# Metacognition and Mobile-Assisted Vocabulary Learning

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**Abstract**
Mobile Assisted Language Learning, known as MALL, is an approach to language learning that is enhanced through the use of a mobile device, such as mobile phones. The ubiquitousness of mobile phones has opened up more platforms for vocabulary learning, resulting in increased metacognition among learners; which can be seen as a predictor of successful vocabulary learning.This article describes the results of a study conducted on 21 undergraduates that analysed the most frequently used activities facilitating self-directed mobile-assisted vocabulary learning outside the classroom based on the pedagogical framework for mobile assisted language teaching and learning. The study also looked into to the extent these activities enhanced the learners' metacognition. Data was collected from video reports, interviews and an activity log, and analysed according to the pedagogical framework for mobile assisted language teaching (Kukulska-Hulme, Norris, & Donohue, 2015). The findings revealed that the most frequent activities utilized outside the classroom were (1) using online dictionaries to assist with understanding word meanings, (2) using video features on their phones for speaking and pronunciation practice of new words and (3) posting on social media as a means of practicing their newly acquired vocabulary in writing. The self-directed nature of these activities were reported by the participants as enhancing their metacognitive skills, resulting in increased learner confidence and deeper gains in vocabulary learning. The implications of these findings are discussed.
*Keywords*: affordances, metacognition, mobile-assisted language learning,  vocabulary learning,

**Introduction**

Mobile assisted language learning (MALL), considered as the next generation of Computer assisted language learning (CALL), is a progression from a bulky desktop or laptop to a portable device offering the same technological conveniences (Looi, Seow, Zhang, Chen & Wong, 2010; Tai, 2012). The proliference of smartphones and other handheld devices has further developed both the scope and range of learning activities as well as dimensions of learner autonomy (Benson, 2007), by giving learners greater responsibility and flexibility over the direction of their own learning.

The language learning process has benefited from this flexibility by enabling learners to take advantage of a "seamless learning space" (Chan et al., 2006, p. 5), where one can learn anywhere, anytime, using affordances that harness functional and meaningful properties of the environment (Gibson, 1977). Inherently, technological affordance provides the potential for increased metacognition which is positively associated with greater gains in learning by enabling learners to keep track of their learning progress, who now have more options of utilizing self-directed learning strategies.

This element of control over the learning process is optimally channeled by MALL in that the "learning space is thus augmented or expanded and becomes a means of looking outwards and making connections" (Kukulska-Hulme, 2012, p.2). Learning resources such as formal online learning portals and mobile vocabulary learning apps are now available 24/7, and these impromptu sites of learning create an ecologyfor learners to manipulate according to their learning requirements (Luckin et al., 2010). In short, learners can learn language seamlessly and at any time, sometimes without even having to be conscious of the learning process.

These current developments in MALL have given rise to new and exciting areas for research. However, studies that focuses on the intersect between mobile assisted language learning, vocabulary learning and metacognition is still in its developmental stage (Azevedo, 2005) and therefore warrants further exploration.

Furthermore, vocabulary learning, regardless of whether it is enabled by a mobile device or otherwise, is a life-long endeavor that extends beyond the classroom. In short, one is constantly having to learn new words as technology develops and impacts lives. Presently, there is still a lack of research that involves a qualitative inquiry into how learners engage with their mobile devices independently for vocabulary learning. Current research focuses mostly on specific classroom activities and instructor designed apps, which may be beneficial in a language classroom; but what happens when the semester is over? In other words, how do learners engage in vocabulary learning without a classroom, language instructor, and formal syllabus; using their mobile phone? How are metacognitive processes affected when using the mobile phone in managing one's learning? This paper addresses these questions.

**Vocabulary Learning and MALL**

Vocabulary learning is a cognitive process that involves creating an understanding of words in both form and meaning. Knowing a word means having knowledge of collocations, connotations, and grammatical forms (Nation, 2006). Building a strong vocabulary knowledge is

critical to effective reading comprehension, and the earliest notion of vocabulary knowledge begins with what Richards (1976) posits as being the 7 aspects of knowing a word, which are "syntactic behavior, associations, semantic value, different meanings, underlying form and derivations" (in Shen, 2008, p.136). Vocabulary knowledge is also seen by Goulden, Nation and Read (1990) as having receptive and productive properties, which incorporates form, grammatical pattern, meaning, function, and relation with other words. Formal activities for learning vocabulary often featured these elements to ensure that learners could use new words effectively and appropriately.

When mobile phones became ubiquitous, they were introduced in classroom activities for language learning. By harnessing the affordances within the smartphone, learners were able to pitch the learning processes and manage content according to their own levels, temporal availability, and convenience, resulting in a more adaptable learning space. Mobile devices can produce unique educational affordances in that they provide "portability, social interactivity, context sensitivity, connectivity, and individuality" (Klopfer, Squire & Jenkins, 2002, p. 95). Additionally, the smartphone enables the learner to engage in more meaningful learning processes, whereby these affordances can function specifically as tools for "multimedia-access, connectivity, capture, and as a representational and analytical tool" (Churchill, Fox &King, 2012, p.252). Thus, the learner is able to utilise the device in any way that is convenient and beneficial to engage more meaningfully and independently in the learning process.

The earliest application of mobile- assisted language learning was in vocabulary learning (Stockwell, 2010). Researchers took full advantage of the existing on-campus infrastructural conveniences that enabled language instructors to update and access materials to distribute to students, as well as keeping records for tracking students' work. Earlier studies were conducted within classroom settings and were primarily teacher-centered, in that the learning activities or modules were designed by the instructor. Thus, this initial stage of exploring the application of mobile technology in vocabulary learning was top-down, with the learner not being given the autonomy for choosing what and how to learn. These earlier studies were experimental in nature and activity-based, usually building upon the concept of flashcards to augment knowledge structures (Browne & Culligan, 2008), as well as viewing videos describing idioms (Thornton & Houser, 2005) to aid in the contextual understanding of vocabulary. Chen, Hsieh, and Kinshuk (2008), who examined the role of short-term memory when acquiring meanings of newly learned words, found evidence that graphic–annotations of word meanings were of some benefit to learners with lower verbal ability. In short, vocabulary enrichment activities involving the mobile phone in its earlier incarnations were little more than modified pen-and-paper activities that hinged on the novelty effect of having a new toy to experiment with. Nevertheless, positive reactions to this new mode of learning were reported (Stockwell, 2010; Kukulska-Hulme, 2012).

There were also studies that focused on learner-directed learning. These studies were the antithesis of a structured approach, in that the researchers attempted to harness what was already available on the mobile phone (such as email or browsing) to explore the potential of the mobile phone as a learning device. For instance, studies such as that of Kiernan and Aizawa (2004) studied how sending emails "could assist in teaching targeted structures" (in Stockwell, 2010, p.95), Taylor and Gitzaki (2003) studied using the browser functions to conduct Internet searches, while

Levy and Kennedy (2005) looked into sending notifications through SMS. However, some teething issues were reported with these types of activities. Stockwell (2010), for example, who looked into how learners tried to complete listening-based vocabulary activities, found that despite positive attitudes towards mobile phone technology, the momentum for use dropped as the study wore on, with students citing issues such as "cost, screen size, and inconvenient keypad" as reasons. Thus, once the learners were outside the classroom sustaining the use of the smartphone became a bigger challenge.

When Android launched in 2008, technology caught up with the demands of users and some of these issues became irrelevant. After the launch of iPhones (in 2007) and further expansions of Android platforms, the direction of MALL took on a different, more exciting turn. With the Internet now ubiquitous, and vocabulary and language learning apps more available; learners had greater flexibility and options than ever before. Although recent studies have tracked mobile phone usage outside the classroom to study emerging patterns (Stockwell, 2013),  there is still a lack of qualitative research that studies how learners "engage in mobile learning outside the classroom" (Stockwell, 2013, p.118), without having to depend on the use of specially designed apps, which provides justification for the current study.

## MALL, Vocabulary Learning and Metacognition

Cognitive and metacognitive processes are the building blocks of vocabulary learning. Cognition refers to the "mental process by which external or internal input is transformed, reduced, elaborated, stored, recovered, and used", and incorporates "perception, attention, memory coding, retention and recall, decision-making, reasoning, problem-solving, imaging, planning, and executing" (Neisser, 1967,  as cited in Pawlik et al., 2006, p.3), while metacognition can be seen as the act of thinking about thinking; and refers to "the knowledge about and regulation of one's cognitive activities in learning processes" (Flavell, 1979,  as cited in Veenman et al., 2006, p.3). It could be seen that in the active process of learning vocabulary, metacognition seems to be embedded within the cognitive process itself.

Cognition and metacognition interplay during self-directed tasks such as incidental vocabulary learning, which is the act of learning vocabulary that is not limited to the classroom, but which expands beyond it. Incidental learning is learning that progresses organically, driven by the learner and often takes place in informal yet input-rich environments, such as by watching a movie or short video in the target language, and is defined by Schmidt as "learning without the intention to learn" (1994, p.173). Incidental vocabulary learning can positively aid vocabulary development during reading by providing a context for the target word, thereby encouraging learners to guess the meanings from the context available (Huckin &Coady, 1999).  When a target word or words frequently occur in the text, and there is sufficient contextual scaffolding for the reader to bridge gaps in understanding, there is increased potential for memory retention due to increased exposure (Reynolds, Wu, Liu, Kuo & Yeh, 2015).

Metacognition plays a strong role in influencing positive gains in vocabulary development, as indicated by current research (Ma, 2013; Ebner & Ehri 2013; Vandergrift, 2012; Gollek & Doherty, 2016). Vocabulary learning especially requires metacognition as there will be many instances when learners are confronted with a familiar word that suddenly seems to take on a new

meaning in a new context. For example, the word "bank" could have different meanings in "*bank in the money*" vs "*the plane banked to the left*").  In this case, the learner must implement Problem-solving and Evaluation strategies to enable more understanding of the meaning of the word. Other metacognitive strategies such as Planning (in the form of setting targets, making learning schedules, and identifying learning "buddies"), and also Monitoring; where they can both plan their learning as well as monitor their progress, such as by using instructor's feedback during classroom learning, can be utilised for managing their learning progress.  Traditionally, the point of reference for the learner would be the instructor, or a more advanced peer. However, now that there is mobile technology in hand, the potential sources for reference are increased manifold. We shall see how this influences the framework for learning in the next section.

**Pedagogical Framework for Mobile Assisted Language Teaching and Learning**
        Current research on mobile learning is still in its developmental phase, where studies are mostly descriptive, with an emphasis on experimental studies (Viberg & Grönlund, 2013).  At present, there is a lack of qualitative research that studies how both cognitive and metacognitive are impacted by mobile assisted language learning, which justifies the current study on how learners conduct their vocabulary learning using mobile phones outside the classroom, without the confines of an instructor, formal class schedules, and a syllabus.  Additionally there is also a lack of theoretical and conceptual frameworks that capture the *learning process* of mobile assisted vocabulary development (Viberg & Grönlund, 2013), despite the existing frameworks that attempt to capture vocabulary acquisition from a pedagogical perspective.

        There have been some attempts to capture the mobile learning process, such as the Theory of Mobile Learning, which views learning as a "cultural-historical activity system" featuring a semiotic system that facilitates activities through "cultural tools and signs" (Sharples, Taylor, & Vavoula, 2007, p. 11).  This theory has contributed to an understanding of how technology is viewed from a user perspective, and underscores the interaction between man and machine to achieve a learning goal. Its limitation is that it was not operationalized clearly, perhaps partly due to the rapid developments of technology.

        One pedagogical model that attempts to encapsulate both the teaching and learning process using a mobile centred approach is the one proposed by Kukulska-Hulme, Norris, & Donohue, (2015).  Known as the *pedagogical framework for mobile assisted language teaching and learning,* it highlights how mobile devices can be optimally used for exploring new linguistic boundaries for learning, such as through:

> …creating and sharing multimodal texts, communicating spontaneously with people anywhere in the world, capturing language use outside the classroom, analyzing their own language production and learning needs, constructing artefacts and sharing them with others, and finally providing evidence of progress gathered across a range of settings, in a variety of media.(Kukulska-Hulme, Norris, & Donohue, 2015, p. 7).

The framework espouses the use of the mobile device as a starting point to be used in the classroom, upon which the learner must then embark on self-directed activities to further consolidate the learning. It consists of 4 main concepts which serve as considerations when

selecting or designing a teaching/learning task, namely *outcomes, inquiry, rehearsal* and finally *reflection*. *Outcomes* relates to the extent the task can result in improved language proficiency, while *Inquiry* refers to how the task adapts itself to changing situations of use. *Rehearsal* focuses on how a learner can maximize the potential for practice, while *Reflection* entails self-awareness on the learning progress. This framework shall be used to capture and analyse the findings of the current study by investigating how these concepts are actualized during incidental learning.

**Methodology**

This phenomenological study was that of a single, instrumental case study (Stake, 1995), where the researchers focused on the issue of concern and then selected a bounded case to highlight this issue (Cresswell, 2013). We deemed the case study approach as being the most suitable for the purposes of this study as it investigated the most frequently used activities that assist vocabulary learning using a mobile device and delved into how the smartphone was utilized by the participants. It is also due to the fact that since the actions of the participants were not modified in any way, the context in which the study took place was also the focus of the study, and there was little that demarcated between the context and phenomenon being studied (Yin, 2003;  as cited in Baxter &Jack, 2008).

*The participants*

Twenty one   volunteers comprising nine female and twelve male freshmen agreed to record and report their use of the smartphone in their vocabulary learning over a 14-week period. They were all students enrolled in a language-based elective paper called, *Critical Reading and Thinking*, which featured an emphasis on the development of reading skills; and came from a range of majors - Actuarial Science, Applied Mathematics with Computing, Physics, Quantity Surveying, and Mechanical Engineering; all of which are 3-year degree programs. The course was aimed at teaching the learners how to read and respond critically to reading texts, and featured many vocabulary learning activities, as well as exposure to different rhetorical structures.

The respondents were selected based on their level of articulateness, their ability to express their opinions clearly and to provide rich descriptions of their activities and experiences, as well as being able to engage in learning activities independently.  This was crucial as their responses would serve as the primary source of data for the study and a rich description would provide for better analysis.

The participants were briefed on the objectives of the study and were given free rein to engage in and explore their use of their smartphone in vocabulary learning. They were asked to pay attention to not only how they used the smartphone in vocabulary learning, but also how they used it when managing their learning. A summary of the participants' details are presented below.

Table 1
*Participants' details*

| Course | No | Gender Male / Female | | Percentage |
|---|---|---|---|---|
| Actuarial Science | 6 | 4 | 2 | 28.6% |
| Applied Mathematics with Computing | 4 | 3 | 1 | 19.0% |
| Physics | 1 | - | 1 | 4.8% |
| Quantity Surveying | 5 | 2 | 3 | 23.8% |
| Mechanical Engineering | 5 | 3 | 2 | 23.8% |
| **TOTAL** | **21** | **12** | **9** | **100%** |

**Research Design &Data Collection**

The participants were instructed to record and report not only the activities related to vocabulary learning, but also how this affected their metacognitive processes. They were instructed to record their thoughts in their smartphone in the form of video reports to enable the immediate capture of experiences and to keep the report data 'fresh'. These video reports were later transcribed, and then analyzed for emerging themes. They were also expected to update an Activity Log with a description of their most frequent activities.

Upon completion of the project, the learners submitted their video data and completed Activity Logs to the researchers for analysis. The following questions were used as a guide for the data analysis.

1. What are the sites most frequently visited when using the smartphone for vocabulary learning outside the classroom?
2. Do learners prefer to guess meanings of words or refer to an online dictionary instead?
3. What are the features in the smartphone that are most frequently used during vocabulary learning?
4. How do learners use their smartphones when practicing new words?
5. How do learners use their smartphones when planning and monitoring vocabulary learning?
6. How do learners use their smartphone when gauging their progress in vocabulary learning?

**Findings**

A total of 16 hours of data from the video reports submitted by the participants, together with data from their Activity Log were collected and then analysed for recurring themes.  For this study we have decided to utilize the framework by Kukulska-Hulme, Norris, & Donohue (2015) for analyzing the findings as it adequately captures the domains covered.

The following table lays out the categories of findings, mapped against Kukulska-Hulme, Norris and Donohue's *pedagogicalframework for mobile assisted language teaching and learning* (2015).  Although the framework covers both the teaching and learning aspects of MALL, this table shall focus on the vocabulary learning aspects as described and reported by the participants,

as the emphasis of the current study is self-directed mobile-assisted vocabulary learning outside the classroom.

Table 2
*Categories of findings*

| | | *Activities* |
|---|---|---|
| INQUIRY | How does the activity relate to ever changing contexts of language use? | Accessing reference sites , eg: online dictionaries, online thesauruses<br>Accessing relevant reference sources related to topics studied in other classes |
| REHEARSAL | How does the activity make the most of circumstances and resources to enable more practice? | Blog posts, Facebook newsfeed updates and comments, and participation in online forums<br><br>Internet access, capture tool , video function |
| REFLECTION | How does the activity design ensure reflection on learning? | Planning, monitoring, problem-solving and evaluation |
| OUTCOMES | How does the activity lead to improved language proficiency and other outcomes? | Writing updates on learning portals<br><br>Blog posts, Facebook newsfeed updates and comments, and participation in online forums |

As can be seen in the table above, the participants reported using their smartphone for learning language and vocabulary in various ways. The following section presents a deeper analysis of the findings according to each research question.

RQ 1: *What are the sites most frequently visited by learners when using the smartphone for vocabulary learning outside the classroom?*
The participants reported that the sites that they most frequently visited for vocabulary learning were online dictionary sites, such as www.oxfordonline.com, as they were felt to be the most useful sites for looking up words. They found these sites easy to access, convenient to use, and useful for learning not only new words, but also new meanings of words that they already knew. They felt that learning the antonyms and synonyms of words was more effective through these sites, as these items were placed side-by-side on the page, or linked. The same is true when it came to learning about meanings of idiomatic expressions.  The participants reported that content in online dictionaries is more updated than that in regular dictionaries, and since online dictionaries are more convenient to use, accessible, and less cumbersome, this resulted in more frequent use. In other

words, this increased interaction with the online dictionary resulted in a greater volume of newly learned words.

> *Online dictionaries are…very convenient for me to use. I can also learn more words and meaning (sic)…it's faster and I can understand better because...I don't forget.*
>
> *Participant A, 22 (Physics major)*

> *I like to find out the opposite meaning...I mean, antonym! Yes antonym…also I check for the synonym too, in case I read [come across] that word again later...in different form…(sic)...I think it's good to learn more meanings for the same word…very useful in writing...you can explain better…*
>
> *Participant B, 21 (Actuarial Science major)*

RQ 2: *Do learners prefer to guess meanings of words or refer to an online dictionary instead?*
When asked about contextual guessing for understanding meaning, the participants' response was unequivocal – guessing the meaning of words was no longer a popular strategy. This was also the finding of Supian (2012), who reported that guessing is no longer seen as a favoured vocabulary learning strategy use due to its instability and Frankenberg-Garcia (2011) and Dziemianko, (2010), who found that learners no longer relied on guessing from contextual cues to 'figure out' the meaning of a word as the dictionary in their mobile phone, or online dictionaries, can provide the answer within seconds. Guessing was now seen as risky, and "this kind of risk-taking can be counter-effective when applied wrongly" (Doczi, 2011, p. 34). When students rely on inferences based on word form associates rather than actual cues from the text, the outcome is incorrect word-meaning determination (Bensoussan & Laufer, 1984). In short, learners preferred to be *decidedly certain* rather than take the risk of being *potentially wrong*

> *I feel...very frust (sic) because I spend so much time trying to look for clues...like the lecturer said...for the meaning of the word (sic)...and then I find that I still cannot understand the word, and now I cannot understand the passage also! It make (sic) me want togive up…also sometimes when I try to guess I cannot because I got (sic) the context also wrong, so now everything [is] wrong also!*
>
> *Participant C, 21 (Financial Mathematics major)*

> *I feel it's a waste of my time to be guessing...I have been wrong so many times that now I (am) scared...so I might as well refer to online dictionaries so that I don't waste time.*
>
> *Participant B, 21 (Actuarial Science major)*

RQ3 : *What are the features in the smartphone that are most frequently used during vocabulary learning?*
The participants reported using the Internet most frequently to access online dictionaries; read short articles on the way home on the train, bus, or car; access virtual learning portals such as weble (web-based learning environment) to download lecture notes, additional reading materials, and tutorial worksheets; and also access announcements and information uploaded by the

instructor. It was also used as a capture tool to record anything that can be considered of value to the participants (such as notes on the whiteboard), and to record the students' practice for presentations.

> *Normally I use the phone...to download all my notes so that I can read ahead. Then I can print my materials at home. Also, I download tutorial worksheets...it is easier...however I find that referring to tutorial worksheets can be a problem if I have low battery. The phone screen will switch to save mode...so I need to remember to bring my power bank!*
>
> *Participant C, 21 (Applied Mathematics with Computing major)*

> *[I]got use Internet access (sic) a lot…I use it to refer to wble and the online dictionary..*
>
> *Participant D , 22 (Actuarial Science major)*

> *For myself I use my phone for reading articles on the train home…to get to my house usually take (sic) about 1 hour so I use that time to read..*
>
> *Participant E, 22 (Financial Mathematics major)*

> *I use the smartphone for capturing notes on the whiteboard…this way I won't lose them so it is easy to keep and store.*
>
> *Participant F, 22 (Financial Mathematics major)*

> *My lecturer recommended using the phone to practise and prepare for oral presentation...so I tried it...I record my presentation at home so that I can check my pronunciation…if got correct or not...clear or not…like that ..(sic)*
>
> *Participant G, 22 (Actuarial Science major)*

RQ 4 : *How do learners use their smartphone when practicing newly learned words?*
The participants reported using the video feature on their smartphone to record their presentation practice to prepare for their oral presentations. This was to ensure that newly learned words were correctly pronounced. Prior to that, they reported clicking on the speaker icon available on online dictionaries to check for the correct pronunciation of a word. They then used that as a model for their own pronunciation practice.

This gave the participants more confidence that they were pronouncing the words correctly. Weaker learners reported feeling a lack of confidence in speaking, and the fact that whenever they were laughed at, or scolded for mispronunciation in the past, that experience was often hurtful and embarrassing. These negative experiences resulted in their being afraid to try and speak in public. However, once they were able to model the correct pronunciation, they reported that they were more willing to try out new words and phrases. In short, they reported increased feelings of motivation to try out words and phrases in both formal activities in class, and informal activities such as discussions with friends and family members.

The participants also reported that they used these new words in their writing. They had their own Facebook accounts, and they were encouraged to respond to newsfeed updates, using

their newly learned words. Some of them responded that they were able to add new friends from foreign countries, as they were more confident now in their writing abilities. A few participants even reported that they received feedback on their new 'bombastic' language!

Apart from Facebook, they were also encouraged to write comments on articles written in online news portals or blogs related to subjects of interest. They reported trying as much as possible to write in complete and grammatical sentences to avoid misunderstanding. The range of sites visited varied from cooking blogs to news portals to videogame reviews. The participants reported uploading their comments to give feedback, and reported feeling very happy when other users 'green arrowed' or 'liked' their comments.

> *I learn new words but then I don't know how to pronounce…so I click on the speaker icon to listen…get UK and American pronunciation...so I try both. I make sure that I try and use the words in sentences with my girlfriend...she also get (sic) to learn new words...I am more confident in my pronunciation now as compared to before...*
>
> *Participant D, 22 (Actuarial Science major)*

> *It is useful for practice...like when I got (sic) oral presentation due...can get very stress (sic)...when I stress (sic) I tend to be very nervous...then my pronunciation also can become wrong like that…(sic)...my lecturer suggested I practice and record myself...so I tried...now I see what I need to improve..*
>
> *Participant B, 22 (Quantity Surveying major)*

> *My Facebook has been buzzing with newsfeed since I started participating in this study...I have been uploading comments on issues that I post….some of my friends also post comments. Sometimes we even argue about issues. II can structure my argument better now…got comment (sic) the other day...wahh, your English now so bombastic! What happened to you!...haha I felt kind of happy...that my writing has improved a bit....*
>
> *Participant C, 21 (Applied Mathematics with Computing major)*

RQ 5 : *How do learners use their smartphone when planning and monitoring vocabulary learning?* The participants reported using the smartphone features such as the calendar for organizing their schedules. According to the data gleaned from the interviews, MALL has resulted in new affordances that enable greater learner autonomy, with increased flexibility and choices for planning and managing learning. More conveniences for managing time and communication have been incorporated into the smartphone standard features, and participants reported using Gantt charts and project timelines to assist them in their formal learning. Some participants also reported using tools for planning—scheduling meetings and calendar appointments with pre-set alarm reminders on deadlines that are synced with those of other members. However, these features were mainly utilised in formal learning tasks, especially in managing group assignments for other courses that semester.

    The participants in this study did not use the above features for managing their learning of vocabulary as they felt that they would 'get in the way' of actual learning. They reported that they

did not see the sense in spending time to keep a record of the management of their learning; instead, they preferred to incorporate their incidental vocabulary learning with other cognitive learning tasks, such as reading.

> *No, I don't keep track of the learning process...waste of time, right? Afterall, we have other things to do...so much (sic) of assignments...so because of that I am too busy..*
>
> *Participant B, 22 (Quantity Surveying major)*

> *If we want to keep track like that...it is difficult because we have no time to do so…*
>
> *Participant D, 22 (Actuarial Science major)*

RQ 6 :*How do learners use their smartphone when gauging their progress in vocabulary learning?*
The participants reported that they were able to gauge their development by participating in language activities like chats and forums, and receiving feedback on their vocabulary use. They also reported using messaging services, video uploads, and live feedback sessions in online message boards.  When the participants wished to have group chats, they used the Whatssap and Viber messaging services to coordinate their discussions. An added feature to Whatssap is that users can upload videos and captured photos to share with others. Some of the participants found this to be a particularly enjoyable activity as their friends could post comments featuring newly-learned adjectives – for example,"I watched a movie with my girlfriend (last weekend) ... I liked it but she found it *pedantic"*.  The participants contributed to this exercise organically and on their own volition, so there was more interest in the discussion. Feedback was given freely and the participants were able to gauge their vocabulary learning based on their contribution and involvement in the chats with their peers.

Gaining individual feedback from instructors has also been positively impacted by MALL. The participants responded that getting feedback from their instructor is important for their development; however, they realised that most instructors faced time and logistical constraints and would not be able to provide feedback to every student. The solution to this problem, as mutually agreed upon by both instructor and student, was the use of open-review using peer-assessment of writing. Peer-assessment has a lot of potential for monitoring vocabulary learning through collaborative feedback, resulting in greater interaction and sharing among students regarding learning performance. It also has the potential for more focused cognitive engagement; because since the work is to be shared, viewed, and critiqued, students try harder to write well.  This could be done formally in class, or it could be done informally as a group.
Unfortunately, only two participants reported doing this for informal learning. The others reported doing so only when they wanted to discuss their group assignments. The two participants who used peer-assessment were taking part in a writing competition; and thus it did not count as part of their formal learning process. The technological demands were simple; they simply uploaded a captured photograph of what they had written on WhatsApp and requested for

comments and feedback from their peers. Their friends gave feedback, although most of it was hollow; for example, "It looks ok..".

*WhatsApp is very easy to use...and since we live quite far from each other, group discussions we can do … (sic) using Whatssap.*
*Participant F, 22 (Financial Mathematics major)*

*Yes, we tried using Whatssap...to prepare for the writing competition..we managed to get some friends to critique and give feedback…but not all the feedback was helpful...or useful..*
*Participant C, 21 (Applied Mathematics with Computing major)*

The participants who attempted to provide peer feedback reported that while it was a useful technique in evaluating performance, they still preferred validation from an instructor-led assessment. However, messaging services could still be of use for uploading and sharing relevant videos, brainstorming for ideas, and creating shared lists that can be updated and critiqued in real time.

**Discussion**

These findings provide evidence demonstrating the link between learner-driven practices/activities for vocabulary development and increased metacognition, suggesting that the use of the smartphone has positively impacted the learning process, consistent withKukulska-Hulme'spedagogical framework for mobile assisted language teaching and learning. While the process of looking up words in a dictionary still remains the same, the smartphone has now made it more convenient, quick, and productive since word meanings are presented within seconds; and with links to additional information such as synonyms, antonyms and corresponding parts of speech that enables contextualized vocabulary learning. This provides deeper learning gains in vocabulary knowledge and supports the *Inquiry* phase of the framework.

Furthermore, there is also the spillover effect–because using an online dictionary is so convenient, it results in increased engagement and frequency of use, with positive outcomes for vocabulary learning. These findings are similar to those of other studies, such as Doroszewska and Lew's (2009), who found that high retention rates were reported among their participants due to "the engagement value … and the flexibility to look up words in the pattern that suits the individual preferences of the student" (p. 252), and also that of Dalton and Grisham (2011), Levy (2009), Loucky (2005), and Prichard (2008).

Furthermore, it can be seen that the vocabulary learning in this setting is more personalized to the learners' interests, levels, and needs, rather than externally set by the instructor. This resulted in more depth of processing, especially in building and consolidating knowledge schemas of words and concepts to enable the effective comprehension of reading since the cognitive process of comprehension involves "lexical access to retrieve word meanings, memory retrieval to elaborate on the text, and forming connections to prior knowledge" (Moss et al, 2011, p. 675). Hence, it stands to reason that being exposed to different views on an issue reinforces existing knowledge schemas, thus improving memory retention (see Majerus et al., 2006; Leclercq et al., 2010).

The results also show that the learners had less tolerance for ambiguity when learning new vocabulary. When there is a possibility of misunderstanding a word, the participants reported that they were more confident of getting the correct answer right away by using online dictionaries, as opposed to taking the time to make 'intelligent guesses'. Guessing is also viewed by these students as being fraught with risks, because, as Laufer, et al. (1998) have argued, without sufficient vocabulary size and knowledge, it is a fruitless activity that could result in more confusion. One participant highlighted that making inferences without an online dictionary was only resorted to "during examinations, when they (the invigilators) instruct us to switch off our phones". Apparently, this is the only time that old-fashioned inference is used by these students.

This is a major departure from previous findings that indicated guessing as one of the most popular vocabulary learning strategies (Huang & Eslami, 2013).Indeed, in some English courses, guessing as a skill was even taught in class. Guessing was seen as plugging the gaps in the understanding of texts, and usually incorporated knowledge of "linguistics, strategies, and the world" (Nagy, 1995  as cited in Huang & Eslami, 2013, p.2). Oxford describes contextual guessing as the use of linguistic and non-linguistic clues; the former referring to semantic or syntactic knowledge while the latter referring to knowledge of "context, text structure, and general world knowledge" (Oxford, 1990; as cited in Huang & Eslami, 2013, p.2).  It used to be that guessing from context "showed positive correlation with vocabulary size and general language proficiency" (Gu & Johnson, 1996, p. 667).However, this process had its inherent drawbacks, namely time and inconvenience. Another was the accuracy of the guess, in that a learner could very well have misinterpreted the context wrongly, or got the context right but the word meaning completely wrong. This usually resulted in slower reading and demotivated learners (Laufer et al., 1998).

A positive finding of this study is that the participants are fully harnessing the educational affordances provided by the smartphone. These affordances can perform functions for multimedia-access, connectivity, capture, and representational and analytical tools.  Since most of them take the train to and from campus, that one-hour commute can be effectively utilized for incidental vocabulary learning. Even listening to the news or watching YouTube videos with English subtitles can be considered as exposure to new words. Thus, the smartphone has enabled increased cognitive engagement with activities that promote incidental vocabulary learning (Gikas et al., 2013; Kovacev et al., 2011; Wong et al. 2010; Kukulska-Hulme, 2006)

Another positive finding is that the respondents reported increased levels of engagement when they practised newly learned words and when they were exposed to a variety of activities that sustain the learning process, which is consistent with the *Rehearsal*phase of the framework. They reported that this increased frequency of use of newly learned words resulted in better retention, suggesting that working memory is given an added boost. This is important because working memory has been cited as being necessary when learning new rules in an L2 through its "involvement in the noticing and encoding of new information" (Mackey, Philp, Egi, Fujii, &Tatsumi, 2002; in Martin et al., 2012, p. 383).  The practice of using the newly learned words in actual writing forms (ie., blog posts, Facebook newsfeeds and comments, and online forums), as well as informal presentations, has had a two-fold effect. Firstly, vocabulary is learned in context, with pronunciation models and example sentences, which increases confidence for the oral and written practice of the newly learned words. Next, the fact that the writing forms are not held in

the 'safe' confines of a classroom gives an added 'real' dimension to the practice element. There is a certain 'danger' or risk when posting feedback online, as some readers may find your writing confusing, or they may disagree with you outright and put you down in their reply with disparaging remarks. The fact that the participants were willing to attempt to use these newly learned words in real discussions online indicates increased confidence in their learning, and deeper processing in the consolidation of knowledge schemas. Overall, the participants who posted comments on news portals reported getting positive feedback to their ideas and comments, which further bolstered their motivation to learn new vocabulary which is consistent with both the *Reflection* and*Outcomes*phases of the framework.

Finally, the study also discovered that while the learners were happy to engage in and explore vocabulary learning activities, they were not as motivated to use it as a metacognitive tool for peer assessment, preferring instead to deal directly with instructors for feedback and suggestions for improvement. This is consistent with the notion of incidental vocabulary learning as the "learning of vocabulary as the by-product of any activity not explicitly geared to vocabulary learning" and is viewed differently from intentional vocabulary learning, which can be seen as "any activity geared at committing lexical information to memory" (Hulstijn 2001: 271, as cited in Rieder, 2003). Since peer assessment was not reportedly viewed as desirably as instructor feedback, this indicates that the potential for the smartphone to be used as a metacognitive device can still be explored further.

## Limitations

This study has uncovered some limitations regarding the application of smartphones in vocabulary learning. Notably, while the participants reported being comfortable with the use of the smartphone (since it was their own property), they reported not being as comfortable with it compared to using a larger tablet device such as an iPad. This was due to the limitations of the physical attributes of the smartphones, such as small screen size and short battery life.  Another frequent complaint was network speed and reliability—especially on campus, where there was more opportunity to engage in incidental vocabulary learning in between classes. Most reported having problematic keypads, particularly touchscreen keypads. Nevertheless, the participants were still able to utilise their smartphone for vocabulary learning, despite these hindrances.

## Conclusion and implications

This study has yielded many interesting findings that enable us to gain a deeper understanding of the autodidactic process of mobile assisted language learning. The cognitive processes of incidental vocabulary learning has been positively impacted by harnessing the full potential of educational affordances. By having personal access to the Internet for reading and online dictionaries, they were able to increase their exposure to new words, concepts, ideas, different forms of expressions, and rhetorical structures. The structure of vocabulary learning was also impacted, in that learners checked for meanings of unfamiliar words immediately, and guessing as a strategy was no longer seen as a viable strategy for determining meanings of unknown words. The features on the smartphone such as video, and messaging services such as Whatssap have given new dimensions for learners to engage in collaborative feedback, paving the way for more opportunities to try out new words and develop confidence. The convenience of having a learning device in your pocket also made the learning process less burdensome, especially

when they were able to learn vocabulary through reading what they liked. However, this study found that the smartphone was not always fully utilised for the metacognitive processes of planning, monitoring and evaluating of performance of vocabulary learning.

The findings have several implications for language learners and language instructors. Firstly, this study has revealed that autodidactic language learning through mobile technology has much potential, and that the smartphone offers affordances for increased metacognition; thus, learners should fully embrace and explore more avenues for learning. Instructors should also be aware of this, and perhaps incorporate a sharing session where everyone gets to share their weekend activities with the class, with an added emphasis on what was learnt that weekend. Vocabulary learning should be fun, exciting, challenging and rewarding. Perhaps it is time to throw out those word lists!

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