A Mobile Game World for Māori Language Learning

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Abstract. This paper describes the development and evaluation of a mobile assisted language learning tool that teaches some aspects of the Māori language within a virtual game world. The game uses a simulated world, which reflects aspects of Māori art and culture, to structure Māori language learning experiences. It was developed using the Corona SDK and can be deployed onto multiple platforms. Android tablet devices were used for our evaluations with learners. The approach to language learning theory embodied in the game is based on a well-established Māori language learning technique known as 'Te Ataarangi.' This is modelled on 'The Silent Way' method which uses Cuisenaire Rods. However, rather than rods, the game uses the relationships between virtual characters and artefacts in the game. A design science research methodology was used, with prototypes being developed and tested with teachers, students and academics as design partners. This involved testing early prototypes with educators, then subsequently whole classes of students. In between testing, the software was redeveloped based on the observations and feedback collected. Classroom observations during the iterative development cycle showed the tool was both engaging and effective for vocabulary learning. Knowledge was generated about how a wide range of game mechanics can be used in a game world to structure mobile, Māori language learning experiences. Quantitative evaluation showed that students were able to learn vocabulary over a short time using the tool.

Keywords: Māori language learning, the silent way, gamification, virtual game world

1 Introduction

This paper describes a mobile assisted language learning tool that teaches some aspects of the Māori language within a virtual game world. The Māori language, which is the indigenous language of New Zealand, has been going through a process of rejuvenation since the mid-1900s. A wide range of multimedia resources have been created to support the process of language rejuvenation, but computer games are underrepresented in the wealth of Māori language resources, and globally there have been

few language learning tools developed within purpose-built simulated game worlds. There is growing interest in the application of modern game mechanics (gamification) to mobile learning [1]. The work described in this paper applies dynamic features of modern games within a simulated game world to structure Māori language learning experiences.

1.1 Māori Language Learning and Mobile Devices

There is currently limited literature on Māori language learning on mobile devices. However, McKenzie [2] provides an extensive study of how mobile devices can play a part in revitalising the Māori language. A focus of this study was using the audio and video functions of mobile devices. The key findings of the study were that the portability and discretion of mobile devices allowed for learning in a wide variety of contexts. Timoko [3] investigated an indigenous model of effective mobile learning and the development of a mobile learning model adapted to meet the needs of teachers and students within a Māori environment, in order to improve outcomes for Māori learners.

These two studies represent the most relevant academic work to date on Māori language learning on mobile devices. There are, however, a number of mobile Māori language learning applications available. These include 'uTalk Māori' [4] a Māori vocabulary learner that utilises pictures and audio and has structured interactive 'flash-card' type activities for memorisation of vocabulary. It mainly focuses on single words rather than phrases. Kaitiaki [5] is not specifically a language learning app; rather, it is an ecology game app for school students that is bi-lingual. Kura [6] is a Māori language learning app that is 'gamified', and users compete against other learners for places on leaderboards. It is designed more for immersion education than second language learning and has a variety of activities that go beyond vocabulary learning. Puna [6] is an app developed by the same researchers that created Kura and it builds on the effective features of Kura. It has more options for customising content and structures learning across levels that are laid out on a minimap. It allows users to listen to audio in male and female voices and has structured handwriting activities. Te Pūmanawa [7] is a full online Māori language course that is available as an app for mobile devices and in browsers. It is designed to be a comprehensive beginner's course, including lessons, audio, learning management and the ability to record your own voice for practice. Hika [8] is an app that is based around sentence construction. It splits the sentences into parts that the user can substitute to create different meanings.

1.2 Target Users

The software tool was developed and tested mainly with a mixed class of primary school aged students and a limited number of high school aged students. While the benefit of engaging, game based learning is the ability to scaffold learning experiences for younger learners, it was designed to be engaging and relevant to older learners too. Beginning language learners have to learn the same basic vocabulary and sen-

tences regardless of their age. One of the key areas of investigation was the potential of features of modern, mobile software to structure diverse levels of challenge to different learners so the software was not developed with an upper age limit in mind. In terms of language learning level it was structured for beginning learners in that it taught vocabulary and sentences from scratch and used game mechanics to scaffold the repetition and practise required to learn the language.

1.3 Gamification

Gamification is the use of game based mechanics in a non-game context. It is a relatively new term; Deterding et al [9] date its first documented use to 2008 and widespread adoption in 2010. The term can often be misinterpreted as no more than placing educational content within a game or the basic implementation of stars and badges. Various authors have put forward multiple views of the components of gamification. Hamari, Koivisto and Sarsa [1] categorised the motivational affordances of gamification as points, leader boards, achievements/badges, levels, story/theme, clear goals, feedback, rewards, progress and challenge. Reeves and Read [10] described a range of successful elements of games, including self-representation with avatars, three-dimensional environments, narrative context, feedback, reputations, marketplaces, competition and time pressure. Robinson & Bellotti [11] categorised seven features of gamification; general framing, general rules and performance framing, social features, intrinsic incentives, extrinsic incentives, resources and constraints, and feedback and status information. Each of these seven categories has several different types of features.

Despite these various interpretations, there is some consensus in relation to the types of features that define gamification. Notably, more abstract concepts like progress and challenge have been listed alongside more observable features like badges and leaderboards. Most features of gamification predate the widespread use of the term; the term was created as a result of the increasing trend in applying these features to non-game contexts.

The game described in this paper has a number of features not previously explored in Māori language learning games. In particular it has a more developed gamification approach than previous examples, with a 2D virtual world within which learners explore interactive language learning activities and tools.

1.4 Mobile Aspects of the Software Tool

Beyond physically being developed and tested on Android devices there were several aspects of the project that related to mobile learning. The software tool created was designed to develop knowledge about specific mechanics and features from modern mobile games applied to language learning experiences. Features such as the interface, user controls, level structures, 3 star system and level progression were based on features in many modern, mobile games. More specifically they were based on more ‘casual’ games that are widely accessible and provide diverse levels of challenge for a wide range of users. Breaking the individual learning experiences into small tasks

with frequent and diverse levels of feedback was a key feature; this is essential to new usage trends associated with mobile learning where learning can take place in a wider range of times and places. Breaking the learning into smaller chunks also had a significant positive impact on motivation and engagement as it increased the learners' sense of progress.

2 Theory and Method

When investigating Māori language learning methods, an effective approach was identified that had many conceptual and structural similarities to the potential concepts and structures of tasks afforded by a virtual game world. Te Ataarangi [12] is one of the well-established Māori language learning techniques in New Zealand, and is modelled on 'The Silent Way' method established by Caleb Gattegno [13]. As part of this technique learners listen to instructions relating to actions they carry out with coloured rods called Cuisenaire Rods and then give instructions to other learners.

2.1 Applying the Silent Way

The three major features of The Silent Way as summarized by Richards [14] are:

- Learning is facilitated if the learner discovers or creates
- Learning is facilitated by accompanying physical objects
- Learning is facilitated by problem solving involving the material to be learned

A key part of this is that learners relate the instructions they are giving and receiving to physical actions carried out on real objects by themselves and other learners. A specific example of this would be asking a learner to pick up four orange rods and place them on top of green rods. This concept of the learner creating understanding through their own actions rather than interpreting a teacher's explanations or reference material is valuable in the context of modern mobile learning tools.

2.2 The Relevance of the Tasks in The Silent Way

One key feature of The Silent Way as a language-teaching method is that it focuses more on the propositional meaning than the communicative value of sentences. Focus is given to learning the underlying structures of the language and the meaning attached to different words and sentence structures. An example of a common area focused on in Māori language learning and The Silent Way is locative prepositions, for example, 'The red rod is on top of the green rod'. These sentence structures are studied for the understanding the meaning of the sentences not their immediate communicative value. The specific nouns/objects used in the sentences relate to physical props the learner can interact with. Traditionally in The Silent Way, plastic rods of varying colours and sizes known as Cuisenaire Rods have been used; this is so learners can construct meaning by physically interacting with objects that relate to the

meaning of sentences. Varying colours and sizes of rods create opportunities to use sentences that contain adjectives. Importantly the relative position of nouns, adjectives and locative prepositions varies between languages. Practising sentences relating to physical props the learner can physically interact with helps develop understanding of the underlying propositional meaning of the sentence. This understanding is transferable to sentences with communicative value in other contexts. On a more basic level vocabulary can be learnt by building associations between the physical objects and the word in the target language rather than relying to translating back to the first language.

2.3 Nature of Language learning Tasks in the Simulated Game World

In the simulated game world the learner can physically interact with a range of game objects that can conceptually take the place of Cuisenaire Rods. A 2D platform game is well suited to building an understanding of locative words and sentences as it has a clear spatial component in which learners can physically move objects similar to the way props are used in The Silent Way. In the game, users create meaning from sentences with locative prepositions by moving rideable objects to positions relative to other objects in the sentence; the game then provides feedback but, if incorrect, gives the learner time to keep searching for the right answer, similar to a teacher in The Silent Way. Figure 1 shows a screen capture from the game, where the learner has to position a moa (a now-extinct bird from Māori history) on top of a coloured box, and compares this activity with the use of coloured rods in The Silent Way.

Fig. 1. Similarities between activities in the software tool (left) and The Silent Way (right)

The transferable knowledge about the relative position of different words in the sentence is the valuable part of what is being learned. In the sentence above the literal

word by word translation would be more like ‘at top the moa of the box green’; notably the nouns and adjectives change position and the locative preposition is at the start of the sentence. Correctly using parts of speech like adjectives and locative prepositions is a common difficulty of language learners and many learners beginning to learn languages that swap the order of adjectives and nouns struggle to learn the new sentence structures. While the learner may practise with rods, moas and boxes the sentence structures are used in many contexts. Importantly when a learner uses a sentence structure to talk about something that is not applied to the Cuisenaire Rods or game world they will likely have some sort of conceptual visualisation or understanding of the concept they are communicating like they have when they are physically interacting with the task. On a more basic level the game world also allowed the key concept from The Silent Way of building associations between physical objects and the vocabulary in the target language without referring back to the English words. Because of the time limitations in the project more development was carried out on the more basic learning progressions relating to vocabulary learning that the more complex and lengthy progressions of learning experiences requires to scaffold the understanding of sentences containing locative prepositions. This is outlined in the results section.

The role of the game world in helping learners learn vocabulary and sentences is similar to that of the rods in The Silent Way; learners have an interactive, physical representation of the sentence and vocabulary they are learning in front of them. In the software tool the game mechanics and structure of the game help structure the learning tasks in a similar way to a human instructor.

2.4 Iterative Design and the Design Science Research Process

We utilised a Design Science Research Process [15] with prototypes being developed and tested with teachers, students and academics as design partners. Aspects of human centered design were used within iterative design cycles to ensure that design partners were involved in the whole design and research process. In practice this involved testing early prototypes with educators, then subsequently whole classes of students. In between testing, the software was redeveloped based on the observations and feedback collected. The game was designed over iterative cycles of development, testing and evaluation; each testing session provided the basis for the next iteration. Knowledge generation was increased through iterative improvement. Knowledge about the implementation of game mechanics in a virtual game world to structure language learning experiences was generated through iteratively implementing and evaluating specific features. Most of the data gathered was qualitative, with some quantitative assessment in the final iteration. This process of knowledge creation through artefact creation was beneficial in the context of this project where a novel combination of features was being investigated.

3 Game development

From reviewing the wide range of development kits available, and the potential dynamic content each can create, it was concluded that the Corona SDK would be the best tool to develop the game. Corona is optimised for 2D applications and allows the easy addition of a physics engine. It also allows the creation of original functions and code to create new features in the software more easily than some more graphical tools that do not fully support scripting. The other major feature of Corona is that it allows for software to be programmed and deployed to Android, Windows Phone 8 and, in the future, Mac and Windows desktop. The game design uses a 2D side-on format, which allows the easy control of a player character and more action intensive game play. The representation of space in side-on games is also ideal for representing objects and concepts in language learning as the perspective allows for the representation of smaller objects, and positions above and below other objects, more easily than top down views.

3.1 Culturally and Nationally Relevant Game Content

When consulting teachers and other design partners, a common feature that was reported to be important was culturally significant content. These features were included in the software tool during development in the form of vegetation, structures, animals, design elements and characters. Another popular feature was the idea of relating different levels of the game to common Māori conceptualisations of the natural environment; specifically, earth, air, sea, forest and sky in relation to the deities/gods of these regions; this represents a common theme in visual art, performing arts and traditional stories. Another culturally significant feature is the abstract patterns and designs used as graphics in the game; the incorporation of designs into menus and buttons creates a uniquely New Zealand and Māori feel to the software.

Fig. 2. Example of draft designs

Culturally relevant visual themes and content were consistently reported as important by teachers and other adults who were interviewed as part of the research process. Great care also has to be taken in choosing designs that are appropriate. While they are unlikely to be final designs developed into any widely distributed version of the software, the designs shown in Figure 2 are original designs developed by people involved in the project. At no point were designs taken or copied. The grey design in the background was given by a wood carver who created it and chose it as an appropriate design to use in the software. The manaia figures were designed by the researcher and carved by students at the school where the research took place. The appropriateness and meaning behind designs is a very important consideration.

3.2 The Virtual Game World

There were several reasons to use a virtual game world as the context for learning tasks in the software tool. The most fundamental one is motivation and engagement. Computer games and interactive media represent a medium that is underrepresented in many areas outside of entertainment. Specifically virtual game worlds represent a potential context for learning experiences in software tools but are very seldom used. Most studies relating to learning and virtual worlds use existing virtual game worlds rather than purpose built game worlds. The opportunities presented by existing or purpose built software applied to learning are very different. Creating purpose built virtual worlds allow a level of customisation to shape specific learning experiences through tailoring game mechanics to incentivise specific user behaviours that help achieve particular learning outcomes. Pre-existing virtual worlds on the other hand offer vast resources with more open learning experiences that are different in nature.

One of the main reasons that few educational software tools have tried utilising virtual game worlds is the resourcing and expertise required to create interactive virtual worlds. Games are financed largely from sales and as an entertainment medium they are generally bought and consumed more widely than educational software. Educational software is often created with limited resourcing that is not sufficient to develop many more advanced features of interactive media. This is changing as more powerful tools are developed for creating modern interactive media. Educational software is also becoming more widely purchased and monetised through app stores. It is likely that there will be more educational software developed that makes use of features of modern interactive media like virtual game worlds and a subsequent increase in interest.

3.3 Game Mechanics

In addition to the virtual game world and learning tasks, specific game mechanics were developed within the software tool. Techniques such as scores, coins, star systems, ranks and in-game currency with purchasable rewards were developed and tested.

An aim in the project was to iteratively develop game mechanics as an integral part of the structure of the learning experiences that were being developed in the learning

tool rather than superficially adding scores or stars that played no functional role. The mechanics were used to incentivise certain behaviours that were designed to increase identified learning outcomes and additionally motivate and engage users. Vocabulary learning was the main skill being targeted. A desired behaviour was for learners to repeat levels where they made mistakes in order to practice the words more. Getting learners to repeat tasks multiple times is not always easy; however, incentivising rather than forcing repetition helped shape the learning. Importantly the right mechanics offer differentiated incentives for users based on previous interactions. The most fundamental mechanic is the three star system.

The three star system is a way of rating user performance for a specific task which usually relates to one game level; users can receive between 0 - 3 stars for each task. It has increased in popularity as a mechanic due to its prevalence in modern mobile games. Modern mobile games are also often referred to as casual games due to their wide appeal and usability, a feature that is also desirable in learning tools. Usability in modern mobile games is increased by creating more differentiation in challenges; there is a very low skill threshold for progression but a high skill threshold for perfection in contrast to other formats of games in which there is consistently a high skill threshold for passing every level. The applicable concept for structuring learning experiences is that of giving all users a consistent sense of progression while still incentivising perfection. In the 3 star system obtaining at least 1 star is a requirement to unlock the next level and is normally very easy.

In this project each level contained a specific amount of vocabulary to be learnt; users had to read instructions that required them to navigate to specific objects in levels. If learners had not learnt the words they would struggle to match them correctly but still be able to complete the level through trial and error. This is where the 3 star system is useful as a game mechanic; completing a level through trial and error still unlocked the next level but only one star was given if more than one mistake was made. Making only one mistake would gain the user a 2 star rating and no mistakes earnt a 3 star rating. Differentiation in feedback and next learning steps is an important feature of this mechanic. While it is not an overly complex way of tracking and displaying achievement it is very effective when compared to some other systems of feedback. We could compare it to standalone quizzes with percentage scores. A key feature of the star system is the overview screen that shows all of the levels. This allows users to view a summary of their performance on every level indicating the next level to progress to or previous levels that can be perfected.

Implementing this mechanic throughout iterative cycles in the research provided valuable findings. The effectiveness of the 3 star system was dependent on the specifics of how they were implemented. It was consistently found that spreading the learning in smaller chunks over more levels was more effective than learning the same content within fewer levels. Increasing the frequency of feedback and reward had a noticeable effect on motivation. Importantly, the nature of the levels as part of the structure of the program are an integral part of shaping the user experience and making other mechanics effective. This was directly observed across the iterative cycles of development, observation and evaluation. In early iterations, more words were included in each level and at sometimes repetition of words was required. When early

levels were more lengthy engagement was noticeably lower than when early levels were shorter and gave users a sense of achievement very quickly. The levels can then be steadily increased in difficulty as the user progresses. One observation that seems quite logical and intuitive is that once users had achieved 3 stars in earlier levels they would then persevere on more difficult levels to achieve the higher star rating; if they were presented with harder levels early on they were much less likely to aim for perfection.

4 Results

Classroom observations during the iterative development cycle showed the tool was both engaging and effective for vocabulary learning. Knowledge was generated about how a wide range of game mechanics can be used in a game world to structure mobile, Māori language learning experiences. The quantitative evaluation showed that students were able to learn vocabulary over a short time using the tool.

The results of the study were based on qualitative observations and two sets of quantitative pretests and posttests. The qualitative data gathered in observations were part of the iterative design cycles; observations were followed by subsequent cycles of evaluation, design and testing. The pretests and posttests were part of the last two iterative design cycles. Quantitative data was not gathered earlier on as its purpose was not to provide actionable information to inform the next iterations. The qualitative observations were focused on testing how game mechanics and the game world affected students' learning experiences in order to make actionable observations about features of the game world and learning tool.

4.1 Qualitative Observations from Iterative Cycles

Figure 3 summarises some of the most important observations from user testing within the iterative design cycles. For the sake of brevity the 10 iterative cycles have been summarised into iterations 1-3 and 4-10. Iterations 1-3 have been grouped together as they tested a single game level with teachers and some limited testing with small groups of students. Iterations 4-10 tested multi-level progressions with a whole class and groups of four students at a time. Some features in the early iterations were immediately successful; the 2D game platform itself, the use of 'rideable' objects for locative prepositions and vocabulary matching activities, where users had to match a set number of words with a score counter. Other features were not so successful. The ability to carry and place objects turned out to be neither very usable nor very intuitive, and carrying and placing objects seemed contrived to the users. This feature was abandoned. Other features needed further work. For example the tasks related to making meaning from sentences with locative prepositions, and carrying out corresponding actions in the game world, were functional but required some optimisation to be understood better by all users.

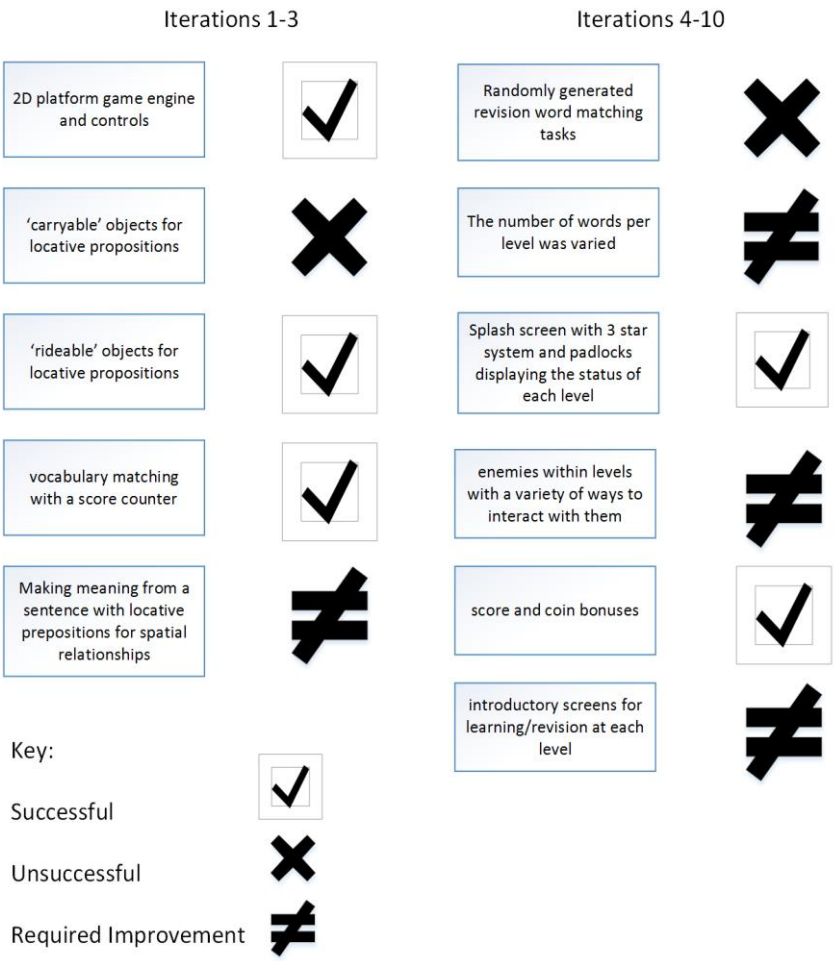

Fig. 3. Overview of the two main phases of iterative development

In iterations 4-10, the successful features were a splash screen to collate all levels with a 3 star system and padlocks displaying the status of each level, and score and coin bonuses. Repeating words for random revision was perceived negatively by testers as it created some confusion as to what was required to pass the level, so this was abandoned. Features that required improvement included the number of new words in each level, enemies (actually mosquitoes - while users enjoyed some challenge within the game, many users were not gamers who enjoyed very difficult challenges) and introductory screens at each level; these had to be given some dynamic content to make them worth using.

Although this is a major simplification of the actual process, it gives an indication of the way that the interaction with users in the design science framework led to gradual evolution of the final game.

4.2 Summary of Iterative Design Cycles

The iterative design cycles were invaluable to creating and evaluating a range of features. The overall focus on knowledge creation rather than the completion of the final product within the limited timeframe allowed the repeated implementation of new features rather than volume of content; this created valuable findings relating to the use of and effectiveness of game mechanics and the virtual game world. The most important observations related to how tasks were structured within and across levels. The 3 star and padlock system created a great way to structure learning experiences by allowing all learners to progress but incentivising repetition for learners who had not perfected vocabulary lists. In different iterations vocabulary sets were varied and observations showed that users gained confidence quicker when initial levels contained smaller vocabulary sets with around 5 words; these could then be increased to around 8 - 10 words in later levels. Users were observed to more readily repeat levels that required more vocabulary learning if they had already achieved well in the preceding levels. Similar observations were made about other game mechanics like star ratings, enemies, bonuses and the user interface; only a sample have been listed in this publication.

A secondary observation relates to engagement and motivation. While it was always expected that different students would have different levels of interest in the software, it was observed that students universally seemed to be engaged by the software and throughout every one of the iterations did not put the test device down until they had completed every one of the levels; most users would repeat all levels until a 3 star rating was achieved. Users were never told they had to complete all levels or keep using the software.

4.3 Testing Locative Prepositions

While the observations from iterative design cycles indicate that modern game mechanics can help structure learning experiences, structuring learning progressions relating to more complex sentences containing locative prepositions was only preliminarily tested during iterations because of time constraints. Tasks involving locative prepositions were tested and definitely provided proof of concept. Users who had a basic understanding of sentence structures found the activities relating to complex sentences involving locative prepositions and adjectives engaging. The problem was that from observing the structure of learning progressions required to teach vocabulary and sentence structures from scratch, it was evident that the learning progressions required to properly scaffold complex sentences would be too lengthy to quickly iterate upon during the iterative design research process. For this reason quantitative testing was only carried out on vocabulary learning tasks and more focus was given to testing different aspects of other game mechanics.

4.4 Quantitative Testing

During the last two iterative cycles of classroom observations, quantitative pre-tests and post-tests were used to evaluate how much vocabulary was being learnt in the testing sessions. The quantitative evaluation of the software tool was based on a paper in which a dialogue based CALL tool was developed for Māori language learning [16]. There was no control group used in this study; partly for ethical reasons but also because it was not a comparative study. The main question to be answered from the quantitative evaluations was whether vocabulary could be learnt effectively with the software tool.

The tests consisted of connecting twelve words with their definition in the first pre-test and post-test in Iteration 9, then ten words in the second pre-test and post-test in Iteration 10. Individual results and averages were compared.

The tests were carried out on a group of students that had a wide range of abilities; they were not offered any extra instruction relating to the vocabulary or any special instruction on how to use the software, though they had used it before with different vocabulary lists. During both sets of testing the users played through 6 levels which required them to learn the required words in 2 smaller vocabulary groups and repeat them across revision levels. The change from 12 words in the first test down to 10 words in the second test was made in order to repeat the vocabulary more often over the same amount of levels. While this meant that the results of the 2 tests could not be compared, there was little value in comparing separate iterations of the software anyway as other features were changed between the iterations. The amount of words that learners already knew in the first test is far greater as more effort was put into finding completely unfamiliar vocabulary in the second test. In the first test, vocabulary that hadn't been used in previous iterations and user testing was used; however, many of the students had some existing knowledge of vocabulary. In the second pre-test and post-test completely unfamiliar vocabulary was used; the 2 correct words achieved by 4 students represent words that were possible to guess.

The results of the two different tests showed some variation. This was because they involved different vocabulary and were tested during different iterations. The first test used a word set that students already partially knew; this is not a problem in itself as sometimes learning tools are used to reinforce vocabulary that is already known. The results showed an average improvement of 6.875/12 to 10/12. The results of this test are shown in Figure 4

The second quantitative test tested a vocabulary set that was unknown to the students; there were still two words that some students knew or managed to guess in the pre-test. This test showed an average improvement from 0.72/10 to 6.45/10, as shown in Figure 5. T values and P values strongly indicated that there was a low chance the results were accidental. The results are good overall considering a lot of the users were younger students who did not have a lot of existing strategies for memorising vocabulary. It can be hard to recall more than 7 items from memory at once so the 12 word and 10 word vocabulary sets for a 10 minute playing session were on the higher side. It is notable that all learners showed some improvement.

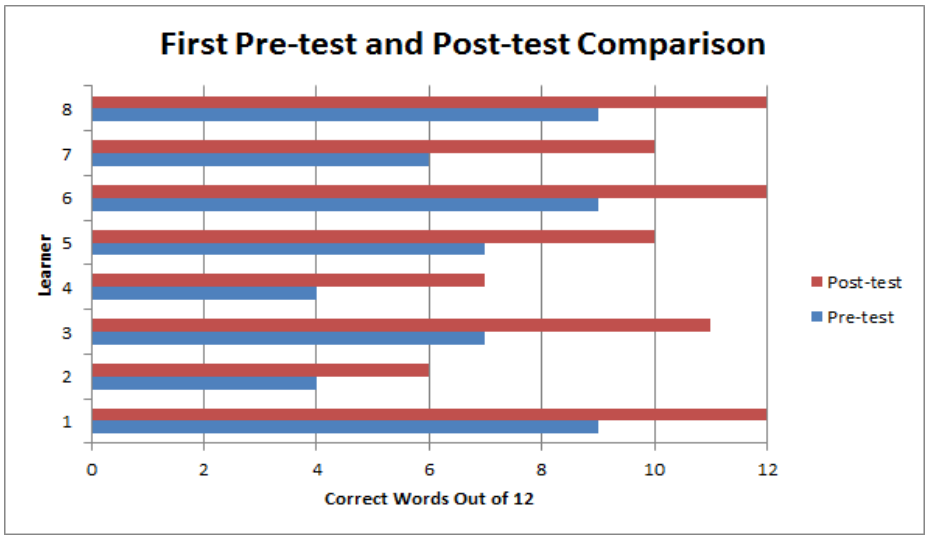

Fig. 4. Results of First Quantitative Pretest and Posttest

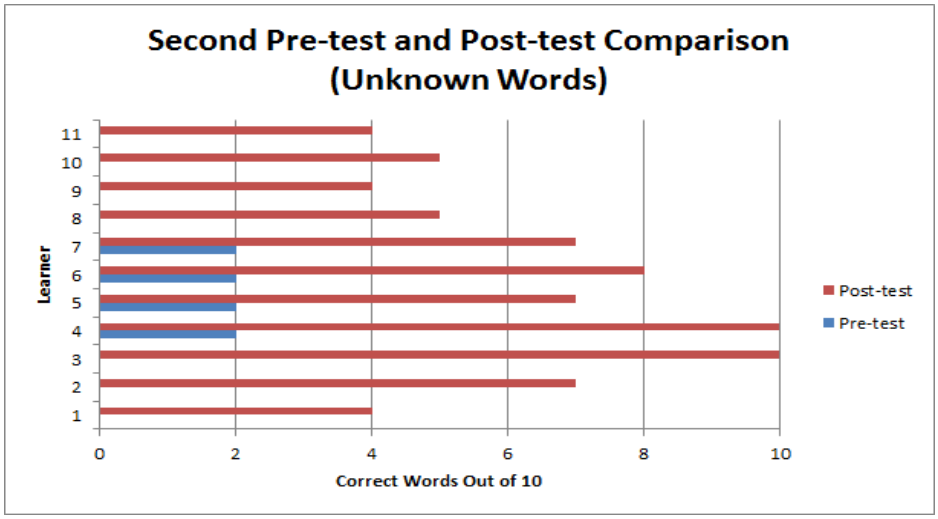

Fig. 5. Results of Second Quantitative Pretest and Posttest

5 Conclusion

This study used the Design Science Research Process to create knowledge about game mechanics used in a virtual game world to structure Māori language learning experiences. Progressive iterations built upon each other and provided valuable observations and knowledge about how particular mechanics could be used in specific

ways to enhance learning experiences. Importantly, the specific details about how mechanics were balanced was repeatedly evaluated and implemented. While the study did not provide a comprehensive quantitative comparison between the software and other learning methods it provided a large amount of comparisons of progressive implementations of game mechanics and the virtual world. Given the novel nature of the software tool these comparisons and observations throughout the iterations were of more utility in developing the tool than any comparison with other methods.

The virtual game world provided a highly engaging context for learning which students instantly wanted to explore. The ability of the game engine and game world to run its own logic and rules meant that there was no explanation needed for students to start interacting and learning; students could easily interpret feedback relating to where they were within the learning task and what they should do next. The virtual game world allows the instructional designer to structure learning experiences in a way that gives users a sense of freedom and exploration while maintaining a high level of control over the overall structure and progression of learning.

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