublished Master's thesis, Masaryk University.
- Kang, S., McDermott, K., & Roediger, H. (2007). Test Format and Corrective Feedback Modify the Effect of Testing on Long-Term Retention. *European Journal of Cognitive Psychology*, 19, 528–558.
- Kim, S., Son, J., Lee, G., Kim, H. & Lee, W. (2013). TapBoard: Making a Touch Screen Keyboard More Touchable. In *Proceedings of CHI 2013*, April 27–May 2, 2013, Paris, France. 553–562.
- Kohn, K. (2009). Computer Assisted Foreign Language Learning. In K. Knapp, & B. Seidlhofer (Eds.), *Handbook of Foreign Language Communication and Learning* (pp. 573–606). Berlin, New York: Mouton de Gruyter.

- Kukulska-Hulme, A. (2018). Mobile-Assisted Language Learning [Revised and Updated Version]. In C. Chapelle (Ed.), *The Concise Encyclopedia of Applied Linguistics*. Hoboken, N.J.: John Wiley & Sons. Retrieved August 26, 2019, from <https://core.ac.uk/reader/161526368>
- Kukulska-Hulme, A., & Shield, L. (2008). An Overview of Mobile Assisted Language Learning: From Content Delivery to Supported Collaboration and Interaction. *ReCALL*, 20(3), 271–289. Retrieved August 26, 2019, from <http://oro.open.ac.uk/11617/5/11617.pdf>
- Kumar, S., & Tammelin, M. (2008). *Integrating ICT into Language Learning and Teaching. Guide for Institutions*. Linz: Johannes Kepler Universität.
- Lander, B. (2016) "Quizlet: What the Students Think - A Qualitative Data Analysis." In S. Papadima Sophocleous, L. Bradley, & S. Thoušny (Eds), *CALL Communities and Culture - Short Papers from EUROCALL 2016* (pp. 254–259). Dublin: Research-publishing.net. Retrieved August 26, 2019, from <https://doi.org/10.14705/rpnet.2016.eurocall2016.571>
- Laufer, B., Elder, C., Hill, K., & Congdon, P. (2004). Size and Strength: Do We Need Both to Measure Vocabulary Knowledge? *Language Testing*, 21(2), 202–226.
- McLean, S., Hogg, N., & Rush, T. (2013). Vocabulary Learning through an Online Computerized Flashcard Site. *The JALT CALL Journal*, 9(1), 79–98.
- Nakata, T. (2011). Computer-Assisted Second Language Vocabulary Learning in a Paired Associate Paradigm: A critical Investigation of Flashcard Software. *Computer Assisted Language Learning*, 24(1), 17–38.
- Nakata, T., & Webb, S. (2016). Vocabulary Learning Exercises: Evaluating a Selection of Exercises Commonly Featured in Language Learning Materials. In B. Tomlinson (Ed.), *Second Language Acquisition Research and Materials Development for Language Learning* (pp. 123–138). Oxon, UK: Taylor and Francis.
- Özer, Y., & Koçoğlu, Z. (2017). The Use of Quizlet Flashcard Software and Its Effects on Vocabulary Learning. *Dil Dergisi*, 168(1), 61–82. Retrieved June 27, 2019, from <http://dergiler.ankara.edu.tr/dergiler/27/2188/22676.pdf>
- Ozok, A., Benson, D., Chakraborty, J., Norcio A. (2008). A Comparative Study Between Tablet and Laptop PCs: User Satisfaction and Preferences. *International Journal of Human-Computer Interaction*, 24(3), 329–352:
- Pollitt, A. (no date). The Oxford Online Placement Test: The Meaning of OOPT Scores. Oxford University Press. Retrieved April 23, 2019, from <https://www.oxfordenglishtesting.com/defaultmr.aspx?id=3048>
- Purpura, J. (no date). The Oxford Online Placement Test: What Does It Measure and How? Oxford University Press. Retrieved April 23, 2019, from <https://www.oxfordenglishtesting.com/defaultmr.aspx?id=3048>
- Quizlet. (2019). Quizlet: Company and Mission. Retrieved August 26, 2019, from <https://quizlet.com/mission>
- Robertson, C. (2015). Implementing an Online Vocabulary Training Program. In F. Helm, L. Bradley, M. Guarda, & S. Thoušny (Eds), *Critical CALL - Proceedings of the 2015 EUROCALL Conference, Padova, Italy* (pp. 486–489). Dublin: Research-publishing.net. Retrieved August 26, 2019, from <http://dx.doi.org/10.14705/rpnet.2015.000380>
- Sandberg, J., Maris, M., & Hoogendoorn, P. (2014). The Added Value of a Gaming Context and Intelligent Aadaptation for a Mobile Learning Application for Vocabulary Learning. *Computers & Education*, 76, 119–130.
- Shadiev, R., Hwang, W.-Y., & Liu, T.-Y. (2018). Investigating the Effectiveness of a Learning Activity Supported by a Mobile Multimedia Learning System to Enhance Autonomous EFL Learning in Authentic Contexts." *Educational Technology Research and Development*, 66, 893–912.
- Smith, G., Li, M., Drobisz, J., Park, H.-R., Kim, D., Smith, S. (2013). Play Games or Study? Computer Games in E-Books to Learn English Vocabulary. *Computers & Education*, 69 (2013) 274–286.
- Stroud, R. (2014). Student Engagement in Learning Vocabulary with CALL. In S. Jager, L. Bradley, E. J. Meima, & S. Thoušny (Eds), *CALL Design: Principles and Practice; Proceedings of the 2014 EUROCALL Conference, Groningen, The Netherlands* (pp. 340–344). Dublin: Research-publishing.net. Retrieved August 26, 2019, from <https://files.eric.ed.gov/fulltext/ED565152.pdf>
- Than, T., Ngoc, N., & Linh, N. (2018). Blending Quizlet and Edmodo for designing English vocabulary practices: An experimental study. *TNU Journal of Science and Technology*, 186(10), 153–158.
- Thompson, T., & MacDonald, C. (2005). Community Building, Emergent Design and Expecting the Unexpected: Creating a Quality E-Learning Experience. *The Internet and Higher Education*, 8(3), 233–249.
- Tight, D. (2010). Perceptual Learning Style Matching and L2 Vocabulary Acquisition. *Language Learning*, 60(4), 792–833.
- Tondeur, J., van Braak, J., Ertmer, P. & Ottenbreit-Leftwich, A. (2017). Understanding the Relationship between Teachers' Pedagogical Beliefs and Technology Use in Education: A Systematic Review of Qualitative Evidence. *Educational Technology Research and Development* 65, 555–575.

- Tran, P. (2016). Training Learners to Use Quizlet Vocabulary Activities on Mobile Phones in Vietnam with Facebook. *JALT CALL Journal*, 12(1), 43–56.
- Vargas, J. (2011). *Modern Learning: Quizlet in the Social Studies Classroom*. Unpublished Master's thesis, Wichita State University.
- Wang, T.-H. (2010). Web-Based Dynamic Assessment: Taking Assessment as Teaching and Learning Strategy for Improving Students' E-Learning Effectiveness. *Computers & Education*, 54(4), 1157–1166.
- Wang, T.-H. (2011). Implementation of Web-Based Dynamic Assessment in Facilitating Junior High School Students to Learn Mathematics. *Computers & Education*, 56(4), 1062–1071.
- Wang, T.-H. (2014). Developing an Assessment-Centered E-Learning System for Improving Student Learning Effectiveness. *Computers & Education*, 73, 189–203.
- Wang, T.-H., & Chiu, Y. (2011). Assessing E-Learning 2.0 System Success. *Computers & Education*, 57, 1790–1800.
- Waring, R., & Takaki, M. (2003). At What Rate Do Learners Learn and Retain New Vocabulary from Reading a Graded Reader? *Reading in a Foreign Language*, 15, 130–163.
- Webb, S. (2007). The Effects of Repetition on Vocabulary Knowledge. *Applied Linguistics*, 28, 46–65.
- Winters, F., Greene, J., & Costich, C. (2008). Self-Regulation of Learning within Computer-Based Learning Environments: A Critical Analysis. *Educational Psychology Review*, 20(4), 429–444.
- Wolff, G. (2016). Quizlet Live: The Classroom Game Now Taking the World by Storm. *The Language Teacher*, 40(6), 25–27.
- Wouters, P., van Nimwegen, C., van Oostendorp, H., & van der Spek, E. (2013). A Meta-Analysis of the Cognitive and Motivational Effects of Serious Games. *Journal of Educational Psychology*, 105(2), 249.
- Wright, B. (2016). Transforming Vocabulary Learning with Quizlet. In P. Clements, A. Krause, & H. Brown (Eds.), *Transformation in Language Education* (pp. 436–440). Tokyo: JALT. Retrieved August 8, 2019, from <https://jalt-publications.org/files/pdf-article/jalt2016-ppc-057.pdf>
- Wu, Q. (2015). Designing a Smartphone App to Teach English (L2) Vocabulary. *Computers & Education*, 85, 170–179.
- Xerou, E., Papadima-Sophocleous, S., & Parmaxi, A. (2016). A Social Constructionist Approach to Teaching and Learning Vocabulary for Italian for Academic Purposes. In S. Papadima-Sophocleous, L. Bradley, & S. Thouësny (Eds.), *CALL Communities and Culture - Short Papers from EUROCALL 2016* (pp.485–489). Dublin: Research-publishing.net. Retrieved August, 26, 2019, from <https://doi.org/10.14705/rpnet.2016.europcall2016.611>
- Xue, G., Dong, Q., Chen, C., Lu, Z., Mumford, J., & Poldrack, R. (2010). Greater Neural Pattern Similarity across Repetitions Is Associated with Better Memory. *Science*, 330(6000), 97–101.
- Yang, F.-C., & Wu, W.-C. (2015). Using Mixed-Modality Learning Strategies via E-Learning for Second Language Vocabulary Acquisition. *Technology & Society*, 18(3), 309–322.