# An Bat Mírialta: Stateful Development of an Irregular Verb Bot for Irish

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## Abstract

This paper outlines a system description and small-scale usability study of *An Bat Mírialta* - ('The Irregular Verb Bot')- a newly developed educational application embedded within the Irish intelligent-Computer Assisted Language Learning (iCALL) platform *An Scéalaí* (www.abair.ie/scealai). *An Bat Mírialta* is being developed to aid learners in their mastery of the 11 irregular verbs of Irish. The work is presented in the context of a novel conceptual framework for CALL artefact design, implementation and evaluation - *LeTAT*. Challenges and concerns faced in developing an educational technology for a low-resource, endangered language are also described.

**Index Terms**: Computer Assisted Language Learning, intelligent Tutors, Endangered Languages

## 1. Introduction

Irish has been described as an anomaly among endangered languages. It is recognised as the first language of the Republic of Ireland, and is an official language of the European Union [1]. 2022 census figures show that 1.87 million people (40% of the population) indicated that they could speak Irish [2]. However, figures for actual daily use paint a different picture - less than 72,000 people throughout the Republic and 20,261 people in the *Gaeltacht* (predominantly Irish-speaking regions) use Irish daily (outside the education system), a decrease on 2016 figures. Irish is designated as *'definitely endangered'* by UNESCO [3].

The education system is critical for the maintenance and revitalisation of the language. Irish is a compulsory subject for the full 14 years of schooling, but unfortunately, many students leave school reporting that they have little to no speaking ability. Lack of exposure to Irish in everyday settings, an artificial classroom environment and an emphasis on examinations are some of the notable factors contributing to the less than positive sentiment towards the subject . Harnessing rapidly developing language technologies is one means by which we may improve the educational experience and learning outcomes of students.

The ABAIR initiative, Trinity College Dublin, has for a number of years been developing speech technologies and resources for Irish [1]. It embraces three key concepts: the development of technology-oriented linguistic-phonetic resources; the development of core technologies - speech synthesis and recognition; and the development of applications that utilise these community-centered technologies to enable their integration into mainstream activities. Recent advances in the core speech technologies [4] mean the range of potential applications that can be created has greatly expanded. For example, the significant reduction in word error rates for speech recognition opens up avenues for applications using dictation and computer-assisted pronunciation training (CAPT).

The expanding potential for educational platforms necessitates a system for structuring their creation, development and testing. As a low resource language, careful consideration must be given as to how best use the available resources to maximise the impact on the learner community. Despite a number of attempts to standardise the development and testing of CALL applications, see ([5]), there has, to date, been no widespread adoption of a single methodology for the conception, development and evaluation of iCALL platforms. This is a serious weakness in the field, as researchers have to create their own paths, often running into issues others have previously faced. There have been calls for this type of convergence, e.g. evaluation using an established method [6], but comparing and contrasting results from the research literature remains difficult.

In this paper we present a novel, stateful framework for building CALL platforms - *LeTAT* (§ 2), and illustrate a platform developed in accordance (§ 3). A system description of the platform and results of a small-scale prototype user study are provided (§ 4). Conclusions and further work (§ 5) follow.

## 2. The LeTAT Framework

LeTAT is an opinionated, language-independent framework for developing CALL applications [7]. It covers the theoretical and practical considerations of CALL platform development in a sequential, stateful manner to provide researchers with a useful tool for navigating the path from project conception to delivery.

CALL has seen a number of proposals in the area of platform design. Hubbard [8] proposed a methodological framework that aligned with established frameworks for language teaching. Colpaert [9] proposed 10 steps for "pedagogy driven design", which involved analysing the learning situation, teaching methods, and existing technologies, before proceeding with the development of dedicated systems. These approaches outline a broad range of factors to be taken into consideration for CALL development. However, they do not define the process of development, or forms of evaluation.

LeTAT is an elaborated version of the original TATL framework [10, 11], which identifies four key areas for consideration in developing CALL applications: theories of language acquisition; activities/actions undertaken by the learner; capacity of technologies to deliver these actions; and learner context. Experience developing and testing CALL platforms based on TATL, particularly the story-writing and grammar-checking *An Scéalaí* platform [12, 13, 14], with 5,000+ registered users and 42,500+ user generated stories, has been used to tweak the framework to improve outcomes. The main difference in the instantiation of LeTAT is the introduction of clearly defined states along the path of development, with directions of progress based on outcomes at these states. Included in this *stateful* process, is the

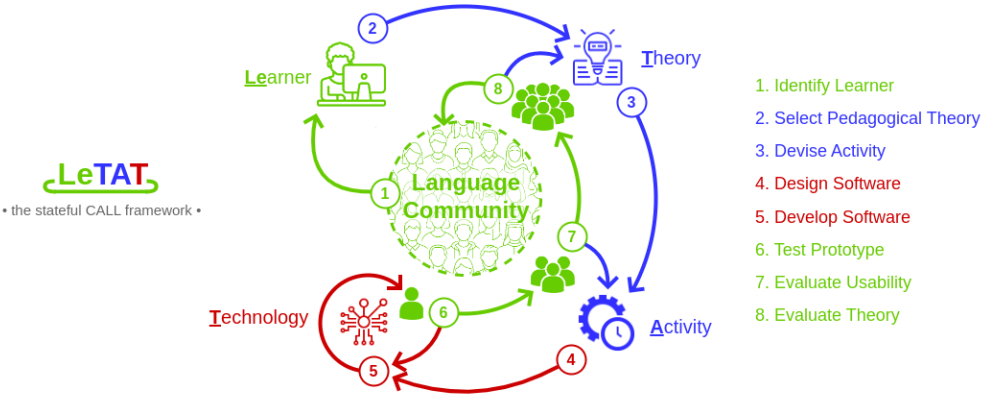


Figure 1: *The LeTAT (**Le**arner, **T**heory, **A**ctivity, **T**echnology) CALL Framework*

formalising of testing and evaluation methods.

A visual representation of LeTAT is given in Figure 1. All development begins, ends, and has the language community at the center. The first step is to identify the target learner, e.g. second level students, with an intermediate level of proficiency in Irish, who regularly use mobile phones. Selection of pedagogical theory and activity follow. The theory should be grounded in empirical evidence from the research literature, and the activity be both appropriate to the learner context, and the availability of the current technology. Designing and developing the software follows. The hairpin turn at the bottom of the diagram represents a move back toward the language community to incorporate their input in user testing and evaluation.

Initial prototype tests must be carried out with learners to ensure that the technology works, the task can be completed as planned, and an appetite is shown for using the technology. Only if this is the case, can development move to stage 7, where a formal usability test is employed. It is up to the researcher which test to use, but it is recommended to select an established Usability Test, e.g. TAM [15], UTAUT2 [16], which will allow for comparisons between platforms, irrespective of language or learner. Ideally, a minimum usability standard in a single use evaluation at prototype stage should be reached before moving on to a multi-use test over a longer period (min. 2 weeks). Finally, a longer term (min. 8 weeks) controlled study to test for learning outcomes can be carried out. Only after demonstrating satisfactory usability and positive learning outcomes should the platform be made available to the wider language community.

## 3. An Bat Mírialta

An Bat Mírialta is a web application designed to help Irish language learners master the 11 irregular verbs of the language. It is one of a growing suite of applications emanating from *An Scéalaí* ('the Storyteller'), an iCALL platform for Irish (www.abair.ie/scealai) [14].

The rationale for An Bat Mírialta arises from the aspiration to enhance grammatical accuracy among learners of Irish, beginning with topics as fundamental as the irregular verbs, which are among the most commonly used verbs in the language. The concept of *'drilling'* as a part of language teaching has fallen out of favour in Irish classrooms in the past number of decades. In the absence of widespread exposure to the language, achieving accuracy in aspects of language acquisition such as irregular verb acquisition becomes somewhat elusive. The approach being proposed here combines self-directed learning with exposure to a large amount of authentic language through a medium and format the learner is already familiar with. As such, we aim to achieve the positive learning outcomes of a *drill*, without the motivational *kill*.

### 3.1. An Bat Mírialta Development (following the stages outlined in the LeTAT framework)

With reference to the LeTAT framework diagram in Figure 1, An Bat Mírialta currently occupies state 6 - a platform has been developed and a prototype test has been carried out. Progress to this point has passed through the following states:

#### *3.1.1. Identify Learner*

The target users - second level and university students - are tech literate, and primarily use mobile phones to access the internet. Attention span may be low. General attitudes to Irish are generally positive [2], however, learners' use of Irish outside of classrooms would be very limited. They would have little experience in reading Irish texts or hearing the spoken language in their environment or through general media, and consequently would have a reasonably low level of grammatical accuracy.

#### *3.1.2. Select Pedagogical Theory*

*An Bat Mírialta* was designed to promote autonomous/self-directed learning among this particular learner cohort. Fossilisation of errors amongst cohorts of learners is common because of the limited exposure to the language in natural contexts and the absence of rote learning as a consistently upheld teaching methodology. Corrective feedback on errors is therefore considered a vital component. The current design is strongly form-focused, as the students cannot gain high points as they progress through the activity without correct use of the intended grammatical format. The content behind this bot includes a large amount of authentic language data, which aligns with the noticing hypothesis, that states in order to convert input into intake, noticing is necessary [17].

#### *3.1.3. Devise Activity*

Considering the target learners and the theoretical aspirations described above, it was decided to develop a short activity, straight to the point on corrections, while not giving feedback that may cause the learner to give up. The platform should be

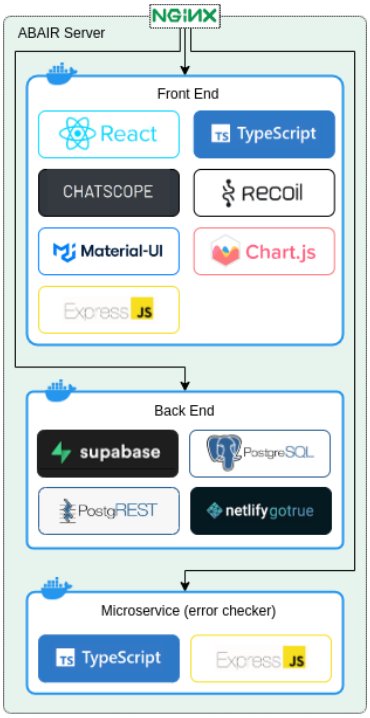


Figure 2: *System Diagram*

available on mobile, and the interface needs to be intuitively usable. Chat applications (WhatsApp, Snapchat, etc.) are among the commonly used apps by this group. Emulating these applications, with a bank of fill-in-the-blank prompts for each verb, tense and form was thus chosen. A set of 2400 utterances, with answers and hints were developed. These prompts were composed specifically for this chat-type interaction. They had a strong emphasis on everyday language and included many examples of commonly used proverbs and phrases with variations in tense, number, case and form. An introductory chat dialogue was written, as were interjections in the form of positive encouragement, and corrective feedback. Attention was given that corrective feedback was framed positively and negative feedback avoided.

#### *3.1.4. Design Software*

Irish, being a low-resource language, had a significant impact on the software design choices (State 4 in Figure 1 above). Often, where there is a small team of full-time, technical researchers, university students become significant creators and contributors. The may have limited programming experience, and could be involved with the project for very short periods of time. Therefore, the learning curve for the technologies used must remain as shallow as possible.

Utilising a small set of the most popular, established, well-documented technologies with easy-to-follow tutorials was determined to be the best approach. It allows new recruits to quickly be brought up to speed and contribute to the project. Modularisation of independent functionality into discrete micro services also allows novice programmers to freely experiment, without fear of impacting the core platform.

#### *3.1.5. Develop Software*

Figure 2 shows the design setup for An Bat Mírialta. On our main ABAIR server, the front-end, back-end and one micro service are run in separate Docker containers, reverse proxied through Nginx. The front-end uses a common stack of technologies, with Supabase chosen as a Back-end as a Service (BaaS) as it contains a database with API endpoints, user authentication and storage. In addition, Supabase provides a Graphical User Interface to allow non- or less technical researchers to upload, edit and analyse data. Finally, an error checking microservice, which compares the learners input with the target and provides feedback accordingly, is also hosted.

The resulting chat interface of *An Bat Mírialta* is shown in Figure 4. Before entering the chat, learners can select one of 11 irregular verbs, 4 tenses, and 6 forms (statement, question, negative etc.) to practice. They can also choose to be presented with a mix of all verbs, tenses or forms in the one session. The chat begins with *An Bat Mírialta* welcoming the learner by name (taken at registration), and then explaining the task - 5 questions, with 10 points available for each question. The '?' button allows learners to ask for a hint if they are unsure. Each hint provided, or incorrect attempt, reduces the total points the learner can gain. If an answer is incorrect, a request is sent to the Error Checker microservice. It checks for common errors - typos, wrong person/tense/verb, incorrect lenition/eclipsis - and provides feedback as a hint to the correct answer, e.g. *'Pay attention to the fadas (vowel length markers)'* if one is missing. The keyboard at the bottom is newly developed for this project and is specific to Irish, with representations of initial mutations (lenition and eclipsis) and vowel length markings all made easily accessible to the learner.

### 3.2. User Study

#### *3.2.1. Test Prototype*

During the software development phase, ABAIR researchers frequently tested the application and provided feedback on design and bugs. Once it performed reliably and to the specification set out in State 4 of the LeTAT framework, it was time to perform a first prototype test of usability with target learners (State 6). This is not intended to be a formal usability test, but more (i) a test of system performance when a larger group use it simultaneously and (ii) an evaluation of initial responses from the target users, which provides insight into how the application is likely to perform in State 7. Since significant time and effort is required to set up, carry out and analyse a comprehensive evaluation in State 7, this is an initial, quick means of determining whether a redesign of the software or task is required.

#### *3.2.2. Participants*

Twenty 1st year students, studying to be primary school teachers (all of whom will in future teach Irish as part of the primary core curriculum) were recruited. These participants were from a wide spread of areas around the country. Their general exposure to Irish is very limited, as are their production opportunities. The average age of the participants was 19 years. This group were taking an Irish immersion course together in the Kerry Gaeltacht (Irish speaking area) when the study was conducted. The group spent 30 minutes testing the prototype of An Bat Mírialta and providing feedback on their experience via a short Google Forms questionnaire. They also had the opportunity to discuss their reactions to the prototype application in the group setting once they had completed the task.

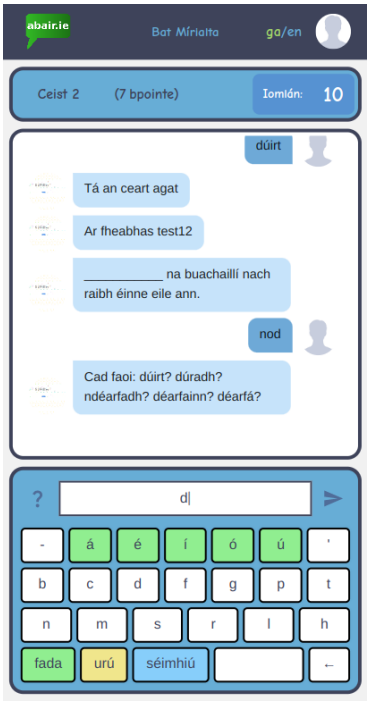


Figure 4: *An Bat Mírialta Chat Interface*

### 3.2.3. *Activity*

Each student teacher was asked to sign up for an account and complete a chat (with 5 questions) with *An Bat Mírialta*. They were then asked to fill out a simple questionnaire, based on the main categories of TAM. Four questions were asked:

1. Apart from non-educational/casual use of social media, do you use your laptop/phone to help your learning? (5-point Likert scale: all the time - very rarely) 2. I completed the assigned task on *An Bat Mírialta*. (Yes/No) 3. I believe that using *An Bat Mírialta* regularly would help improve my knowledge of the irregular verbs in Irish. (5-point Likert scale: strongly agree - strongly disagree) 4. *An Bat Mírialta* is easy to use. (5-point Likert scale: strongly agree - strongly disagree)

## 4. Results

All 20 learners reported completing the task, however, the data collected showed 15 learners fully completed at least one chat. A total of 76 chats were initiated. Most learners, after completing one chat, started another using a different set of verb/tense/forms. On the issue of Usability, the main findings are shown in Figure 3. More than three quarters of participants (i) believe regular use would help improve their knowledge of irregular verbs and (ii) found An Bat Mírialta easy to use.

## 5. Conclusion and Further Work

*An Bat Mírialta* passed the initial prototype evaluation with target users. It was rated as easy to use and beneficial to improving ability in Irish. However, development will not immediately move on to State 7 on the *LeTAT* framework, as there is some necessary functionality to be added. The next steps involve speech enabling the application. Embedding speech was always intended in the development of this application and the feature was in fact requested by the student participants without prompting - which is a positive sign for the next development phase. Integrating the ABAIR synthetic voices will give students access to authentic pronunciation and further exposure to native-speaker models [18]. The ABAIR-ÉIST speech recognition system for Irish will also be added so that learners can speak their responses, giving greater opportunities for their oral productive capacity. It will bring *An Bat Mírialta* in line with the holistic approach to language learning which is inherent in the general *An Scéalaí* project.

Linking to a dictionary to assist with the comprehension of the prompts is also planned. Some student participants reported that they did not understanding some of the prompt contents. It is intended to do this as a two-step process, where an explanation through Irish will be given in the first instance and should that not suffice, a further link to an English translation could be provided. This 'irregular verb bot' is the first of what is intended to be a number of applications that individually target specific aspects of Irish grammar. The modular architecture is designed to allow a relatively easy shift to other activities, once the content is designed and developed. The acquisition of semantic variations inherent in prepositions, nominal case markings and gender variations in nouns are envisaged as future instances of this application.

## 6. Acknowledgements

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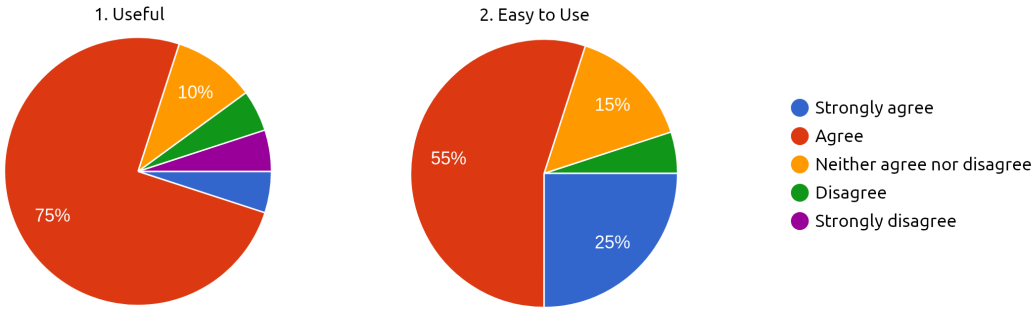


Figure 3: *Survey Results*

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