THEORY AND CONSTRUCTION OF A LANGUAGE LEARNING VIDEO GAME

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Abstract

This paper discusses the theoretical choices underpinning the creation of a video game called *Medicina*. This game is designed to broadly foster better language skills among international nursing students with English as a Second Language (ESL) and more specifically to teach confusable medication names and improve reaction time to verbal orders. Research shows that the intentional learning of vocabulary is important to language learning. Without adequate vocabulary knowledge, it is difficult for an international student to interact in professional and university settings. This situation is compounded by the expectation that students will learn key vocabulary incidentally through academic pre-readings, despite the research demonstrating this to be an inefficient and inadequate method of learning. Moreover, medication names are low-frequency vocabulary. Thus, the international student who seeks to enter the health profession encounters the task of learning an entire subset of language but without the amount of exposure theorised as being necessary to it. Repeated exposure to these words is needed, leading to automaticity. The paper will outline how the language-learning video game is designed to encourage discrimination between word forms, allowing for multiple exposures to both written and spoken vocabulary, and promoting automaticity in pharmacological terminology.

Key Words: automaticity, low-frequency vocabulary, word form, medication names, international nursing students, English as a Second Language (ESL)

"Theory and construction of a language learning video game"

1. Introduction – background and rationale for a video game that teaches medication names

The problem

International nursing students with English as a Second Language (ESL) sometimes find they are unable to fully engage in their university studies and clinical placements as a result of communication difficulties (for example, see Chiang & Crickmore, 2009; Donnelly, McKiel, & Hwang, 2009; Guhde, 2003; Gunn-Lewis & Smith, 1999; Shakya & Horsfall, 2000; Starr, 2009). The factors contributing to their communication problems include: the range of language registers (from colloquial to specialist language), the physical environment (usually a noisy clinical placement or group-based tutorial/laboratory space), and communicative pressure (quickly, accurately, and under pressure) (Author, 2011). Communication errors can have serious consequences in a medical context. An example of this is mishearing a medication order given verbally over the phone and subsequently administering the wrong medication to a patient.

Vocabulary is a major underlying contributor to the problem

A major issue contributing to communication error is a lack of vocabulary knowledge, but also an inability to relate spoken to written forms. It is common to find that international nursing students have difficulty with low-frequency vocabulary in both speech and writing. As a result, they may not be able to easily recognise a spoken word, repeat it correctly, nor match it to the written form. Moreover, students tend to display a general lack of familiarity with medical vocabulary (understandably, since it is low-frequency specialist language), difficulty with the phonological requirements of medical terms, and a frequent inability to identify affixes and roots in medical words. This lack of familiarity with medical vocabulary may have negative consequences for students' further study. The research indicates that, for reading activities, English language learners need to be familiar with 98% of the words used in order to have full comprehension (Schmitt, 2008, pp. 329-30). In real terms, that means if 1 in 50 words is unknown, comprehension is hampered. Furthermore, in order to have good comprehension in speech, a similarly low threshold of 95% vocabulary knowledge is needed (Schmitt, 2008, pp. 331-2). In a medical context, low-frequency words are most likely to be unknown and yet crucial to comprehension. Anecdotal evidence from one-to-one diagnostic interviews with struggling international students in our department is useful here. Students often state that their lack of vocabulary hinders their ability to understand lectures and clinical facilitators. However, once students are able to manage the vocabulary, they can better interact with the curriculum.

Current vocabulary support and its use by students

Specialist language support varies among schools and universities: some even have credit-bearing courses dealing with the jargon of a profession. In our school, students are expected to acquire medical terminology from reading texts and through listening in class. The research, however, reveals that this kind of strategy results in a low uptake of new words and a low rate of retention (Schmitt, 2008, pp. 348-9). Reading glossaries in textbooks is another

method expected of students, but these are written lists which do not help with pronunciation for the international student. Other audio options are available, such as online mp3s or CD packages that accompany some textbooks, and it has been found that audio input accompanied by written text improves both listening and reading ability (Liu, Moore, Graham, & Lee, 2002, p. 260). However, disparate written and audio files require extra effort to combine into an effective learning tool. Multimedia flashcards and vocabulary software are two current possibilities for combining audio and writing, and these are also sometimes found on the internet or as an online package. This seems to be a viable option for vocabulary learning because computer-based teaching of second-language learners has a history of being an effective strategy (Hulstijn, 2000, p. 35). Students prefer computer-based learning because they find it motivating (Nakata, 2008, p. 3). Nonetheless, despite the large number of medical terminology resources available to the student, it is not uncommon to find that they have never picked up a medical terminology book, rarely looked at online files, and lack the motivation to compile materials. Even then, a common complaint from students who have gone online is that they mostly encounter American accented materials rather than our local variety of English. Moreover, resources that focus on medication names alone are even more difficult to find, partly because the commercial names of medications can differ between countries.

The computer-based medium seems to be promising for international students, and a video game that addresses the aforementioned issues has not yet been developed. As a result, our school decided to produce a medication name game, but one with multiple educational outcomes, including learning to distinguish between confusable medication names and the improvement of phonological awareness around medical terminology. The gaming option is appealing because it holds promise to motivate students while also having the capacity to deliver, in a multimodal fashion, local content in a timed and modified interaction task. This paper describes the theory underpinning the features and design of this video game, called *Medicina*, and some preliminary results of its efficacy. It is hoped that this methodology can help to guide other teachers about how they might approach the design of their own language-learning video games. Before looking at the theory, we first need to establish a basic outline of the *Medicina* game's features and properties.

2. A description of the *Medicina* game

The *Medicina* game has a simple short gameplay. The player watches the action on a computer screen and listens to audio commands to find the correct medication among five similarly named bottles. The player has four seconds to complete the entire process, after which feedback is given on their choice – in the form of a spoken response, their chosen avatar's reaction, and the effect of their choice shown on a cartoon-rendered patient (see Figure 1 for illustration). Points are accumulated for correct answers. Not selecting an option or choosing three incorrect answers ends the game. Scores and usernames are displayed on the game's public leaderboard shared by all players.

Once the game has started, the selection and feedback cycle for each medication name takes about eight seconds to complete, which equates to 900 verbal exposures and 2250 written exposures per hour to the database of medication names. Furthermore, exposure is increased if the student uses the accompanying click-and-play list of medication names. This is an important educational resource that supports the game when the student is too challenged and needs untimed interactions with the medication names.

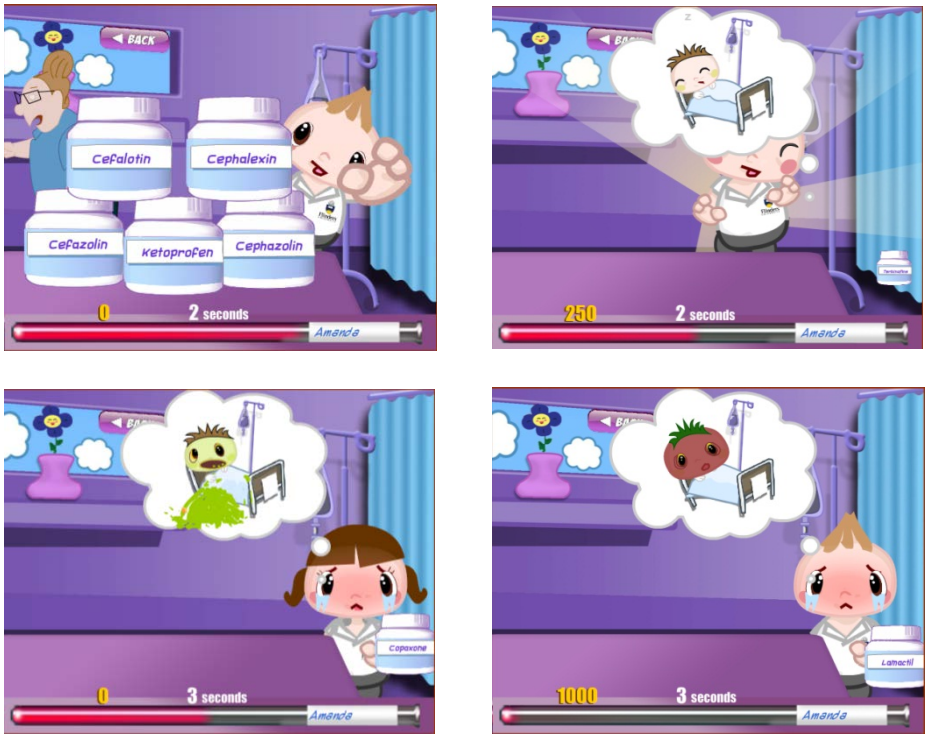

Figure 1. Screenshots of the game: choosing an option and receiving feedback.

Now that an understanding of the game's features and properties has been outlined, we will look at the theoretical choices underpinning the focus and content of the game, starting with the focus on similar word form rather than on word meaning.

3. The educational focus on word form

Nation (2001, pp. 26-8) theorises that gaining full knowledge of a word is a multifaceted task. The three main aspects involved in knowing a word are understanding of form, meaning, and use (Nation, 2001, pp. 26-8). Knowledge of word form involves an understanding of the spoken and written forms as well as word parts: sound, pronunciation, appearance, spelling, recognisable segments, and how they are put together. Knowledge of word meaning involves knowing the definition, concepts, referents, and associations. Knowledge of word use involves an understanding of grammatical functions, collocations, and constraints on how the word is used in communicative activities.

In his review of research on teaching second language vocabulary, Schmitt (2008) highlights how the research points to "the necessity of thinking of vocabulary learning in incremental terms" (p. 334) rather than asking for a uniform approach. The use of Nation's model of segmenting vocabulary learning into stages helps to address the need for different teaching approaches that respond to a student's level of acquisition. An objection to the design of the video game is that it might seem a basic task for university students who are upper-intermediate to advanced English users, i.e. IELTS 6.5, CEFR B2-C1, and so on. The acquisition of language is an uneven process of approximation rather than perfection, which often leaves gaps to be filled later on. It is not unusual to find phonological difficulties among upper-intermediate learners as a result. Furthermore, since it has been identified that the students are at the rudimentary level of acquiring familiarity with medication names, the *Medicina* game teaches the basic aspects of vocabulary knowledge: form. This focus on form

allows the *Medicina* game to comprehensively develop students' knowledge of both spoken and written word forms and the links between them. This kind of improvement in phonological awareness is a meta-linguistic skill that supports the development of all language skill areas. Thus, a basic task which develops phonological awareness can result in large gains in overall language competence.

Further evidence that focusing on form is a good educational strategy comes from a number of sources. Schmitt (2008, pp. 334-5) writes that an explicit approach that focuses on form is most effective when beginning to learn a word, partly because it enhances general word-knowledge beyond the actual word being focused on. Nation also recommends that readers should employ a range of decontextualization skills when approaching new lexical information (2001, p. 402). Laufer (2009, p. 341) similarly suggests that decontextualized vocabulary learning is effective for studying basic vocabulary quickly. Thus, contrary to common approaches to teaching vocabulary which focus on learning meaning, it is a false economy to take instructional time away from learning vocabulary at the level of form (Schmitt, 2008, p.335). Indeed, Hulstijn (2001, p. 285) theorises that when more attention is given to factors such as morphophonological, orthographic, prosodic, and intraword or interword relations, the result is better retention of new lexical information. Furthermore, the benefits of focusing on form usually spread across the learner's lexicon, since form-based information enhances meta-linguistic knowledge and general language ability.

4. The selection criteria for medication names and their incorporation in the game

The medication names chosen for *Medicina* are based on strict selection criteria. The game draws exclusively upon the Australian Prescription Benefit Scheme list (Department of Health and Aging [DHA], 2010a). Medication names were selected if they met any of the following criteria: it is a common prescription item (DHA, 2007, pp. 24-6; DHA, 2010b, p. 13; DHA, 2010c, p. 15); it has been reported as a being confused for another similarly named medication (Australian Council for Safety and Quality in Health Care, 2002, pp. 75-7; Chi 2008, p. 3; Hicks, Becker, & Cousins, 2008; Institute for Safe Medication Practices, 2010); or it is identified as possibly confusable (according to the name's similarity to the orthographic and phonetic properties of other names). Indeed, a key aspect of the game is the grouping of medication names according to sound and spelling similarities, the task itself inspired by the concept of minimal pairs in linguistics. In the game, the use of a verbal request to the player to find and click on the correct medication itself is inspired by Asher's (1984, p. 35) theory that command-based physical responses improve language learning, and that learners should demonstrate their comprehension of language input by carrying out verbal instructions given by the teacher.

Over three thousand medication names are provided in the Australian Prescription Benefit Scheme list alone. For the purposes of the *Medicina* game, medication names were selected for their capacity for first language interference or phonetic similarity. This is a practice based upon the theory of language interference where the person's first language is said to interfere with their performance in the second language (Flege, Bohn, & Jang, 1997; Strange, 2010). It has been shown that giving students an opportunity to consciously attend to novel phonetic forms may be a way to enhance their learning (Pederson & Guion-Anderson, 2010). Through the use of distractor items, which are chosen for their phonological or morphological features, the student is given the opportunity to develop bottom-up processing skills, where they enhance their ability to distinguish between minimal pairs, gain exposure to phonemes that do not exist in their own language, and learn how certain sounds relate to which letter

combinations in the medication vocabulary subset. This is an important skill because whole-word and word-part recognition play an important role in reading fluency (Sadoski & Paivio, 2004, pp. 23-26). Over time, it is expected that international students will become quicker and more efficient at reading medication names, and eventually switch to using top-down processing, just like native speakers.

Another feature of the *Medicina* game is a continuous flow of background noise typical of a hospital, including random individual hospital sounds. These act as distraction items, because a common problem among international students is the difficulty they have in coping with this kind of background noise. The rationale for this is explained later. Accent also poses difficulties for students. As a result, the game uses four different voices for the audio requests and feedback. The rationale for this strategy is based on research by Sommers and Barcroft (2011, pp. 431-2) who found that greater acoustic variance produces better phonological competence in students.

5. The influence of theory on educational design

Theories regarding linguistic exposure and its role in language acquisition have strongly influenced the design of *Medicina*. For example, in a review of the literature on vocabulary learning, one of Schmitt's (2008) conclusions is that a good practice for learning programs is to include "a component based around maximising exposure and incidental learning" (p. 329). Krashen's (1982) input hypothesis can be used to expand on this advice. He argues that we acquire further language "only when we understand language that contains structure that is 'a little beyond' where we are now" (pp. 32-3). Often, the students who use the game are highly unlikely to have previously come across these medication names; thus, the presentation of each medication extends them. Krashen (1982) theorises that low-frequency words will cause unnecessary difficulty for adults seeking comprehensible input (p. 58). It is in this kind of situation that Krashen (1982) asserts the language learning teacher can do their best work: "the main function of the second language teacher is to help make input comprehensible, to do for the adult what the 'outside world' cannot or will not do" (p. 64) which, contextualised to a video game, means to offer learners a simpler form where the teacher creates accessible language-teaching materials. As a result, the design of the game was guided towards this kind of input, or exposure, that the international nursing student needs.

In order for the game to be designed properly, an important question to ask is how many exposures of the material are optimal for vocabulary acquisition. The answer determines the amount of interactions that need to be built into the teaching resource before improvements can be expected to show. Chang and Read's (2006) research shows that merely hearing the input twice improved performance on a listening comprehension task, and was better than being given vocabulary instruction instead (p. 393). To promote incidental learning from reading, Webb's (2007) research suggests that significant increases take place after three exposures, with continuous improvement from there. After three presentations, learners gained significantly more receptive knowledge of orthography than after one presentation, and after seven presentations, learners gained significantly more productive knowledge of orthography than after three encounters. After ten encounters, receptive orthographic knowledge was 88% and productive orthographic knowledge was 77%. Thus, as Webb (2007) argues, "by ten meetings with a word, there is the possibility that learners will be able to recognize its spelling and words that it is associated with" (p. 62). Schmitt's review of the literature reveals similar results to those found by Webb (2008, p. 348). In another study,

Pigada and Schmitt (2006) were less certain of when the acquisition of meaning took place, but they did find that the learning rate increased from 10 exposures or more. Similarly, Brown, Waring & Donkaewbua (2008) found that 10 exposures or more were most likely to get results, with familiarity with the words needing to take place before meanings could be remembered consistently (pp. 151-154). The *Medicina* game safely achieves this amount of exposure and more.

The nature of exposure, both in selection of materials and the number of revisits, is important for acquisition but the timing of the task also needs to be considered. Time limitation is a key aspect of the *Medicina* game, encouraging students to acquire faster recognition of words. According to Chapelle (2001), a student's attention can be directed towards a focus on word form (pp. 69-70). The *Medicina* game design harnesses this kind of attentional manipulation to improve learning. Chapelle (2001) draws upon Skehan's 1998 guidelines which assert that the manipulation of student's attention can be achieved through time-based pressure, modified interaction, and stakes (p. 49). The use of time pressure for an answer in each round in *Medicina* is itself an attempt to compel students to concentrate on the factors that will produce success: in this case, attention to form. Students cannot pause, ask for a repeat of the command, or hedge for time. They either answer or not, and then see the consequences of their actions. This encourages them to focus on form, because without it they will not succeed. Moreover, while the *Medicina* game builds the passive skills of listening and reading, the student cannot be passive in their learning. They must become active users and learners to master the task. Finally, to address Skehan's other two guidelines mentioned above, a variation of modified interaction can found in the action of the *Medicina* game (since the student must interact and get feedback on their interactions), and the stakes are built into the game through the scoring system and avatar responses/rewards. It must be noted that these are features common to many quiz formats, and is an educational advantage of the gaming format generally. However, the inclusion of these elements needs to be consciously managed during the creation of a game which is intent on providing multiple exposures.

6. The educational outcome of automaticity in processing medication-based word forms

The utilisation of time-pressure and multiple exposures are useful tools for learning, two among many, and their proper management should result in the educational outcome of automaticity. Automaticity involves a 'resistance to the temptation to analyse language forms' and moves towards 'a relatively unlimited automatic mode of processing' (Brown, 2007, p. 64). Automaticity occurs when it takes little time and effort to retrieve information, reaching a point of unconscious effortless processing of input (DeKeyser, 2001, p. 128), and word-recognition training is a means of achieving this (Akamatsu, 2008). Hulstijn (2006) argues that it is not sufficient to simply know vocabulary in order to produce fluent communication, but that there needs to be fairly rapid processing of vocabulary in order for fluency to occur. Hulstijn (2006) argues that "the recognition and retrieval of words needs to be automatized" (p. 711). In his investigation of the psycholinguistic mechanics of fluency in listening skills, Hulstijn (2006) found that "lower-order processes of word recognition play a crucial role in these automatic processes, as it is at the level of words (i.e., lexemes) that forms are matched with meanings" (p. 708). Moreover, he similarly found for fluency in reading, that "word recognition is the most important factor" and "most deficiencies in literary skills are caused by problems at the lowest cognitive levels, in particular in the coding of acoustic, phonetic, and phonemic information" (Hulstijn, 2006, p. 709). Thus, Hulstijn (2006) comes to the conclusion that "an important element of fluent language use is automatic word recognition" (p. 711). DeKeyser (2001) summarises the effect of this for ESL

learning: “without automatization no amount of knowledge will ever translate into the levels of skill required for real life use” (p. 126). Hulstijn (2000) also points to how technology-based instruction can act as a vehicle to increase automaticity of vocabulary knowledge (p. 36). In the *Medicina* game, the educational outcome is automatic processing of sounds and words forms to set the foundation for improved medical terminology recognition and better linkage between spoken and written medication forms.

7. The role of cognitive load theory in instructional design in game construction

One of the strengths of the gaming medium is the ease of presentation of multimodal input and the inherent requirement for user interaction. Sadoski and Paivio (2004) suggest that automaticity is achieved through improved representational processing, which greatly economises on cognitive resources (pp. 11, 16-17). Sadoski and Paivio (2004) explain how the practice of combining the written and spoken forms of a word can improve automaticity:

> If the visually recognized word was also familiar from speech, its associated auditory-motor phonological logogen usually would be activated rapidly in turn […] All this would be carried out in milliseconds and perhaps without conscious attention. If the visual word was not familiar, visual and phonological logogens at lower levels such as letter combinations would be activated, requiring more time and attention” (p. 11).

The implication is that, after a period of time, it can be expected that repeated exposure will improve processing speed, but more importantly, the representational processing between the visual and phonological modalities should be strengthened. When familiarity is achieved, it will be comprehensive, i.e. across modalities, rather than just remembering the spelling or the sounds. The gaming medium is an excellent vehicle for providing coordinated repeated exposure to spoken and written forms as a method of reaching automaticity and fluency. Thus, as a teaching tool, a game can be used to improve the overall recognition speed of both written and spoken low-frequency vocabulary. This knowledge was an important contributor to the choice of using a gaming medium and the design of the *Medicina* game itself. However, when creating a game, the visual and auditory inputs need to be carefully designed and balanced, especially when there is a time limitation placed on the person to focus. They need a clear point of focus and bad design can impede learning. Thus, before the game could proceed, a further consideration of the game design needed to take place, focusing specifically on cognitive load and its role in learning.

Cognitive load theory informs a number of critical aspects of the *Medicina* game design. Cognitive load theory is premised upon the idea that a person uses a limited-capacity working memory to assimilate new information (Baddeley, Sala, Robbins, & Baddeley, 1996). Since working memory can only process a certain amount of new information at a time, it restricts what can be encoded into long-term memory (learned) at any given time (Paas, van Gog, & Sweller, 2010, p. 116). A simplistic analogy for this model of memory is a computer, where the RAM is the working memory, and the storage space is the long-term memory. While our brains are much more complex than this, the fact remains that a person can only attend to a certain number of items at the same time. Indeed, Cowan (2001) suggests that we can hold in our mind only four meaningful chunks of information at a time. Sweller (2010) extends on the notion of cognitive load theory and applies it to an educational context. He defines two kinds of loads on the working memory: intrinsic and extraneous. Intrinsic load refers to the

complexity of the material to be learned and extraneous load refers to demands on working memory which is not due to the inherent complexity of the material. The idea is that when working memory resources are devoted to extraneous load, fewer resources remain to deal with the intrinsic load (or desired educational content). Sweller's instructional design principles can be used to analyse the types of input that can be used in a game and the processing requirements placed on the student, creating a maximal learning environment. Sweller's principles help to create a suitably difficult educational gaming task, defined by Salen and Zimmerman (2004, p. 351) as one which wards off boredom but does not increase anxiety. As such, these principles were used in *Medicina* in an attempt to create the best opportunity for student learning. The application of the principles will be explained in greater detail in the following paragraphs.

The first aspect of Sweller's cognition-based instructional design principles revolve around intrinsic load. Intrinsic cognitive load is thought to be determined by element interactivity, where an element is defined as "anything that needs to be or has been learned" (Sweller, 2010, p.124). In the game, the elements are phonemes and written morphemes. Element interactivity levels depend on the number of interacting elements and the connections needed to be made to other elements in order for the learning to take place. The vocabulary learning task in the game uses two modalities in which one element (verbal instruction) needs to be contrasted to five other elements (written options). Thus, the intrinsic load of the game would be considered to be at a high level, which theoretically would demand the student's attention to stay focused on the task (recall the earlier comments by Chapelle on focus on form). In Sweller's cognitive load theory, he outlines a principle of managing intrinsic load that should be used in practice when a task is complex. This is called the "simple-to-complex strategy" (van Merriënboer & Sweller, 2010, p. 89). This involves the management of intrinsic load by initially simplifying the tasks and then adding more elements or interactions. DeKeyser (2001) summarises how this might work: "the smaller, lower-level chunks occur by far the most frequently, [and] they are the first to be learned" and "as these newly formed time-saving devices are used very frequently, they lead to a dramatic improvement in reaction time" (p. 138). The idea is applied in the game through its focus on form rather than through the teaching of meaning and use, because the student needs to be equipped with the basic skills before they can apply them in complex situations. Additional elements and interactions will be gained through use of the words in the student's wider nursing education and clinical placements. This preparatory approach is typical of CALL approaches (Reinders & White, 2010, p. 63).

Even when intrinsic load is high, learning can be maximised by using different modalities to provide input (e.g. listening to words while looking at a diagram). This is called the modality effect and it can be used to expand working memory capacity (Sweller, 2010, p. 135). Paivio proposes a number of modalities, including visual, auditory, and haptic input (1991, p. 257). There is also evidence that the language has independent modality-specific representations (Sadoski & Paivio, 2004, p. 6). For example, there is a phonological store that can hold acoustic or speech-based information for 1 to 2 seconds. Similar sounds may be confused within the phonological loop of the working memory (Baddeley, 1990), which is why words might be misheard if not treated with care. After the verbal instruction in the game, the student's phonological loop will be engaged as they internally rehearse the spoken input and try to identify its written equivalent. Furthermore, as the theory suggests, when the student is exposed to multiple modalities, they would be using different modality-specific memory stores. A video game is especially well-placed to take advantage of this optimization of learning. *Medicina* is designed to draw upon three modalities of the verbal code, hopefully

allowing maximum uptake into the memory. To explain, the modalities used in *Medicina* are visual (printed letters, word shapes, pictorial feedback), auditory (spoken words), and haptic (touching occurs through the avatar which is a projected identity operating within the game moved using the mouse and which grabs objects on a screen using a mouse click – the result is that each word selection is punctuated by a physical grabbing movement). Finally, students should prefer the use of multiple modalities of input, since the research shows that they prefer reading while listening over single modality input, and they make greater gains through this method (Brown et al., 2008, p. 156; Chang, 2009, pp. 660-2).

The second aspect of Sweller's cognition-based instructional design principles revolve around extraneous load. Extraneous cognitive load is different to intrinsic load because its presence is largely under the control of the teacher. Extraneous load refers to 'non-optimal instructional procedures' that theoretically places an undesirable burden onto the learning task (Sweller, 2010, p. 125). The extraneous load found in the design of the game involves the use of interference noise. This extraneous load is not caused by a lack of care in instructional design since it was purposely meant to invoke the split attention effect. This effect occurs when two kinds of input are presented in one modality at the same time. Variations of it are identified by Baddeley (2003, pp. 831-2) as the irrelevant sounds effect and the phonological similarity effect (both caused by the phonological loop in working memory). Sweller's (2010) split attention effect involves a decreased attention capacity as a result of having two sources of information presented in the same modality (a picture and a diagram). There is a limited ability to do two things in the same modality at the same time (Sadoski & Paivio, 2004, p. 6); thus, it is usually recommended in cognitive load theory to reduce the extraneous load on the working memory by removing factors that cause split attention.

In *Medicina*, there is a purposeful application of extraneous load because the game seeks to present the cognitively difficult listening conditions of a hospital. The split attention effect has been used to simulate the kind of environment that the nurse often communicates in – many competing noises demand attention while the nurse reads written documentation and speaks with others. In the game, the extraneous noise in the background puts a strain on the player's audio channel, since the learner hears authentic noises competing for their attention while they attend to spoken commands. Furthermore, it can be argued that the task has parallels in clinical placement, where students must deal with many demands on their attention and, in the case of medication names, students are rarely asked to pick between just two bottles in a medicine cabinet. They must learn to deal with multiple demands and possibilities under time pressure in a distracting noisy environment, and the split attention effect in the game is meant to encourage the student to develop the metacognitive and coping strategies. Indeed, Cutler, Weber, Smits, and Cooper (2004) found that background noise does not increase phoneme misidentification, but it does increase levels of listening effort for the second language learner.

The use of distracting background noises is essential but manageable. Indeed, recent findings from research on selective attention indicate that a heavy load on the working-memory, based upon task difficulty rather than perceptual difficulty, increases the distractor effect on students (Kelly & Lavie, 2011; Lavie, 2005). This means that students will find it harder to inhibit the extraneous distractions. Indeed, students will certainly need to learn how to use their cognitive resources to activate both early and late inhibition of the distractors, both in the game, and eventually, in clinical placement. This is especially important considering that reading words requires some degree of silent phonological recoding in the mind of the person

(Sadoski & Paivio, 2004, p. 38). This increases task difficulty because the student is attempting to match the word they have heard to the internal recoded forms of the five words they read. So, while the student will still perceive the distraction, they will learn how to fine-tune their allocation of attention and ignore extraneous input. Thus, the game prepares the student for the kind of distracting environment they often complain about that makes communication so difficult for them.

8. Preliminary findings of *Medicina's* efficacy

A pre-test/post-test study with a qualitative survey of *Medicina* involving 25 international nursing student participants was conducted and reported in Author (2013). The results will be briefly repeated here. The study found a significant improvement for the recognition of words and word forms ($t(24) = -5.18$, $p < .0001$, $r = .73$). However, it must be noted that the study had a small sample size of 25 participants and requires replication, preferably with a control group.

In the study, participants made important qualitative comments about *Medicina*, particularly about the timing of the task, the use of distraction items, and the motivating effect of the gaming medium. In regards to how the game encourages faster processing by using time pressure, participants wrote that "*it improves my reaction in finding the right medication each time I play the game*" and "*I can recognise the medication word immediately*". Another participant wrote that "*The speed of game was really good. It was faster than I could do so it could enhance my skill for catching the word. If it was slow I would never improve. It boosts me to learn more and more.*" Participants realised the application of the game to real life, and one stated that "*This game helps to act quickly like in wards during our placement, we need to get medicines very quickly. So it helps to practice that.*" Participants also appreciated the distraction items and noisy background. They felt that it "*makes it more of a real situation*" and helped them "*imagine yourself in a real situation*". In addition, participants felt the gaming medium was motivating, and they wrote comments such as "*I'm more interested in games than books*", "*The fun would make me play again*", "*When I read the textbook I feel really bored. When I play the game I feel really excited*", and "*The score motivated me. I loved to be there in the ranking list.*"

Finally, participants commented on the more generalised effect the game was having on their wider language skills. A common theme that emerges is summed up by one participant who wrote that "*I hear more names in lectures and study. I now know more words in class and books.*" A poignant comment made by one person was that "*This game is very helpful for me. In class, the teacher uses the words and it quickly reflects in my mind and I know it is a medication – it ease my fear of new words.*"

9. Final comment

With careful design and a basis in theory and evidence, the gaming medium may become a mainstream method of teaching content which otherwise is overlooked by many. However, the gaming medium has important qualities of combining multimedia items in a controlled pace environment while eliciting student responses and promoting active learning. This, coupled with the projection of identity, may be an important tool for teaching language, particularly for the typically passive skills of reading and listening. Schmitt writes that "the overriding principle for maximising vocabulary learning is to increase the amount of engagement learners have with lexical items" (Schmitt, 2008, p. 329). This paper has shown

how the gaming medium has great potential to engage students and help them concentrate on important low-frequency words. More specifically, the *Medicina* game is uniquely positioned to (1) provide the opportunity for students to encounter the words in written and spoken form, and (2) complete a language learning task, in an (3) attention-manipulated situation, which (4) improves concentration on the words and their automatic processing of medication-based word forms. Further research in this area needs to be conducted, but the preliminary results are promising.

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