Cases on Digital Game–Based Learning:

Methods, Models, and Strategies

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Chapter 9
Medicina:
Methods, Models, Strategies

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EXECUTIVE SUMMARY

The School of Nursing & Midwifery at Flinders University provides dedicated support for the English language needs of over 500 international students. As part of a strategic plan to deal with communication difficulties among these students, a series of language-learning initiatives are being implemented. One of these is a game called Medicina, which has already undergone the full cycle of development, testing, and release. This game familiarizes students with confusable and common medication names. It also aims to improve phonological awareness through a focus on word form. This chapter discusses the creation of Medicina from inception through to dissemination, detailing the stages, challenges, and lessons learned in the process, in the hope of informing other educators of the level of commitment involved in a digital game-based project.

OVERALL DESCRIPTION

The School of Nursing & Midwifery at Flinders University provides dedicated support for the English language needs of over 500 international students. As part of a strategic plan to deal with communication difficulties among these students, a series of language-learning initiatives are being implemented. One of these is a

game called *Medicina*, which has already undergone the full cycle of development, testing, and release. This game familiarizes students with confusable and common medication names. It also aims to improve phonological awareness through a focus on word form. This chapter will discuss the creation of *Medicina* from inception through to dissemination, detailing the stages, challenges, and lessons learned in the process, in the hope of informing other educators of the level of commitment involved in a digital game-based project.

LITERATURE REVIEW

The *Medicina* game has been created in order to support learning and address existing problems with language among international English-as-a-Second Language (ESL) students. The exact cause of the communication difficulties needs to be ascertained before a game could be considered. The identification of the problem can be achieved through a number of means: a needs-analysis, educators' judgments, a literature review, feedback from students, and a review of policy. Before *Medicina* was conceived, a needs analysis was conducted, as described next.

Needs Analysis and a Definition of the Problem Addressed by the Game

As a part of the needs-analysis study of international students' language difficulties, a combination of information sources was used. We did a literature review of nursing journals documenting the language problems found among international ESL students in the health field. We also obtained a personal analysis of the commonalities among struggling students referred for one-on-one assessment. We also combined feedback from the clinical coach who deals with struggling students, feedback from clinical facilitators, and other sources of anecdotal evidence gathered at committee meetings and from students within English classes. This needs assessment was published in Müller (2011).

Among the international students, it was identified that a lack of specialist vocabulary knowledge was found to be a key underlying issue, and listening was found to be a focal skill deficiency. While most international students possess an advanced level of general English, it is specialized medical terminology (including medication names) and the colloquial language used by patients which pose the greatest problems. This is unsurprising because these classes of vocabulary can be considered low-frequency, which means that the student is not often exposed to these words, and there are few opportunities to engage with them before being assessed on their use.

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How Serious Was the Problem?

During a literature search of the problematic communicative situations, those that involved medications emerged as a serious issue needing immediate attention. The literature which foregrounds the game points out the level of difficulty students have with interpreting spoken medication names and identifying a specific medication from a range of stored medications. Students report great difficulty in interpreting the names of medications when given by telephone (Blackman & Hall, 2009, p. 179). This is a problem because "nursing is highly dependent on accurate verbal communication and much of the information and many orders are passed on verbally" (Guhde, 2003, p. 113). Less difficult, but still complex tasks are: (1) identifying a specific medication from a range of stored medications; and (2) listening to spoken handovers. The concept of *Medicina* began when we realised that the problems occurred at the level of language encoding and comprehension. Difficulty understanding speech indicates both a lack of automatic vocabulary recognition and an inadequate phonological awareness. Phonological awareness is the ability to process sounds or letters and decode them into recognisable words. Thus, without automatic vocabulary recognition and good phonological awareness, the students' capacity to decode, recognise, and understand a communicative act is substantially hampered.

With regards to difficulties with confusable medication names, clinical facilitators have reported anecdotally the conflation of 'pethidine' with 'betadine' as an example, which is a serious error to make. Since medication dispensing is subject to reporting procedures when an incident occurs, there is a range of publications which list medications which have been confused, often with a number of suggestions about other confusable names to be aware of. In the very least, a game which highlights the problem of confused medications and shows confusable alternatives (this will be explained later in this paper) is in itself an important outcome. When that game also fosters an improvement of reading and listening skills through raising phonological awareness, it is an added benefit.

Acquisition of Vocabulary

Learning vocabulary is not a simple task, and learning low-frequency medication names is even harder to do. Second language learners cannot be expected to hear a word once and have complete mastery over that term. Indeed, when a native speaker hears a medication name for the first time, they may need to hear and use that new word a few times before they feel familiar with it and to 'make it stick' in their mind. Nation (2001, pp. 26-8) provides a theory of vocabulary learning that recognizes three aspects of vocabulary acquisition: form, meaning, and use. The first stage involves gaining familiarity with the form of the word, such as its features,

spelling, pronunciation, and the composition of its parts. The second stage involves knowledge of meaning, which for nursing students would involve understanding what type of medication it is, what it does, and associated medications. The third stage involves use, such as appropriate ways to use the word in a sentence, such as constraints on its use, appropriate terms that can be used with the medication name, and how often we would expect to come across the term again.

Another factor involved with learning vocabulary is the number of times a second language learner might need to pass through Nation's first stage of vocabulary acquisition. The research indicates that between eight to ten exposures, where the second language student might read or hear the medication, would establish a sufficient base to then build a solid understanding of meaning and use (Schmitt, 2008, p. 348). The reason for this is that language fluency requires solid skills at the level of form in order to make decoding and recognition become automatized. This means that less time and effort is spent dealing with the processing of the word itself, with more time and effort being devoted to the intended meaning of the communication. When automatization occurs, cognitive resources are freed for other tasks, instead of being concerned with processing the communicative medium itself. This issue is discussed further in the next section.

Cognitive Processes for Optimal Learning

Digital educational games must take into account the same cognitive factors of learning that language educators abide by: information overload is detrimental to learning. The mind can only process a limited amount of information at any given time, and it is important to understand how people learn in order to be an effective teacher and digital game designer. Important concepts that contribute to successful educational gaming are: the role of working memory in learning, the relationship between working memory and long-term memory, the cognitive structures which contribute to information processing, and the optimisation of learning through multimodal input.

A reference which may be useful is Bruning, Schraw, and Norby (2011). Chapter two of their book defines the separate memory system functions, before going on to explain the limitations of attention and perception, and how cognitive processes may be automatic or controlled. They outline the research on two of the sensory registers, visual and auditory, and the effect on learning. For information on processing through the other sensory registers, specifically haptic representations, see Sadoski and Paivio (2004). An excellent article discussing cognitive load and element interactivity is by Sweller (2010).

Practicalities of Creating the Game

Putting forward a compelling case for a digital educational game can be difficult because there are so many other modes of delivery available. A game can be costly, time-intensive, and difficult to design successfully. This section discusses the method by which the *Medicina* game was conceptualised, and implemented.

Is a Game Needed?

The first question an educator must ask is whether the digital game mode of delivery is an effective choice. At times, a computer game is an inefficient method of delivery for educational content. In such situations, it may be better to offer online tutorials, self-test quizzes, checklists, simple board games, and other methods of delivery. The teacher also has to consider the wider curriculum, asking what is already taught, what delivery methods are already used, and how effective these are for student learning. If there many similar online activities, the student may be bored by the lack of variation in format. A digital game needs to address a current gap or replace a presently ineffective means of content delivery. In the case of *Medicina*, both of these factors were present. The latter provided the impetus for the former: it was clear that ESL students experienced considerable communication difficulties which the current curriculum did not address. The educational strategies of expecting students to naturally acquire health terminology while they studied, helped by reading glossaries or dictionaries, had not been particularly effective. A game might be a suitable means to deliver important language items while also motivating students to focus on these important terms.

Conceptualisation and Design of a
Digital Game-Based Solution

A search across a number of sources and databases showed that there was no existing medication name game that could be bought, so we decided to create *Medicina* and tailor it to our students' needs. The first thing that we needed to decide upon was what sort of game would be suitable for our educational content. What would it look like and what would it do?

As a part of the formation process for *Medicina*, the team played a wide range of existing games, with the objective of discovering how a particular item or feature gains focus in a game, what are the distractions, what components are motivating for the player, and what are the negative aspects. Just as experience of a good and bad classroom help a teacher to improve their craft, gaming experiences may assist an educator to understand how the digital gaming medium might handle the

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information exchange needed for educational purposes. A good knowledge of the learning outcomes and the type of tasks you will set can be particularly useful for evaluating the possibility of a particular game's educational suitability. There are a number of other references which can help with the details of game design. Clark and Mayer (2008) provide gaming principles based on research. Dondlinger (2006) reviews the literature, from 1996 to 2006, that identifies elements of design that support learning. Similarly, Pivec and Pivec (2011) discuss how to design a game, what the important game elements might be, and how to support learning. Finally, Van Eck makes some suggestions about which game types might promote particular learning outcomes (2006, p. 22).

Creating the basic concept for the game is essentially a creative process, but it is aided by a clear idea of what one is trying to achieve and the literature in the area. It helps to have a clear idea of what level of educational interaction are needed between the various parts of the game. In *Medicina¸* the elements that the player will manipulate are words, in both spoken and written form. We found that Biggs' SOLO taxonomy (1999, pp. 66-7) was particularly useful because it highlights the interactivity of elements within a task and helped define how that task might fit into the curriculum.

Another approach to conceptualising a game is to imagine what the student would need to do in order to demonstrate that they have achieved the educational outcomes. This is normally the task of assessment, since good assessment, according to Biggs (1999, p. 65), is part of a bigger picture where the objectives have already been decided. Assessment both defines what needs to be learned and checks the level of learning the student achieves. In *Medicina*, since the heart of the gameplay is multiple choice assessment tasks, students can self-assess their skills by how well they have matched a spoken word to its written form, and they also get feedback on whether they completed the task quickly enough.

The planned multimodal nature of the digital gaming medium is its strength, because it increases the opportunity to simultaneously present key information that requires player interaction. Games allow the control and release of information in a way that can maximize learning. Games can simulate the important elements of a situation or task, but without overloading the senses as often happens in real life. Keeping this in mind, it was decided that cartoon-styled graphics were suitable for *Medicina*, but the voices of the speakers were real and varied, and were presented while a range of hospital-based noises were present in the background. This is aligned with the notion that realism should be minimized if it is not aligned to instructional objectives (Clark & Meyer, 2008, p. 362). Indeed, too much irrelevant detail can be detrimental to learning (Van Merrienboer & Kester, 2005, pp. 79-80). In order to decide upon the important factors which contribute to completing the instructional objective, we used an ethnographic model of communication to analyse where

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communicative breakdown was currently occurring. Dell Hymes' 'SPEAKING' model details the components of linguistic interaction that needed consideration (1974, pp. 53-62). Using the model, we were guided through a delineating process of features such as time constraints, physical environment, and social interactions involved in achieving communicative competence.

Overview of the *Medicina* Game

We decided that the heart of the gameplay in *Medicina* would be to answer multiple-choice questions, which are designed to assess successful listening discrimination and spelling identification within minimal pairs-styled tasks. To complete the multiple-choice task, the student listens to the question posed by a character, moves their character to choose a written option among five similar possibilities, receives verbal and written feedback, experiences their avatar responding to their choice, sees the animated consequence on a patient, and is given a score. The continuation of the game depends on the choice made, where the player is forced into choosing, or the game ends. Being much more than a common multiple-choice test, the game has a number of educational interactions, some occurring simultaneously:

- Repeated exposure to spoken and written medication names – which encourages familiarity with terms, their constituent word parts, and their confusable counterparts, supporting the process of automaticity.
- Discrimination between similar words – which improves phonological awareness (including orthographic awareness), and improves word-part familiarity, and again, supporting the process of automaticity.
- Time-limitation on the task – which forces the player to interact (improving focus on task and personal involvement), to encourage faster listening and reading skills, providing the impetus to improve phonological awareness, and development of word-part recognition.
- Immediate visual, written, and spoken feedback – which allows self-monitoring of performance, modification of inefficient or incorrect metacognitive strategies, thereby providing a measure of achievement.

   It was expected that the skills gained within the game were expected to impact on wider educational and clinical performance. With greater phonological awareness, the student theoretically was better equipped to deal with the content of lectures and tutorials. It was also anticipated that, with a familiarity with medication names in both spoken and written forms, the student would be more confident in situations where they dealt with medications, such as on the hospital ward.

Practicality of Running the Game

Storyboarding and Scripting

At this point, we charted the game onto a whiteboard, refining and defining the basic game concept and gaming action. This included an outline of what the frames would look like, the artistic directions we would take, and the pathways for action (if 'x' happens, then 'y' pathway is chosen). A formal game development storyboard was then written up. This provided a visual outline of the sequencing of the screens, a set of schematics, and a state diagram for gameplay. It also provided an overview of basic action, detailed description, and information about aspects of the game, such as information displays (HUDs) and the external resources used. The game development storyboard is particularly useful for scripting purposes.

- **Start-Up Screens**
  - Splash Screen
  - Loading
  - Login
  - Create Name
- **Menu Screens**
  - Scores
  - Avatar Choice
  - Aims/Credits/Disclaimer
  - How to Play
- **In-Game Screens**
  - Game Countdown
  - Game Play
  - Game Feedback
  - Game Transition Animation
  - End Game Animation
- **Out-of-Game Cheat-Sheet**
  - Click and play website of all the medication names used in the game

Assets

All elements of the game (assets) were specifically created for *Medicina*. These included text files, audio files, written medication names, art files (including avatars and characters), and animation files. The audio files include the background audio/music, interface audio, incidental audio, and vocal audio. A database was used as a master document to show how each file related to each other element, such

as indicating which audio file belongs to each piece of written text. At any given moment during the gameplay of *Medicina*, a multitude of assets are being drawn upon. For each text asset, e.g. for the word 'pethidine', presented during *Medicina* gameplay, four other text assets are also displayed, and for each of these words there is a pronunciation audio file, a request sentence, a negative feedback statement, and a positive feedback statement. Thus, for each group of five words that is presented in each round, there are five text assets and twenty audio assets. The point being made here is that there are many assets being used at any given time and a database is a necessary means of managing all the related elements.

Technology Components: Available Software and Hardware

Most staff in the University have a fairly uniform Microsoft Windows 7 setup with Active Directory and Exchange. A minimum set of desktop applications and utilities are also provided for both student labs and across all staff computers. Flinders University also centrally supports a variety of technologies such as Flinders Learning Online, the set of technologies accessible on the web through a web-based Learning Management system, which enables the creation of online activities such as multiple-choice quizzes, cloze tests, and discussion forums. In each topic, a minimum set of activities and tools are mandated for the student web view. These are asynchronous and mostly text-based – with some images and infrequently, audio. There was no existing protocol for digital game-based learning. As a result, we considered the current software and hardware profile of the university and what we know of how students interact within it, and we decided that a student should not need to install extra software to play the game, nor require access to a particular platform or gaming system. Furthermore, the game needed to reduce any digital overheads incurred in the normal processes of saving gameplay results and other game administration.

Technology Components: Server Load and Download Times

As *Medicina* is a language acquisition game, it requires a lot of audio to work. The complicating factor is that many of our students operate over a variety of internet speeds, and audio files take time to download. Reaction time in these games is often a factor, so streamlined performance is very important. This means as little latency as possible is required when loading and playing audio, which can be a problem when the game uses about 500 compressed audio files. Waiting for sound to be uploaded from the web server during the gameplay itself would seriously interrupt the flow of the game, and thus, the attention of the students. Furthermore, feedback from student surveys in relation to streamed video lectures indicated that students prefer to wait longer for initial uploading, than to have interrupted streaming. We

elected to load the audio files from the server when the game itself was uploaded. A special screen was designed to indicate that the game is uploading, in which the student sees a progress bar, watches an animation, and hears jazzy start-up music.

Even though the game has been created and released to the students, we still have to watch for any problems with server load. The choice of server-side technology and database was pre-determined by the School web development server. This contained a Postgres database and a fixed PHP scripting environment. Flinders University provides some development webspace on one of the servers, likely to be on a virtual machine that was on a computer shared amongst other faculties. When the game was running (despite the audio files being loaded already), some dropouts and transfer time lags were noted during high usage periods. The reason for this is that each mouse click by the student is being saved to a database, and rapid file transfer is also required. We are considering cloud hosting, such as Amazon Web Services to insure against this in the future, when there is an increase in users.

Technology Components: Game Engine

Running a game in an internet browser has many advantages. They can be deployed and shared with others using a simple web link. This also makes them easy to distribute from inside a Learning Management System. However, the choice of game engine was the most difficult technological decision. After consideration, the leading contenders for web technologies were HTML5, Java, Adobe Flash and other web-publishable game engines, such as Torque, Unity and Corona. These are described below:

HTML5

At the time when we decided upon the platform, HTML5 technology held much promise. However, comparable examples at the time either ran too slowly, were restricted to working on only particular browsers, or required additional installations. There was also no reliable way to play audio quickly when something happened in the game.

Java

Java has good support across multiple platforms and generally performs rapidly. Unfortunately, we were not unable to find a mature game development environment. We also had mixed student experiences with conflicts between versions of the lat-

est Java Runtime Environment and the older version of the environment required for our Blackboard learning management system to run on. Together, these points dissuaded us from using Java.

Torque, Unity, and Corona

Torque, Unity, and Corona have great cross-platform and mobile support, however they all require plugin software to be installed, in order to run on browsers using MS Windows. Unfortunately, they are not installed on any of the staff Windows desktops or student computing labs across the University, which we were informed would be a large undertaking.

Adobe Flash Player

Flash is easy to prototype rapidly and proceeds smoothly from mock-ups to a full product. Flash has the disadvantage of not running on Apple Mobile devices; however it can be converted into a form that does. Flash has the advantage of being pre-installed on nearly all browsers on PCs and a variety of tablets. It is also already supported on the University desktop environments.

We decided to use Flash as the browser plugin. There is a plan to provide the game for mobile phones. To provide for Apple mobile devices, we have budgeted to have the games converted to the Apple iOS platform. Although Adobe provide a Flash converter, it is possible that the games will be ported to one of the other platforms such as Corona.

Technology Components: Authentication and Security

The server-side scripting and the database are both fairly basic, merely saving and loading student choices, scores, choice of avatar and login names. The login names presented a problem because we had to decide whether to let students use their existing student identification or choose a gaming nickname. All students at Flinders are given a unique Flinders Access Number or FAN, which is recorded in our TechnologyOne Student System. We decided against using this official student login for the game, instead opting for a simple nickname for three reasons: anonymity, potential audience, and security. An individually chosen pseudonym gives students the option of remaining anonymous, since high scores are posted in the game, and the student can safely explore their environment without embarrassment. The potential audience was also a consideration, so it was decided not to use official university login names. This allowed the game to be shown to people outside the University. Finally, a much higher onus on security would be required if Flinders

student logins were used, as these are used across all student logins. This presents a security problem, and moreover, any integration with the Student System would unnecessarily increase the scope of the project.

EVALUATION

Three types of evaluation are discussed in this section: the ongoing evaluative process during the development of the game, the evaluation of the effectiveness of the game on learning, and the use of a game for formal assessment purposes.

Evaluation during Game Development

Initially, the game's effectiveness was evaluated according to the game authors' reactions. It was played many times, allowing us to tweak aspects for improvement, such as timing, how difficult it was felt to be for international students, or whether it seemed boring. This was an important phase of the game's development because it is when the tweaking and polishing occurs. After the game was deemed ready to play, it was shown to students on a big screen in class to get their initial feedback. From their comments, the timing was tweaked and the audio was adjusted. The game was then released for a small number of people to use. This was to test if the system could withstand multiple users. Thereafter, a study was run using the game, in preparation for its release. The results of this study would allow us to provide students with research-based information about what kind of results might be gained through playing the game, and how long it took to see this improvement. This is explained in the next section.

Evaluation of Game Effectiveness

After gaining ethics approval, we used an intervention pre-test/post-test design to measure student improvement in phonological awareness (which underpins listening and reading skills). We also conducted a qualitative survey. We did not test to see whether students had memorised the names because, after an average of 688 rounds, or 100 minutes spent within the game, it was highly likely that they were familiar with the bank of medication names. Furthermore, it was also highly likely that the students had an increased awareness of how these medicines could, and have been, confused within the health setting. Instead, we focused on the generalisability of the game in terms of the development of phonological awareness, and improvements in the ability to deal with novel medication names. The results of this study can be found in Mller (2012).

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Participants completed the pre-test, played the game (the intervention) as much as they wanted during a two-week period, and then completed the post-test. The same test was used each time. As the test did not use real words, participants were unlikely to learn them, and thus affect the findings. Each test word contained two parts of a real word, either from the game or outside of it. Thus, the word parts 'cele' and 'mide' might be combined to produce 'celemide'. Incorrect distractor answers were variations on this fake word, and incorporated common Asian interference phonemes (most of our students are from China, Korea, India, and South-East Asia). The result was a correct answer of 'celemide', presented next to distractor answers of 'ceremide', 'celemite', and 'ceremite'.

A dependent t-test was conducted on the pre-test and post-test scores. Overall, participants experienced a significant increase in phonological awareness $t(24) = -5.18$, p < .0001), as evident in the scores found in the pre-test (M = 36, SE = .87) as compared to the post-test (M = 40, SE = .55) administered after the intervention. The effect size was $r = .73$, which is a substantive finding. Similar results were found for the word parts that the participants were exposed to in *Medicina*, slightly higher than those which were not found in the game. The qualitative survey was quite positive, with some common themes emerging. There was an overall satisfaction with the ability of the game to familiarize participants with Australian accents. Participants also regarded the game as ideal preparation for the fast-paced and noisy environment of the hospital ward. They felt increased confidence to deal with their clinical placement, and were able to engage better in class as a result. They also felt the school had shown concern for them by creating *Medicina* to help them learn.

Use of a Game for Evaluation of Students

Essentially, *Medicina* was intended to support and prepare the students for assessment in the wider curriculum. It will not be used to test the students for formal grading purposes: adding further formal assessment is unnecessarily stressful when there is already a substantial amount of testing in the curriculum. Furthermore, emphasising educational assessment transforms the game from a fun exploration of skill boundaries into a serious test of ability – with a result that stays permanently on your official record. Nonetheless, the game uses formative assessment for each round and a summative assessment score at the end of the game, but these are arguably forms of feedback rather than assessment in the traditional sense. Indeed, the game harnesses a third type of assessment – ipsative assessment – where the student assesses their own progress against their own previous personal-best scores rather than comparing themselves to an institutionally-dictated norm.

CHALLENGES

The two main challenges in creating *Medicina*, which have not yet been discussed, are the wider issues of convincing an educational institution to adopt game-based learning, and finding sources of funding to make the game. This section will present a series of arguments used to show how these two objectives can be achieved.

Compelling an Organization to Adopt Digital Game-Based Learning

It is important to understand the organizational context within which digital game-based learning might be situated, and *Medicina* was no exception to this rule. It was created within Flinders University, a publically-owned institution that provides education and research. The university has faculties within which Schools follow a line-management structure. In financial terms, it is a Commonwealth-funded organisation enacted by state legislation. The Flinders University School of Nursing & Midwifery has around 2,400 students, with approximately 23% being international students. This percentage of international students is higher than the approximately 18% of the remaining 16,000 students in the rest of the university. Within this context, arguments for the funding and approval of the game had to be made. Particular themes arose from the overall argument which successfully convinced various parts of the institution to accept the *Medicina* concept.

Logistics-Based Argument

The School of Nursing & Midwifery has campuses in both city and country areas, and engages in remote education. The school has at least 500 international students, mostly from China, Korea, India, and South-East Asia. Considering the increased need for ESL support for international students, and the use of distance education for remote campuses, any online resource which can independently improve the skills of the students will also help relieve the teaching load of over 140 staff who teach in the School. Thus, if the digital game-based educational medium successfully improves the less than optimal communication skills of students, it will compel its acceptance in the school.

In the case of *Medicina*, it delivers lessons about what medication names sound like, how medication names are spelled, what confusions might, or have, occurred with medication orders, and this is all achieved in an environment in which the student improves their language processing skills and response times to medication orders. The game delivers immediate personalised feedback and allows students

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to compare personal best scores. The game also allows students to learn at their own pace, in terms of when and where they engage in the task, and when they opt out for rest or further personal investigation. They can engage with the educational content at any time in a 24-hour period. It is physically impossible for a teacher to achieve this kind of one-on-one teaching in an hour-long class which has an average of 30 students. Imagine a situation where you have a minimum of 500 ESL students in your care, undertaking one out of over 25 possible courses with different classes scheduled throughout the week. The ESL students are frequently recognised as being at a disadvantage as compared to native speakers because of their lower language skills, thus such a game, with in-built flexibility and time-efficiency, will be a significant help for this cohort.

Budget-Based Argument

Another argument that can be put forward for an educational game is its value to the budget. This is a variation on the logistics argument that states that there are not enough teaching hours to fulfil the educational needs of the students. A game is useful because it reduces pressure to hire more staff to fulfil this need. The budget-based argument is disliked by teachers who fear they will be replaced by a game. They worry that they will lose their jobs if they are no longer needed. However, this is an unlikely scenario. What must be understood is that a game is an ideal option for skills that require mundane repetition or low-level content learning. When this is removed from the classroom, higher-level cognitive and linguistic development can be encouraged by a teacher who is no longer burdened with teaching the basics. The game will prepare students in advance, and if they are not prepared, the opportunity to engage in the educational content remains open after the class. Indeed, the time to worry is when digital game-based learning is developed as a commercial interest specifically to replace teachers. The market is neither big enough, nor specific enough, to make the kind of money needed to create such a resource, so teachers should have little fear for their employment.

Policy-Based Argument

The policy-based argument was confidently put forward because the Flinders University context is favourable towards innovations in teaching. The notion of forging new directions in the delivery of educational materials aligns with this aim, making favourable conditions for forays into game-based learning. A university with a more traditional educational delivery focus would be much less open to this mode of delivery. It is also fortunate that the School of Nursing & Midwifery itself is placed

within a Faculty which is openly committed to flexible learning and distance education. The faculty openly welcomes simulation as an important means of learning. A digital game has a degree of simulation and the task of a game encourages learning by doing, i.e. experiential learning.

When justifying the creation of *Medicina*, the strategic plan of the university was an important reference point. The strategic plan details the aims and intended directions of an institution, and executives and committees refer to it in their decision-making. A strategic plan which explicitly states the desire to move to on-line learning would be more favourable to digital game-based learning than a plan that seeks to improve on-campus participation in the classroom. In the case of the Flinders University Strategic Plan, there are a number of points which can be used to support a request for digital game-based education: to enhance the student experience, to strengthen internationalisation, and to enhance educational opportunities. The student experience is enhanced by *Medicina* in three ways. Firstly, through a diversification of delivery methods (thus increasing motivation to participate); secondly, through the simulation aspect of *Medicina,* which provides a safe practice area for carrying out communicative tasks, and an improvement in language skills through familiarisation with medication names; and thirdly, through the theorised improvement of language skills which will help ESL students engage with educational content (rather than wasting time on the language processing needed to access the educational content). Since the game is aimed at ESL students, it supports the university's aim to strengthen internationalisation. Finally, the desire to enhance educational opportunities is supported by digital game-based education, because this mode of delivery is portable and accessible.

A further source of justification for *Medicina* was found by accessing and examining government policies for education providers. It was established that the national Good Practice Principles required a certain number of English language initiatives for international students at Australian universities (AUQA, 2008; DEWWR, 2007). Furthermore, it was discovered that the aims of *Medicina* would help students meet the national accreditation body's standards ANMC (2006). This is a policy issue that contains liability problems if some effort is not made to address the guidelines, creating possible grounds for complaint and, potentially, legal action against the school or institution.

Student-Based Argument

The student-based argument can be combined with the former arguments by presenting the same issues from a student point of view. Digital games have been an important part of childhood for many people (Kirriemuir & McFarlane, 2004, p. 8).

Considering the interest level in games for learning reported in surveys of primary and secondary students and their teachers, forays into game-based learning seems reasonable (Facer, Ulicsak, & Sandford, 2007, p.48). The research tends to show improved learning outcomes when comparing games to lectures (Mayo, 2008, p. 29). Games are also motivating and provide important learning opportunities, as detailed in Pivec and Pivec (2011, pp. 3-4) Digital games are also viewed as a good drill and practice medium for learning (Van Eck, 2006, p. 22). Finally, games encourage participation and risk-taking (Dickey, 2006).

Applying for Grants/Funding

Once the areas of student need in the curriculum are identified, a literature review conducted of those areas of need, exploration of the availability of existing solutions, an identification of the various policies, and the formation of a possible digital game-based solution have been made, the next step is to find a way to create the game or obtain an existing one. This usually involves applying for funding. The arguments above provided sufficient rationale to successfully attract funding from three sources, greatly facilitating the quality and expertise needed for the creation of *Medicina*.

Disappointment should be avoided if a grant does not get approved, as the creation of a simple game design may not require funding. There are ways to circumvent the need for money, for example, by involving local student programmers and artists looking for experience or a placement as part of their studies. Any audio recordings can be created by the teacher, or sometimes obtained legally online for free or for a small cost. If the educator has a clear idea of a simple game with simple responses to a set task within the game, it can be a laborious, but cheap, process to create. The real cost is on the educators' time. In this case, the only task for the educator is to ensure that the game is approved by the intended institution, and permission is sought (and granted) to have the game hosted on the school website or distributed via memory stick, DVD, or another storage medium. It should also be noted that there are downfalls to making a game without funding. A game produced using volunteer labour cannot be sold without causing a number of legal issues associated with intellectual property, contributor rights, and profit distribution. An educator may find that they cannot alter other people's contributions, or distribute the game to others without all parties consent. This pathway requires careful planning and contracts to be drawn up before work is commenced.

SUMMARY

This chapter has detailed the steps involved in the creation of *Medicina.* It began with an analysis of the problem that was to be addressed through a digital game-based solution. This involved an understanding of the nature of the problem, the processes involved with learning medication names, and the cognitive processes that need to be addressed to optimise learning. The conceptualisation of the game itself was discussed next, and how to support the creative activity involved in educational game design. This lead to a full exploration of the features which might need to be in the game, such as the screens, assets, and game engine. The technological context was seen as a constraining factor which guided the direction of the project, including server load and downloading times.

Next the chapter outlined the feedback and evaluation processes that we undertook. Clearly, evaluation played a key role in deciding the educational content, the ongoing game development, and allowed us to test the effectiveness of the game when used by real learners. The final part of the chapter explored the challenging issue of how to gain approval and funding for a digital game-based project. A number of arguments were presented that might guide others when they promote their own gaming ideas. It was seen that a digital game-based solution has to be considered in terms of logistics, budget, policy, and finally, student needs. Once these factors are successfully identified, application for funding is made easier.

Finally, one issue remains which has not been addressed yet within this chapter. However, it is addressed by the chapter itself, and this is the act of dissemination. Dissemination completes the cycle of development and implementation, for it provides others with important information about what works, why certain elements were chosen, and how the process might be replicated. It is the basis for designing new projects. Hopefully, this chapter has achieved this aim.

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KEY TERMS AND DEFINITIONS

Assets: The assets are the resources that the game engine or game logic uses to make the game work. Assets may be text, graphics, animations, sounds, icons, textures, etc.

Automaticity: Automaticity refers to a rapid and effortless processing of input which indicates a minimal allocation of cognitive resources. Automaticity of word form refers to an effortless processing of sounds, spellings, and features into whole words, thus enabling more attention to be given to meaning and use of those words.

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Game Engine: The game engine is the computational framework, or software platform, that handles the game logic and assets.

Phonological Awareness: Phonological awareness refers to knowledge of the entire phonological system – knowing not only the range of sounds and phonemes used in a language, but also their articulation, permissible sequences and variations, assimilation rules, and more.

Storyboarding: Storyboarding is done pre-production and provides a visual idea of what the game may look like when it is finished. It may be done simply by using graphically depicting the main sequences, but it also can involve more complex descriptions and notes on how the game works.