

A Green Approach for an Irish App (Refactor, reuse and keeping it real)

Monica Ward
Dublin City University
Ireland
monica.ward@dcu.ie

Maxim Mozgovoy
University of Aizu
Japan
mozgovoy@u-aizu.ac.jp

Marina Purgina
University of Aizu
Japan
mapurgina@gmail.com

Abstract

There is a lack of apps for learning Irish, and while there is a potential demand for such apps, good quality, pedagogically sound apps are difficult to develop. This paper reports on a green approach to develop an app for learning Irish. It refactors and reuses an existing app (WordBricks, Mozgovoy and Effimov, 2013) and adapts it for Irish. The app uses existing Irish NLP resources, specifically Uí Dhonnchadha's Finitate Stage Morphological Analyser (2002) and Lynn's Irish parser and treebank (2016), as part of the app. The app was developed in conjunction with teachers to ensure that it was curriculum-aligned and testing with the target learner group (primary school learners) before actual deployment in a real classroom. The app has been used by a variety of classes, ranging in age from 7 to 11 years of age. Results indicate that the app is usable and enjoyable for learners and teachers report that it is beneficial for their students. It would not have been possible to build the app in a relatively short period of time without adopting a green (i.e. refactor, reuse and real) paradigm.

1 Introduction

Irish is one of the two official languages of Ireland along with English. However, only a relatively small percentage of the population speak it as an L1. Nearly all students study the language in school with primary school children studying the language for around 30 minutes each day and secondary school students for 160 minutes a week. The teaching of the language is currently very traditional, with a 'chalk and talk' and 'sage

on the stage' approach prevailing. There is a space for more modern resources for the teaching and learning of Irish. This paper provides an overview of a mobile Irish language app, Irish WordBricks, that allows learners to practice the construction of grammatically correct sentences in Irish. The Irish WordBricks app uses a visual learning paradigm and can be used by learners of all ages.

1.1 Language Learning Apps

Language learning is difficult and anything that helps the learning process is to be welcomed. Motivation is very important in learning (Dörnyei & Ushioda, 2013; Ushioda, 2013), particularly in language learning as the challenges involved and the application of the knowledge acquired may be difficult. In recent years, there has been an increasing use of technology in the language learning process. One area of expanding interest is that of language learning apps. These apps let students learn a language on a mobile device, with an anytime, anywhere approach. Some of the most commonly used apps are Duolingo, Buso and Memrise. These apps are free to use for the basic components and learners can pay extra to have access to more advanced features and additional resources. Many of these apps are used in the informal learning space, but could be used in the formal as well. Duolingo (n.d.) is probably the best known language learning app and is currently available in 33 languages, mainly the most commonly spoken languages but it also includes Irish (954,000 learners), Welsh (347,000 learners), Navajo (251,000 learners) and Klingon (500,000 learners). It works on a translation approach whereby learners have to translate words between their L1 and the target L2 in both directions. It uses a gamified approach to learning (Nacke and Deterding, 2017; Reinhardt, J., & Sykes, 2014) and it can be beneficial for some learners. Duolingo uses a community

development approach but also has a team of developers working behind the scenes.

1.2 Irish App Development Challenges

Language learning apps, such as Duolingo, Buso and Memrise, are often enjoyable and can be pedagogically informed. However, they may not be suitable in some learning contexts. For example, they may not cover all aspects of the language learning process (which is very difficult to do), their pedagogical approach may focus on one particular strategy and learners may have needs that are not met by these apps. Learners cannot construct their own sentences and are constrained by the sentences already predefined in the app. It would be beneficial to have other apps and technology-based resources for learners.

There are many challenges to be overcome to develop a language learning app for any language. The field of Computer Assisted Language Learning (CALL) (Beaty, 2013; Levy and Stockwell, 2013) is a multi-disciplinary one involving language teachers, linguistics, pedagogical specialists, Natural Language Processing (NLP) experts, software engineers, programmers, user interface designers and, of course, language learners. Access to sufficient financial resources, adequate time and availability of relevant experts is also important. This is the ideal scenario and one that rarely exist, even for some of the Most Commonly Taught Languages (MCTLs). In reality, CALL researchers and practitioners must be resourceful and use whatever resources and skills are available to them. The challenges are even greater for Less Commonly Taught Languages (LCTLs) where there is usually less of everything. There is usually not a multidisciplinary team available to develop CALL resources, there are fewer financial resources and often not many available experts to contribute to the design and development process.

ICALL (Intelligent CALL) is a branch of CALL that includes the use of NLP resources in the design and development of CALL resources (Heift and Schulz, 2007). Many LCTLs are also Lesser Resourced Languages (LRLs) and there is often a lack of suitable, good quality NLP resources for LCTL CALL researchers to leverage. This is the case for most of the Celtic languages, although there are some high quality resources available for specific language and functions. For example, in the case of Irish, there is a Finite State Morphological Analyser (Ui

Dhonnachada, 2002) and a parser (Lynn, 2016) that are of high quality and available for CALL resources to use. Mobile Assisted Language Learning (MALL) is of growing interest within the CALL community in recent years ((Holden & Sykes, 2011; Kukulska-Hulme, 2009; Kukulska-Hulme, 2012; Stockwell, 2012)) and there are many MALL apps being developed, particularly for the MCTLs.

Irish is a compulsory subject in Irish primary and secondary schools, although some students can get an exemption from studying the language. Reasons for exemptions include having a learning difficulty (e.g. dyslexia) or if the student came to Ireland after a certain age. In Irish primary schools, teachers are generalists and teach all subjects to their students, including Irish. At second level, teachers are specialists and will have four years of undergraduate study in their subject and two years postgraduate study in education. There are several issues to consider in relation to Irish language teaching. Most teachers, both at primary and secondary level, are not native speakers of the language. Primary teachers in particular have many subjects to cover and Irish is only one of them, so the level of ability in Irish can vary widely from one teacher to another. Some primary teachers are passionate about Irish, while others less so. Some teachers may lack confidence in their Irish language ability and this can have an impact on their teaching of the language. At second level, there is currently a shortage of Irish language teachers and it is hard from schools to find qualified teachers.

Language pedagogy is a specific branch of pedagogy. It is different from studying a subject like biology or history and it is important that teachers have knowledge of language teaching in order to help their students learn more efficiently, effectively and enjoyably. Learning a language does not just involve the four basic skills (reading, writing, listening and speaking), but involves cultural awareness and pragmatics, learning new sounds, having the courage to make mistakes and learn from them and sometimes thinking about things in a completely new way. In Ireland, students learn a Modern Foreign Language (MFL) (e.g. French, German or Spanish) in secondary school. MFL teachers study all aspects of language pedagogy. However, primary school teachers will only have limited exposure to language pedagogy as part of their pre-service teacher undergraduate study and will only have a limited knowledge of CALL. In some university

departments there is a separate department for Irish and a different one for Modern Foreign Languages and this can sometimes mean that there may be a lack of cross-over knowledge in relation to language pedagogy and CALL. Also, there may be a focus on traditional aspects of language teaching with less space for more modern or innovative approaches. This in turn can result in less positive learning experiences for students learning Irish compared with a MFL. Their level of language attainment after 13 years of study is also quite low (Harris et al, 2006). Of course, there have been changes over the years and there are places where there is excellent and innovative teaching taking place, but there are still schools where there is plenty of room for improvement. The lack of teachers compounds this problem.

Irish has a paradoxical role in Ireland. Devitt et al. (2018) report on primary school children’s attitude towards the language and their varying level disengagement with the language. Research shows that people value the language, they see it as part of Irish identity and recognise the cultural importance of the language (Darmody and Daly, 2015). However, when it comes to the classroom, sometimes they are less enthusiastic. Less importance may be attached to Irish language homework and some parents may prefer their child to study a ‘useful’ language like Spanish or Chinese. All Irish language speakers in Ireland also speak English and the lack of utilitarian value can impact perception of the language (Laoire, 2005). The paradoxical role of Irish can impact on teachers. They can feel the societal weight of responsibility for teaching the language, yet feel little support from parents for the actual teaching of Irish. Negative attitudes towards the language can be demotivating for both teachers and students.

| Irish App Development Challenges | |
|----------------------------------|---|
| Challenge | Comment |
| CALL development is difficult | Difficult for any language, more so for Less Resourced Languages like Irish |
| Irish language teaching | Few teachers are L1 speakers, lack of confidence, not a focus for some |
| Irish language pedagogy | Pedagogy is improving but room for improvement |

| | |
|--|---|
| Paradoxical attitudes towards the language | Culturally valued, but less positive in reality |
|--|---|

Table 1: List of Irish app development challenges

1.3 WordBricks

WordBricks is an interactive language learning app (Mozgovoy & Efimov, 2013). It was originally designed for adult learners (Japanese university students) of English. It is based on a visual learning paradigm, somewhat similar to the interface used in the visual programming language Scratch (Resnick et al., 2009; Wilson et al., 2013) and other work with blocks to illustrate grammar points Ebbels (2007). Each part of speech (POS) is given a different shape and colour (e.g. all verbs are blue and start with a straight edge). Learners can construct grammatically correct sentences by putting different parts of speech in the correct order in a sentence. In fact, learners can *only* construct grammatically sentences – the app will not allow them to put POS in the wrong place. The motivation behind the app was to enable learners to experiment with different sentences and play around with word order so that they could familiarise themselves with the structure of a language. When language students use a book to learn a language, they are often restricted to a limited number of example sentences or exercise sentences. They have to consult with their teacher if they want to check the correctness of sentences they construct themselves. This limits the freedom they have to work without teacher support and may restrict their motivation to try out new sentences for fear of making mistakes. The visual learning paradigm used by the app facilitates the pattern matching aspect of language learning, as the more sentences a student constructs, the more obvious the patterns become. Figure 1 shows an example of a sentence in English. The verb component ‘saw’ in blue and starting with a straight edge. It expects a subject that has a rounded side (in this case ‘we’) at the start of the sentence and it expects an object after the verb ‘saw’. The object in this case is ‘things’ and it can be qualified by the words ‘many’ and ‘interesting’ as these are the correct shapes (parts of speech) that can precede the object ‘things’. The full sentence of Figure 1 is ‘We saw many interesting things in the museum’ (although ‘The interesting things saw we in the museum’ would also be accepted).

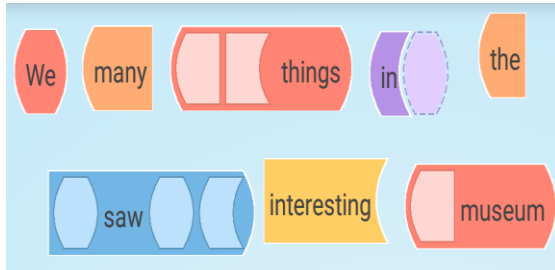


Figure 1: A sentence for the original WordBricks app for English

2 Approach

As with many Lesser Resourced Languages and LCTLs, Irish is under-served by CALL resources. It is not financially attractive for commercial entities to develop CALL resources for Irish. However, there are some good resources recently developed for learners. For example, Irish 101 on the FutureLearn platform is an online MOOC for learning Irish and culture (Irish101, n.d.). It is very successful and has had learners from all over the world studying Irish. Dalton and Devitt (2016) have developed a successful online detective game for primary school students. Hainey et al. (2016) provide an overview of game-based language learning resource at primary school level, including for language, and they note that many of them use commercial off the shelf (COTS) games. This is often not an option in the Irish context. As noted above, it is a challenge to develop CALL resources for Irish. Limited resources (financial, NLP and time) and lack of relevant experts demands a smart approach. A combination of refactoring, reuse and real-world focus were used to develop the Irish WordBricks app.

2.1 Refactoring

Refactoring is the process by which existing code is changed without changing its external behaviours (Fowler, 2018). Refactoring usually takes place when a code smell (lovely term) is detected (e.g. when something ‘wrong’ is noticed). This means that developers will review code that is unusually slow or could be improved (noticed by a ‘code smell’). It can be done to improve maintainability and extensibility. Refactoring in this case took place in the context of making an existing app work in other contexts. WordBricks was initially developed as an app for Japanese university students of English (Park et al., 2016) and needed to be refactored to work for

Irish. The app had been successfully developed and used in a Japanese university, so the technology and the pedagogy had been tested and proved successful (Park et al., 2016). The aim was to refactor the English version of WordBricks so that it could be used to develop an app for Irish. The target user group, the setting and the devices used to run the app were all different. The original WordBricks was designed for adult learners to use outside of the classroom setting on a mobile phone. While it might be obvious, it is important to remember that education with adults (androgogy) is different to that with children (pedagogy) (Knowles, 1968). The Irish WordBricks app was aimed at young primary school learners, in a classroom setting on the teacher’s laptop or a tablet. The refactoring process would involve keeping the same front-end functionality and User Interface (UI), but rework the back-end so that it was language independent.

2.2 Reuse

There were two elements that were reused in the development of the Irish WordBricks app. The first was the reuse of the original WordBricks app itself. The second element was the reuse of existing Irish NLP resources. These were the Finite State Morphological Analyser (FSMA) (Uí Dhonnchadha, 2002) and the Irish language parser (Lynn, 2016). The FSMA analyser is a high quality NLP resource for Irish and it produces Irish morpho-syntactic tags for an input sentence. The FSMA was used manually initially to check part of speech information when developing example sentences for the Irish WordBricks app. The Irish Parser produces treebank information for an input sentence. The idea was to use the knowledge in these resources to ensure the accuracy of the grammar constructions and words used in the Irish WordBricks app.

2.3 Real-World Focus

Many language learning apps and resources get built, tested in a controlled environment and never make it out to the wild (i.e. the real world). This may be because the app may not be sufficiently robust for external use or may need additional resources that are not available in the real world setting. Another reason that this sometimes happens is if the app is not curriculum-aligned. Curriculum-alignment is a key factor in CALL real-world usage for any language (Bax, 2003; Chambers and Bax (2006) and also for Irish

(Ward, 2007). The school curriculum, at both primary and secondary level, is packed. Teachers do not have spare teaching time to devote to additional, optional extras. Therefore, if an app is not curriculum-aligned teachers will be reluctant to use it. In order for an app to be actually useful for teachers and students, it must be designed with a real world focus from the start and be cognoscente of the actual deployment context and real world conditions prevailing in the learning environment. The Irish WordBricks app was designed using a user-centre design approach whereby the teachers were consulted at an early stage in the design process about what topics should be covered and how the app could be deployed in the classroom. They decided that possession, doing something, feeling something, location and asking questions were important topics to have in the app. The presumption was that the teacher would have already taught a topic before the students would use the app i.e. the app would be a tool rather than a tutor (Levy, 1997).

3 Methodology

The process of developing the Irish WordBricks (IWB) app took place in several phases. In the initial phase, the Irish CALL researcher worked in parallel with several primary school teachers and the WordBricks developers on possible grammatical constructs. The Irish CALL researcher and the teachers reviewed the Irish syllabus and current textbooks to decide on the topics to be covered and the vocabulary to be used in the app. The WordBrick developers worked on refactoring their app so that it would work for Irish as well as English. They then worked on incorporating the required grammatical information and vocabulary into the WordBricks infrastructure to create the first version of the Irish WordBricks app. In this Phase, the (Finite State Morphological Analyser (FSMA, Uí Dhonnchadha, 2002) was used (manually) to check the POS of each of the words in the example sentences and vocabulary lists. The information was passed to the WordBricks developers using an informal, ad-hoc structure and they incorporated it into their WordBricks engine (see Figure 2).

An iterative, agile approach was adopted, whereby one topic (grammatical construction) was implement and tested by the WordBricks developers, the CALL researcher and the teacher and checked for correctness before implementing

another topic. The target learner group (primary school children) also tested the app at an early stage to ensure that they could use it without any difficulties.

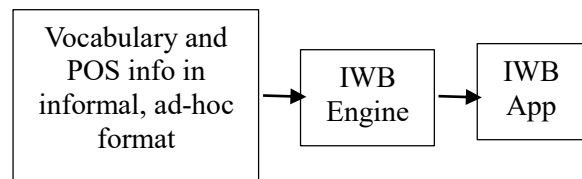


Figure 2: Phase 0 of Irish WordBrick development

Figure 3 shows the informal ad-hoc format used for the construction ‘to have’. The WordBrick developers had no prior knowledge of Irish and it was necessary to explain both the vocabulary and part of speech information to them.

| | | | |
|--------------------------|--|----------------------|----------------|
| Have | | | |
| Format: | bí (verb) + optional article + noun + (with pronoun) or (with Prep + Noun) | | |
| Example 1 | | | |
| <i>Tá hata agam.</i> | I have a hat. | | |
| Example 2 | | | |
| <i>Bhí an hata agam.</i> | I had the hat. | | |
| Tok. | Lem. | POS | Meaning |
| Tá | bí | Verb Verb+VI+PresInd | Is |
| Bhí | bí | Verb VI+PastInd+Len | Was |
| hata | hata | Noun Masc+Com+Sg | hat |
| agam | ag | Pron Prep+1P+Sg | (with me) |

Figure 3: Sample informal information for ‘to have’ construction

In Phase 1 of the IWB development, the individual example sentences were encoded in an XML file. All known words (with their POS information) were stored in the IWB app so that learners could construct their own new sentences as well as constructing the example sentences. This involved the Irish CALL researcher providing the WordBrick developers with the example sentences and the relevant vocabulary list specifying the POS of each word. This enabled the IWB app to be developed using the same black-box architecture as the original English WordBricks app (see Figure 4). While this was very beneficial, it was quite limiting as it was

difficult to decide how best to structure the information and there was an associated turnaround time to enter new examples into the app.

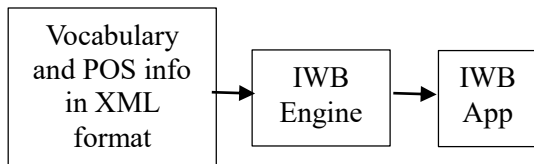


Figure 4: Phase 1 of the Irish WordBricks app

In Phase 2 of the IWB development, existing NLP resources for Irish were used to automate the process and enable learners to have access to a wider range of vocabulary. The Irish WordBricks app was developed on the basis of Uí Dhonnchadha’s (2002) Finite State Morphological Analyser (FSMA) for Irish, Lynn’s Irish parser (2015) and the Irish treebank (universal dependencies version, Lynn and Foster (2016). The user inputted sentence is passed to the FSMA for Irish (Uí Dhonnchadha, 2002). The FSMA produces Irish morpho-syntactic tags which are passed to the Irish parser (Lynn, 2016). The parser’s output is then fed into the Irish WordBricks engine which takes maps the sentence into an XML structure. This XML data is passed into the IWB App where the learner can see the individual words and then construct a grammatically correct sentence. (see Figure 5). The Irish WordBricks app relies on the underlying NLP tools to handle ambiguity. One advantage of dealing with learners with a low level of language ability is that their choice of words is usually limited and they are unlikely to (be able to) construct complex sentences.

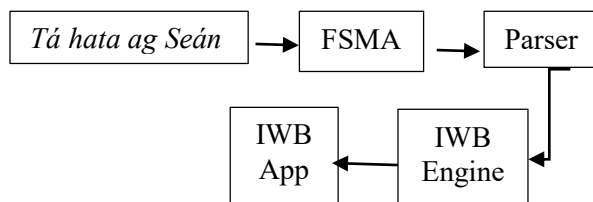


Figure 5: Phase 2 of the Irish WordBricks app using existing NLP resources

The topics covered in the IWB app include: to have something (*Tá hata agam.*), to do something (*Tá Seán ag rith*), feelings (*Tá áthas ar Liam*), location (*Tá leabhar ar an mbord*) and questions (*An raibh Áine ag ithe?*). Figure 6 shows the

construction of simple sentence (*Tá hata agam* – I have a hat). If the word is the correct place, the learner will see the brick turning yellow and the word will click into place.

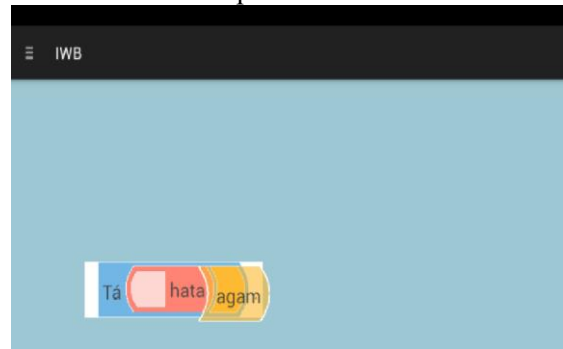


Figure 6: Example of a simple sentence in Irish WordBricks

Figure 7 shows an example of location (*Tá leabhar ar an mbord* – there is a book on the table).

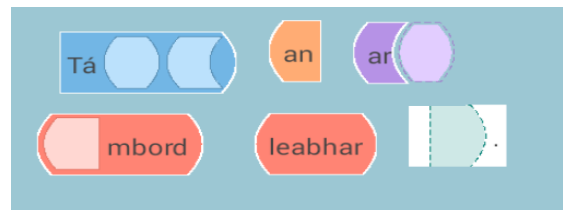


Figure 7: Example of location sentence in Irish WordBricks

Figure 8 shows two sentences lined up together and illustrates how students can benefit from this visual learning approach (e.g. colours and shapes) to remember language and part of speech patterns in a sentence.

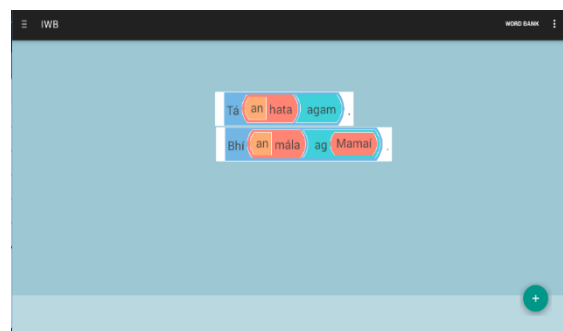


Figure 8: Example of two similar sentences lined up together in Irish WordBricks

Figure 9 shows how the app prevents a student from constructing a grammatically incorrect sentence. The student is trying to add the article

'na' (definite plural) to a singular noun (*hata* – hat) and app does not let the student place the word there.

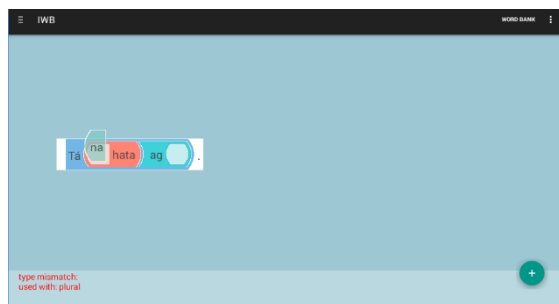


Figure 9: Example of Irish WordBricks preventing the construction of an incorrect sentence

4 Results

The app was initially tested with four adult learners of Irish. Their feedback was positive and they like the user interface and felt the app was easy to use. The app has been used by a variety of primary school learners (Purgina et al., 2017) over a period of three years (including this year). The app has been used by second class students (7-8 years old), third class students (8-9 years old) and fifth class students (10-11 years old). The app was used by three 3rd year classes (n=72) and two 5th year classes (n=44) in Year 1, three 2nd year classes (n=72) and two 5th year classes (n=52) in Year 2 and three 5th year classes (n=75) in Year 3. There were two primary schools involved – one all-boys and one all-girls. Three teachers were involved in the consultations about the content of the app.

The IWB app has been used in a variety of ways. Initially it was used in a whole class setting. This involved the teacher showing the students a particular construct (e.g. to have *Tá hata agam* – I have a hat). This involved putting the IWB on a laptop and using an android emulator to run the app and show it to the class via a data projector. The teacher would then ask some students to come up and construct the example sentences in front of the class. Then several students were chosen to construct their own sentences for the class. This approach worked reasonably well but more students wanted to use the app than time permitted. However, this was the only possible way of using the app as there were no computers or tables in the school for student use.

In the second year, students were given tablets to run the IWB app. Initially, they use the tablets

in pairs but then they were given individual tablets to work with. This had the advantage of enabling students to work at their own pace. This is very important in a subject like Irish where there is a wide range of ability in each class. One slight disadvantage with this approach, is that students try to get the example sentences done as quickly as possible so they can construct their own sentences. Sometimes they try to set up loads of words and they can lose focus on the pedagogical aspects of the app.

In the third year (this current year), the deployment of the app is more structured. The teacher revises a particular construct with the students and asks them to write their own sentences on paper. The students can use the app to do the example sentences and then they can input their own sentences. This structured approach appears to be working well. In the first version of the app, the vocabulary was fixed and was based on the words that the students had studied with their teacher. In the second version of the app, the students have the facility to enter their own words.

Feedback from the students and teachers to date has been very positive. In the Irish language learning context, qualitative research is very important (Ward, 2018). The students find the app easy to use, they think it helped them to learn Irish, and most importantly, they enjoyed using the app (*“Really good, fun and easy to use”*). The students had many suggestions for future improvements. For example, they would like it to be more gamified (*“Maybe a challenge mode to test you”*), *“To challenge people online and get points for longer sentences”*, they would like translations (*“Every Irish word & English subtitles”*) and they would like more words (*“Add new verbs and different names”*). Some students wanted to know when they could download the app (*“Great help, can’t wait until it’s on the app store :-)”*) which is encouraging. One student had a great insight into the app *“I love the method it uses to create sentences. It’s a bit like a puzzle in a way. I also adore the trial and error style”*.

The teachers also had positive feedback. They were happy with the topics covered and were glad to see the level of interaction and engagement of the students with the app. Usually, their Irish lessons do not generate the same buzz in the classroom.

5 Discussion

It would not have been possible for the CALL

developer to develop the Irish WordBricks app from scratch in a reasonable timeframe. The fact that the original WordBricks app could be refactored to produce the Irish WordBricks app meant that learners could start using the app in a period of months rather than years. WordBricks has already been tried and tested with real users and had the WordBricks team demonstrated that it was a useful and viable app for learners. This gave confidence to the Irish WordBricks team that the aim of developing a useful, enjoyable app for Irish language learners was feasible rather than a pipedream.

It was very important that real learners used the app in their real world setting. The IWB app was curriculum-aligned right from the start and teachers were consulted throughout the design and development process. Learners were asked for their feedback and each version of the IWB app has included improvements based on their feedback. For example, students wanted to be able to save their sentences and this is now possible. Students wanted to be able to type in their own words and they can now do this.

From a technical perspective, the new version of the Irish WordBricks app allows for greater flexibility and demonstrates the power and potential of reusing existing NLP resources in the development of CALL resources for Irish. It would not have been possible to develop such a resource in a relatively short timeframe from scratch and it would have required technical and linguistic knowledge of Irish that only a very few people possess. Existing resources from Irish NLP researchers (Uí Dhonnchadha 2002, 2009; Lynn, 2016; Lynn and Foster, 2016) were invaluable in this regard.

6 Conclusion

Irish, like the other Celtic languages, would benefit from having more resources available for language learners. However, it is difficult to build robust, grammatically accurate, enjoyable resources for students. The IWB app works due to a variety of factors. The motivation behind the development of the app was strong – teachers, students and the CALL researcher knew that there was a real need for such an app. There was a multidisciplinary team involved in its development including teachers, students, CALL researchers, education design specialists and app developers. The concept and reality of the app had been proven in another domain. The IWB team was aware of, and consistently conscious of

the real world deployment context of the app. An important aspect to be emphasized is that the system has been used by a variety of students ranging in age from 7 to 11 years and the final product is enjoyable for students and teachers also. The design and development of the IWB app demonstrates the power of refactoring, reuse and keeping it real.

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