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Guidelines for a UX designer of a CALL application intended for a Chinese Demographic.

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A research paper submitted to the University of Dublin, Trinity College Dublin, in partial fulfilment of the requirements for the degree of Master of Science in Interactive Digital Media.

2022

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Abstract

This study sets out to establish a set of guidelines for UX designers of computer-assisted language learning applications (CALL). These guidelines are specific to that of a user base of Chinese origin seeking to learn English. The Chinese market for CALL is one of the largest due to the population, its use of technology, and the need for this market to learn English for education and business purposes. This paper will discuss various aspects of UX rules and fundamentals which apply to CALL applications with the demographic of Chinese learners. This is presented in the form of a Literature Review which will draw on prior research gathered to establish an argument as to what UX design is considered adequate. This is then followed by new data found by the researcher through semi-structured interviews collected from a convenience sample. These interviews were done by a directed content analysis technique to find relevant data from the sample which was then used in Triangulation with the Literature review to form guidelines. These guidelines serve to answer this paper's question: What UX design guidelines a designer should take into account when designing a CALL application for a Chinese demographic?

Acknowledgements

I would like to thank:

My supervisor, Nina Bresnihan, for helping me in my direction and always being there to advise and help the progress of my research. I was extremely lucky to have her as my supervisor and this paper would have suffered without her guidance.

The participants of the qualitative data obtained for this study.

My Family for always supporting me and motivating me to always do my best.

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Chapter 1: Introduction

1.1   Aims and Objectives

This paper aims to explore what aspects of user experience (UX) design in CALL technologies influence the user's learning, specifically a user learning English from a Chinese background. In doing so this paper serves as a guide for designers to make an effective learning app for English learners based in China, concluding with suggestions for the UX design process of CALL.

China remains the largest group of internet users and the largest group of non-native English speakers. Designers face the challenge of not only maintaining the previously established guidelines for the user experience but also that of a learning perspective with cultural differences, requiring an adaptation of design methodology. For example, a colour choice has significant cognitive effects that change depending on the user's cultural association with colour. Hence, today UX design within CALL technologies plays an important role in China for the learning of English due to the cultural obstacles faced.

Through a breakdown of the design process within UX and the phycological impact it has on users, the literature review will provide foundational support for the rest of the paper by establishing design guidelines for CALL technologies in the context of Chinese language learners of English. The interviews that follow will serve in analysing real-world experiences with CALL services and how the currently used software compares to the design guidelines established by the literature. This exploration of design in the context of Chinese language learners of English will conclude with recommendations for designers. When referencing the Chinese language throughout this paper, the dialects of Mandarin Chinese.

1.2 Background & Context

The design of the user's experience is essential when creating an application or web service, especially in the case of CALL as –"given the new digital horizons, instructional designers are not only dealing with course content and learning objectives related issues, but user interface related issues; when the UI is not easy to use, a user must develop alternative paths to complete a task and thereby accomplish a learning goal" (Seppälä, Mitsuishi, Ohkawa, Zhao, & Nieminen, 2020, p. 948).

The reason the perspective of a Chinese learner was chosen for this study is because of the specific obstacles and barriers faced that highlight the importance of UX design within CALL. For example, a Spanish language learner may find the grammatical structures of English difficult, but the two western cultures still share the same alphabet. However the same can't be said for the likes of China, where the cultural differences are vastly greater between the west and east making linguistic associations tougher, along with an entirely new alphabet to learn.

Figure 1 shows the number of people using the internet in China between 2008 and 2021. According to Thomala "As of December 2021, over one billion people had access to the internet in China, resulting in a fast-growing mobile app market in the country. Accounting for more than one-fifth of the four billion internet users worldwide" (Thomala, 2022). However, language usage in the world is dominated by English with 1,132 million speakers, 753 million of which are non-native, in contrast, Mandarin Chinese has 1,117 million speakers with only 199 million non-native speakers and 918 million native speakers (Berlitz, 2021). Observing this culture of East-Asian society, we know that throughout

Asian society information is being accessed and communicated in both their first language and in the English language, doing so for study, business and social purposes (Jarvis, 2013, p. 199). All of this data contributes to the point that China remains the largest potential market for CALL technologies, with the population being the largest internet users and with the English language worldwide being dominated by non-native learners.
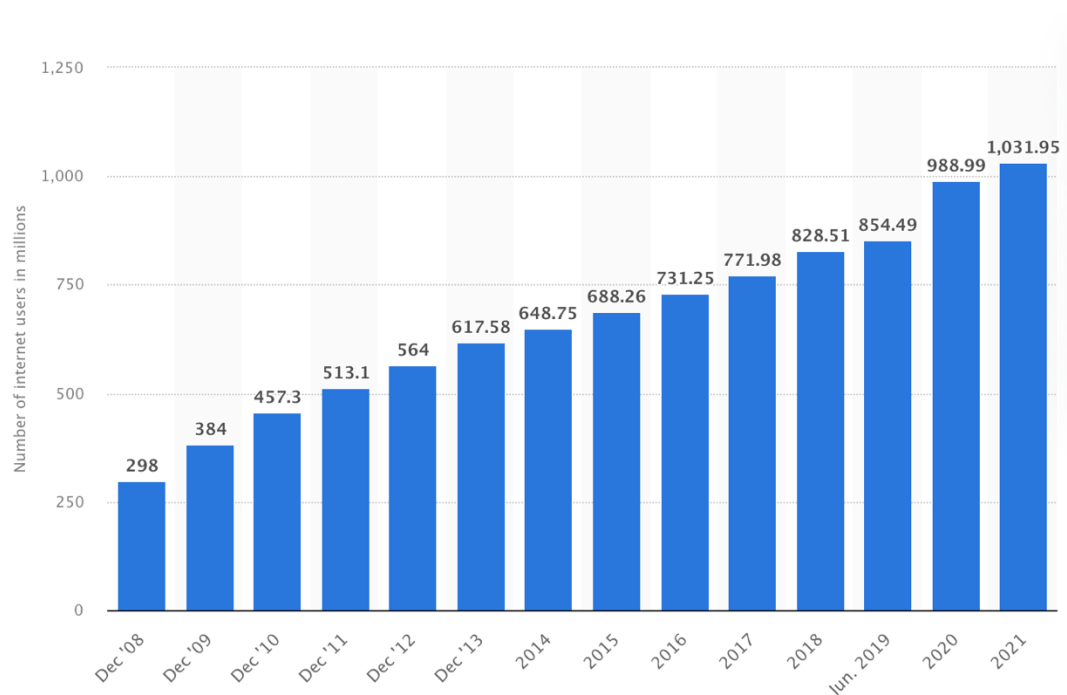
Figure 1: Number of internet users in China from 2008 and 2021 (Thomala, 2022)

It is argued that "users throughout Asia and beyond are accessing and communicating information in both their first language and in the English language, and they are doing so for study, business and social purposes. In many ways, the practices of such users are driving forward our changed frameworks for understanding. First and foremost, they are users of English in a globalised World" (Jarvis, 2013, p. 191). While the internet is being used to develop the English language, this is largely through unconscious acquisition and it is done

with a variety of devices including CALL. Hence this paper will take advantage of this information and the author's connection with primary sources of Chinese language learners that have used CALL to analyse UI design within the platforms to overcome boundaries and increase app efficiency.

As outlined by Jesse James Garett, the methodology behind designing an effective UX within a web application can be broken into five separate planes – The surface, skeleton, structure, scope and strategy planes. These go from abstract practices to concrete practices as the process of UX development continues (Garrett, 2002). Why might the UX design process be prioritised by app and website developers? A user conscious design leads to an increase in efficiency no matter the service it is being designed for. For example, a shopping platform with effective UX will increase potential sales units, if it is a learning platform, effective UX will increase efficiency in educating the user. The end goal of the design process is known as user-centred design (UCD), meaning an experience which is an engaging, efficient, intuitive and accessible experience for any user (Kamarin Merritt, 2021). When applying this logic to educational technology services, such as computer-assisted language learning technologies (CALL) which are the focus of this paper, UX directly affects the educational efficiency of the user. CALL has been used for over forty years now, with a plethora of publications devoted to researching its impact and discussing implications for the practice (Jarvis, 2013, p. 190).

Educational efficiency is achieved through the correlation between design and motivational factors for the user's learning. A design approach is "rooted in the feeling of *competence*; effectiveness and mastery are associated with empowerment & elevated confidence, which arises from overcoming challenges.' (Seppälä, Mitsuishi, Ohkawa, Zhao, & Nieminen, 2020). This can be

broken down further into various strategies to engage with the user within a design. For example, gamification is the process of making the learning environment resemble that of a video game to simulate processes which may trigger reward receptors in the brain and hence increase learning motivation. Another benefit to gamification is the reduction of learners' anxieties when speaking a foreign language such as English in front of others, and also encourages the user to attain a favourable type of learning behaviour. (Dehghanzadeh, Fardanesh, Hatami, Talaee, & Noroozi., 2021) The following quote summarises the significance of the learner's emotional state and its relationship to learning:

'Learning is affected by the total state of the individual. People are feeling beings as well as thinking beings and when their feelings and thoughts are in harmony learning is maximised" (Pine & Horne, 1990).

The direct impact of user interface design on the user can be seen within the work of researchers at Facebook in 2020 when they published a study in *Nature* that measured the impact of three interface design variations on the social participation behaviour (Bond, 2012). This randomized control trial had over 61 million participants and "succeeded in showing how a small design change can have impressive consequences on user thinking and behaviour" (Calvo & Peters, 2014, p. 6).

However, the efficiency of design changes depends on the user, this bears significance, particularly with the cultural background of each user. If one compares the norms of service design across the world, the styles and approaches will differ and change with the culture. This includes the beliefs, traditions, social norms, habits and values all contributing to the mindset of a

designer and user within interactive technology. When applying this logic to English language learning, a problem arises, the differences in cultural knowledge between languages need to be compensated for within CALL applications. Scheme theory contends that individuals understand what they read, only as it relates to what they already know (Cooper & Kiger, 2002), therefore real experiences and internal knowledge of associations provide more comprehension when learning.

The cultural differences between western and eastern countries are vast. From symbolic associations engrained in the languages of Asia to the mental colour associations differing depending on the culture (Wang, Mo, & Shu, 2014), this is especially relevant in user interface (UI) design and UX. The use of colour is dependent on these associations as they are vital for successful application in product design, advertising, and marketing (Ares & Deliza, 2010) or in the case of this paper – CALL applications.

1.3 Research Question

The research question that this research paper proposes is:

"What UX Design guidelines should a UX designer take into account when designing a computer-assisted language learning application for a Chinese demographic?"

1.4 Paper Roadmap

The roadmap of this paper includes the following chapters.

- Chapter 1 – Introduction
- Chapter 2 – Literature Review
- Chapter 3 – Interviews
- Chapter 4 – Guidelines
- Chapter 5 – Conclusions

The literature review will be broken up into multiple sections establishing what prior research suggests as important design choices for UX implemented in CALL. What is discussed in these sections in relation to CALL includes culture, the language learning process, and their significance with UX.

The following section consist of interviews that target various students at Trinity College Dublin who study the M.Sc. of Interactive Digital Media who are from China and who have used CALL. Questions will be asked to decipher what they found useful and what they found problematic when using the technology. The data from these interviews will be cross-referenced with the previously established guidelines in the literature review.

Finally, the previous two sections will be used in triangulation to suggest final guidelines for a designer of CALL technologies aimed at the Chinese market of language learning applications. This will conclude the paper with what CALL technologies and methods are currently the most effective given the research and interviews with primary sources analysed. Hence through a combination of new data and existing research, a designer may use this paper as a guideline to

follow when in the process of creating a new computer-assisted language learning application.

1.5 Methodology

This paper will follow the structure of first a literature review which will target aspects of CALL and UI to analyse the conjunction of the two. This research was conducted via searching library systems and journals for key words such as UX, gamification, dual coding, cultural issues, CALL and cognitive load. This research served to establish a set of provisional guidelines for the designer of a computer-assisted language learning application. This was then followed by qualitative semi-structured interviews from a convenience sample. These took place to establish what the sample considered to be effective UX in CALL. These were conducted both in-person and via online call software 'Zoom' depending on the preference of the interviewee. For the sample group, convenience sampling was used to select interviewees. The data was noted by the researcher, who is in this case the author of the paper, and then cross-referenced with the literature review findings to establish a conclusion.

Ethics approval to conduct the primary research was given by the Trinity Ethics Committee (Appendix A) after a research ethics application was sent and amended. Participants were informed via an information sheet (Appendix B) that while participation would not benefit the participants directly, the search will support the development of a better design of CALL technologies, which will hence benefit other English learners in the future. All participants confirmed that they were over 18, and they were assured all data was stored following the General Data Protection Regulation ("GDPR"). As the individuals being interviewed were known personally by the interviewer, a protocol was

implemented in which each participant was treated equally and no personal information was leveraged to limit any interview bias. It was made clear that each participant was able to withdraw from the study at any time with no penalty to them. The data from these interviews were then triangulated with the Literature review findings before exploring final guidelines and suggestions for designers of CALL software with the intended user base of Chinese Language learners of English.

Chapter 2: Literature Review

2.1 Introduction

This literature review will establish relevant research in the areas of CALL UX design. The first section focuses on 'Foundations of UX and CALL' and will allow this paper's argument to stand on a concrete foundation of logic. One must start at the route of the problem when analysing something as complex UX implications within CALL from an East Asian perspective.

The second section will focus on the cognitive repercussions of design for a language learner and what relationship these have with the previously established UX design fundamentals.

Finally, the significance of culture and the impact it has on design will be discussed in section three, these impacts being directly connected to the two chapters before it.

These three sections will conclude with what this paper suggests as effective for the design of a CALL application that is intended for a user that is approaching English language learning from a Chinese background.

2.2 Foundations of UX and CALL

The UX design process must follow specific rules within the design process to reach its maximum potential of effective use for the user of the website, service or in this case CALL. This chapter will compare and contrast the various books and journals in the academic space on UX to establish a consistent argument of what good UX design is, and how this is implemented within CALL.

2.2.1 Jakob's Law and CALL

To establish these fundamentals and provide a foundation for this paper's argument as a whole, the work of Jon Yablonski (Yablonski, 2020) helps in establishing ground rules to follow within UX design. Designers may take into account Jakob's Law -

'Users spend most of their time on other sites. This means that users prefer your site to work the same way as all the other sites'

Familiarity is when something is recognisable and hence approachable for the user and is something for CALL UX designers to keep in mind. The environment for the language learner must feel safe and encourage confidence in what they are doing to sustain as much motivation from the user. "Familiarity helps the people interacting with a digital product or service know immediately how to use it, from interacting with the navigation to finding the content they need to processing the layout and visual cues on the page in order to understand the choices available to them" (Yablonski, 2020, p. 1).

Here Yablonski is breaking down Jakob's law of familiarity in design for the broader concept of service design allowing for ease of use when interacting with the product. CALL relies heavily on the ability to accept and learn new information with few outside disincentives to learning, such as an unfamiliar, inaccessible interface, hence Jakob's law is especially relevant in CALL UX design. The main idea here is to not discourage the user, allowing for maintained motivation in the process of language learning as Seven writes "It is no doubt that motivation is an important factor for success in learning. It is a combination of two factors: Learning purpose and attitude; if knowledge is important for the learner, learning occurs without any need to learn it" (Seven, 2020, p. 66).

Personal thinking and design are linked as shown by Facebook's 2012 study, (Bond, 2012) hence Jacob's law, which maintains the user's understanding and processing when using the product, is essential within a learning application.
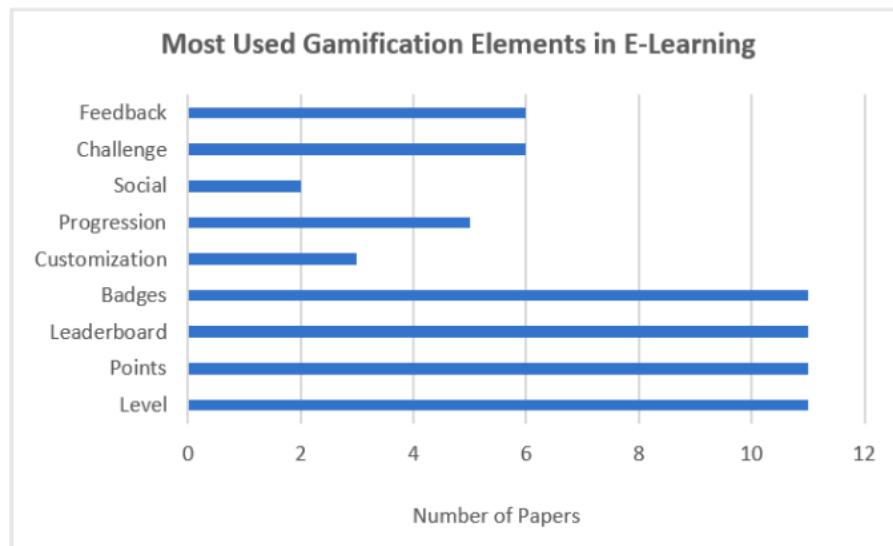
2.2.2   Gamification

Figure 2: Various Gamification Techniques in Designa and their usage measured. (V. Handayani, 2020).

Another design choice UX designers can implement into a CALL service to help maintain motivation and keep user engagement high during situational challenges is Gamification. The term emerged in the late 1960s, defined as a method implemented by which a boring activity, such as learning is converted into a fun activity, to attract interest and attention and motivate and improve performance in certain activities (Udjaja, 2018). The method requires effective implementation within the design of an application as its effects of motivational incentives can easily be counteracted if not integrated properly.

In this way, gamification and UX/UI are interconnected, "gamification is considered to help students increase motivation to learn. With that

technological innovation and new interaction patterns, *User Interface (UI)* and *User Experience (UX)* are becoming increasingly important and changing user expectations and demands. In the context of e-learning, poor UI and UX can affect students' attitudes towards e-learning" (V. Handayani, 2020, p. 1).

UX and UI are used to implement visual cues and establish these gamified motivational incentives for the user such as feedback, social leader boards, points, levels and progression. This can be understood as an example of ICALL through its stimulating non-exhaustive approach. ICALL stands for intelligent computer-assisted language learning, this fits under the umbrella term of CALL. However, it makes itself unique by not relying on the use of exhaustive enumeration of set questions and answers but rather is "able to generate a profusion of unique questions and answers based on the computational modelling of grammar and a relatively small set of exercise templates" (Megan Bontogon, The Canadian Modern Language Review, pp. 338-339). Educational games themselves "concentrate on engagement, simpler features, gameplay and learning activities, which increase the willingness of the player to learn and the effectiveness of knowledge acquisition" (Arhippainen & Alavesa, 2021, p. 1).

A user experience that has included various elements of gamification as shown on figure 2 will benefit the user in their acquisition of the new language and establish an extra of motivation within the design of the application.

2.2.3 User-Centred Design

This information discussed points towards personal response to UX in CALL being a key factor in effectiveness due to the level of importance motivation and emotive response is within the use of CALL. Hence, the deisner needs to maintain a User-Centred Design (UCD). UCD aims to act "as an effective interface for delivering a pleasant experience to users when interacting with computers" (Laborda & Magal-Royo, 2018, p. 25).
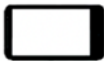
Channel/Data Entry	DEVICE	INTERFACE	USER SETTINGS	ACTIONS
View	Screen	PERFORMANCE CONDITIONS		
		Screen access to a viewing configuration	Resolution screen / brighness/ contrast configuration	Visual access to information about test questions related to reading, writting, listening, oral/ Instructions/buttons/etc...
Listen	Earphones	Screen access to a listening configuration	Headphones configuration/ Volume configuration	Listening access information about test questions related to reading, writting, listening, oral/ Instructions/buttons/etc...
Speak	Microphone	Voice recognition/ recording configuration	Microphone configuration/ Volume configuration	Emit simple words and/or a conversation about test questions related to reading, writting, listening, oral/Instructions confirmation /etc..
Touch	Screen/Tablet	Screen access to touch configuration on the screen	Resolution screen / brighness/ contrast configuration	Select buttons or links access to the information about test questions related to reading, writting, listening, oral/ Instructions/buttons/etc...
Keyboard	Physical/virtual keyboard	Keyboard configuration	Key position/ funtional keys, virtual screen keyboard configuration	Select keys and/or composed keys of words and phrases to access to information test and test questions related to reading, writting, listening, oral/ Instructions/buttons/etc...
Mouse	Physical/integrated mouse/pencil	Mouse configuration	Point and click screen position	Select buttons and/or links to access the information about the english reading, writting, listening, oral assessment/ Instructions/ etc...
View	Physical/integrated webcam	Webcam configuration	WebCam configuration/ WebCam recorder configuration	Create a audiovisual record information about the english listening, oral assessment / Instructions/Record/ Transmission

Figure 3: InputOut data channels oriented to test on-line design for ELF (Magal-Royo, 2016)

Laborda's paper establishes the significance of UX in the language learning environment via advanced analysis. This includes the handling of computer exams of a foreign language through different experimental interactive digital environments.

Figure 3 demonstrates the multimodal computer language level of development revitalized due to technological possibilities, CALL becoming more popular as its new form MALL (Mobile Assisted Language Learning). UX accessibility is defined here as "the central axis that marks formal and normative aspects of foreign language assessment tests since it would allow a more effective interaction" (Laborda & Magal-Royo, 2018, p. 25). Laborda references the guidelines of the World Wide Web Consortium (W3C), an international community where Member organizations, full-time staff and the public work together to develop web standards. Their main principles as established on their website are 'Web for All', making sure the web's benefits are available to all people, and 'Web on Everything', making sure the web's full potential is reached across as many devices as possible (W3C, 2021).

This shows how User-Centred Design is key due to its positive impact on the user The participants in the study demonstrate language ability to their best potential when user centred design is optimised. Hence CALL design should adopt a user centred approach to allow the user to acquire knowledge of the new language to their best of their ability.

2.2.4   **Foundations of UX and CALL Conclusion**

This combination of familiarity, gamification and UCD across devices serve as the core pillars of UX design in CALL. This is because they all serve to support the motivation and potential learning ability of the user. Their importance is emphasised by psychological motivational factors serving as an essential for language learning through technology which will be discussed further in the following section.

2.3 The Language Learning Process and CALL

This section will establish the various cognitive issues relating to language learning and CALL technology and how they intertwine with the previous fundamentals of UX discussed. These include the learning environment, dual coding, cognitive load

2.3.1 The Learning Environment

Before analysing the situational reasoning behind UX design within CALL, one must understand firstly the analogue process to some degree so that the digital process can also be understood.

Some learn English in a classroom, others have the opportunity to move to an English speaking country and integrate themselves into the culture to learn it naturally, and finally, others use digital means and services such as CALL. These methods all have their advantages and disadvantages and are often used in combination to effectively learn. One thing remains consistent across these approaches to language learning, and that is the importance of the learning environment. A specific aspect of this is the target language environment, for example in an analogue setting this would be English language immersion. "This approach involves the so-called immersion of the student in a second language-learning environment. The principles underpinning this approach are typically applied when one spends time among the native speakers of the second language in the country. Immersion programs attempt to replicate such a situation in a classroom" (O'Neill & Gish, 2008).

This approach replicates native language immersion and tries to encourage natural language association and the avoidance of direct translation which leads

to slower and less effective speaking. If one takes this environmental aspect within the analogue teaching setting and applied it to digital teaching, the environmental replication becomes more difficult.

One may need to navigate the application in their language to effectively use a CALL service, hence making a target language environment in a digital equivalent a complex task. To work around this, direct translation methods are often avoided by using word-image association to effectively teach the user vocabulary by visual association. The implications of using visuals within the learning structure and environment is an even greater emphasis and importance of the UI design.

Higher education in China has developed a guideline for hybrid learning in the environment with a combination of regular teaching and computer-assisted language learning and internet resources in actual teaching practice. Figure 4 shows the computer and classroom-based multimedia College English Teaching Model.
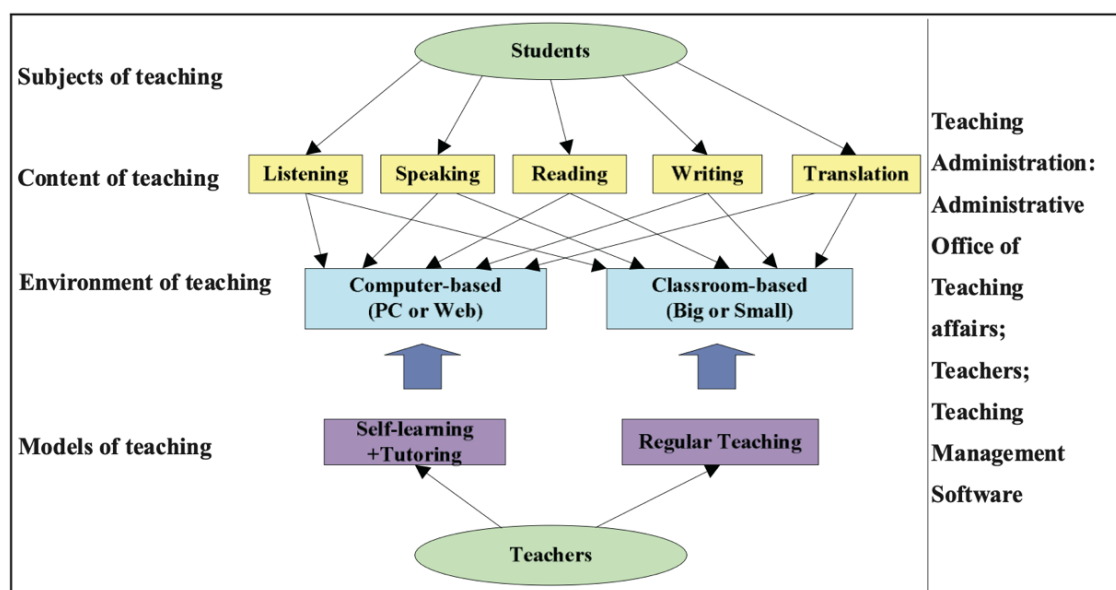
Figure 4 Computer-and Classroom-based Multimedia College English Teaching Model. (Huixin, 2019, p. 2021)

This classroom integration of interactive learning is often achieved through MALL using devices such as phones and tablets. For example, in Vietnam, to "equip teachers with necessary knowledge and skills to use computer-mediated technology in their own teaching (eg, the use of Moodle and Web 2.0 tools), the Ministry of Education and Training initiated nationwide training courses on computer-assisted language learning for English Teachers" (Hoi & Mu, 2021, p. 881). This is another example of a country which resides in East Asia where English learning is recognised by the country's education system as something which benefits greatly from computer assistance. The benefits of MALL include "accessibility-easy and spontaneous access to language learning resources and activities, continuity-smooth learning transfer across devices and learning platforms, flexibility-flexible time and space for learning and adaptability-easy alignment to personal learning habits" (Hoi & Mu, 2021, p. 882). This aspect of MALL contributes to the quality of learning due to the flexible environment within the application that allows for adaptability and accessibility.

2.3.2   Dual Coding

The previously discussed learning model of embedding digital learning within the classroom to act as a joint teaching model allows for an integration of dual coding theory within modern computer technology. Dual coding theory (DCT) established by Allan Paivio in the 1970s is a description of the human cognitive process including two distinct but interconnected input

Figure 5. Dual Coding Diagram. (Dual-Coding, n.d.)

channels: verbal and nonverbal systems. "During the cognitive process, both language generators – logogen – and image generators – imagens – (visual,

auditory) were used to activate stimuli. Compared with unitary coding, Paivio strongly believes that using both two systems is more effective than one." (Liu, Liu, & Li, 2020, p. 2).

This can be integrated into CALL through the use of repetition and visual supports to provide a pedagogical scaffolding for learning vocabulary in a second language. For example, visual supports could be images or pictures of the word being provided to the user on the device alongside the word, integrating dual coding within the design. Wong and Samurda state "Visual supports, which include visual representations of vocabulary words, illustrations, demonstrations, or multimedia, can serve as essential scaffolds for dual language vocabulary learning" (Wong & Samudra, 2021) .

A study was performed on various young language learners from different regions of the world, testing to see how dual coding, via video, images and audio, assisted language learning in a CALL based experiment. It concluded, "In sum, this CALL-situated study provided evidence to suggest that dual-coding is a key mechanism underlying L2 (second language) vocabulary learning for DLL (Dual Language Learners) on screen; that this mechanism is particularly beneficial for those with low L2 exposure in the home as they benefited from more media that used visuals and sounds together, rather than those with high L2 exposure; and that pre-schooler's visual attention to screens facilitated vocabulary learning only when images and sounds were expressed simultaneously" (Wong & Samudra, 2021, p. 1202). From this, we can conclude that the use of media integration within the design of CALL applications can help attention, particularly for those with low exposure to the new language at home.

The concept of absorbing information via two systems to achieve more effective language learning is echoed in the previously established method of gamification. When used in combination with analogue standard teaching practices, as seen in figure 2, we see a similar logic of methodology take place where two approaches used in unison are better than one. The "problem in the learning process shows that the teacher only provides subject matter and rarely provides motivation to students in teaching. Gamification is considered to help students increase their motivation to learn. Gamification supports individuals to acquire the potential to develop critical thinking and multitasking" (V. Handayani, 2020, p. 1)

Apps such as *Duolingo* integrate dual coding into the user experience through picking a subject group of vocabulary, for example, 'travel', and then repetitively teaching the words through images (visual media), listening exercises (audio media), and text-based exercises (text media). If the designers have implemented dual coding correctly it will lead to effective learning responses from users of the application. This also reinforces the previously stated importance of environment, using a target language without direct translation and instead of using images and/or another sensory system such as audio for hearing. Hence the two should be consistently maintained to a high standard by the designer.

2.3.3 Cognitive Load

Dual coding can be effective in CALL when implemented correctly, but a UX designer must keep in mind the potential limit of the user's maximum information consumption. To do so designers must understand *Cognitive Load Theory (CLT)*. Cognitive load is the number of mental resources needed to understand and interact with an interface. We can refer back to Yablonski's Laws of UX, specifically Hick's Law –

'The time it takes to make a decision increases with the number and complexity of choices available" (Yablonski, 2020, p. 23).
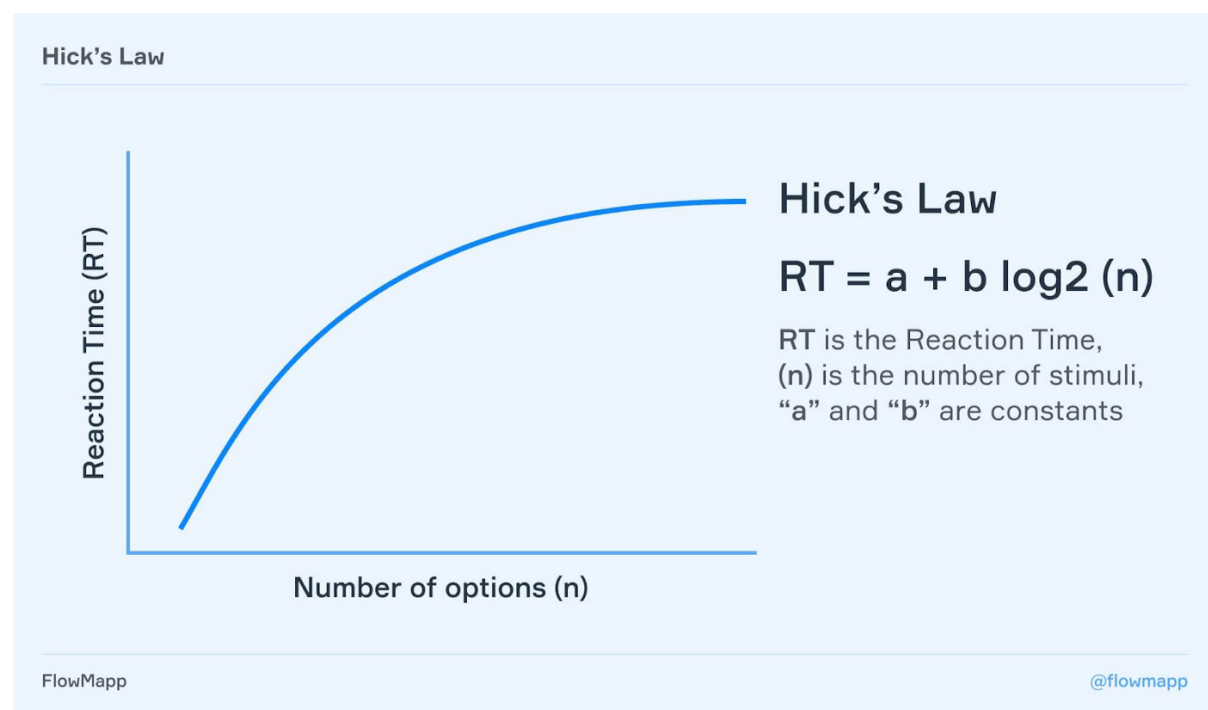
Figure 6 Hick's Law graph and formula. (Hick's Law, n.d.)

This rule states that the designer should always minimize choices when response times are critical to decreasing decision time. The rule recommends breaking complex tasks into smaller steps to decrease the cognitive load. (Yablonski,

2020, p. 23). When applying this UX design theory to CALL, studies have "conversed that during the learning process three kinds of cognitive load may appear which are intrinsic, extraneous, and germane. The intrinsic load depends on the nature of the elements of interactivity that take place during the learning process. For instance, vocabulary learning requires low interactivity elements when compared to developing a statement in an unfamiliar language. Thus it can be implied that the complexity of intrinsic cognitive load depends on the task and proficiency level of learners" (Banu, Siyabi, & Minje, 2021, p. 668). Another law which reinforces this concept of not overloading the user with information is Miller's Law;

"The average person can keep only 7 (+-2) items in their working memory".

The number 7 is simply a rough guideline number and depends on the user, but the general idea is to organize content into smaller chunks to help users process understand and memorize easily. (Yablonski, 2020, p. 35) As language learning is intrinsically memory-based most CALL applications should hence break down sections into chunks of vocabulary with making sure not to overwhelm the user. This was done in the previous example mentioned in *Duolingo* where lessons are broken down into chunks of vocab and imagery, usually no more than 4 on-screen at any given time to avoid cognitive load. This ensures maintenance of motivation while using the service and also ensures that the most learning of new content takes place.

2.3.4 The Language Learning process and CALL Conclusion

To conclude, the process of learning is sensitive and personal, the learner is easily discouraged as it is a hard and long process to learn a new language. However, with the approaches towards CALL design discussed above and UX fundamentals being maintained in tandem. The CALL application should, in theory, aim to make the user's environment accessible and adaptable with a target language used and communicated through dual coding via media. To prevent discouragement, the designer should maintain the prevention of cognitive load by limiting the amount of new information on the screen to no more than 7. These in tandem with the previous section's UX fundamentals allow for CALL applications to be designed effectively for the user's learning experience.

2.4 Cultural and CALL

2.4.1 Overview

Culture refers to the umbrella term which encompasses the associations of social and psychological norms associated with a society. This paper approaches the problem of cultural differences between east and west leading to disruption in the design approach towards CALL technologies. In an analysis of user experience frameworks, Zarour and Alharbi write "Cultural aspects affect hedonic and pragmatic dimensions of UX, hence the future can be related to User needs dimensions" (Zarour & Alharbi, 2018, p. 12). The discussion of cultural characteristics and their implications on design can often be problematic due to a "lack of a robust measure that can identify the implicit levels of culture. In an effort to address this issue, researchers have conceived of culture as a set of 'dimensions' that provide a framework for cross-cultural comparisons of user behaviour" (Kim & An, 2008, p. 4). This, in theory, completely changes everything this paper has previously established in relation to UX, if a designer is to follow a set of guidelines they must do so with a specified cultural user base in mind.

This paper will do so for that of users who originate from China, whose first language is Chinese and who are learning English using CALL. Far from the western origins of English and the Latin alphabet, these learners face an arguably greater challenge than others approaching the language. Along with this, they have different associations with the west when it comes to visual stimuli such as images and colour and other societal impacts which may affect the effectiveness of design within an application. The following sections in this

chapter will break down the various culturally specific aspects of design which may be of consideration when involved in a CALL application.

2.4.2 Colour

Colour can elicit an emotional response and the term colour emotions is often used to describe this, within technology "Colors can be used according to their physiological effects in order to support human information processing and thus enhance the usability of the software. They can influence effectiveness and efficiency directly while dimensions like satisfaction and pleasantness will have an indirect effect on these aspects" (Christian, Karin, Martin, & Andreas, 2009, p. 323).

Colour associations are relative to personal experiences, hence the definition of culture of associations of normality within a society would imply that colour associations would have to adapt to cultural associations. A study done by the school of design at the University of Leeds was done to produce psychological data that could be used to evaluate the performance of algorithms that automatically generate colour palettes (Chen, Yang, Pan, Vazirian, & Westland, 2020). The experiment used 30 words and displayed them in English to UK participants and Mandarin to Chinese participants, with each being asked to choose colours from a colour picker. As seen in figure 7, the words such as 'Red' have strong colour associations across cultural boundaries, however, words such as 'Twelve' are much more ambiguous and differ across the two cultures.

This experiment makes it clear that colour-word associations differ across cultures when words do not have clear strong colour associations. However, what about the emotive reactions to colour and how do they differ between cultures? This is of importance for designers when creating a CALL application

who are intent on manipulating the user's emotion to encourage motivation to keep using the product. An experiment that compares the emotional reaction of Chinese students to the colours red and blue found that results varied depending on the usage if it was verbal or visual. The findings show that "blue represents the colour of sea and sky. It is a safe rather than threatening colour to animals and humans. The optical attributes of blue can also allow people to feel cool and relaxed. Because of the above characteristics, in China blue is often used to decorate public areas such as swimming pools and hospitals and restrooms. It is also noteworthy that unlike in English-speaking countries, blue does not have special meanings in China. Therefore, the verbal stimulus 'blue' induced neither positive nor negative emotions in Experiment 2. Thus we attribute its inducement of positive emotions in Chinese participants to its natural associations with positive emotions, which are formed in the biological environment" (Wang, Mo, & Shu, 2014, p. 156). If a CALL application is designed with an accent of blue emended into the UX, it's logical to expect the emotional stimuli of the user to be positive which would reinforce the quality of learning for the user.

Figure 7: . On the left – The list of 30 words for the experiment. On the right - Each row represents the first colours chosen by one of the participants for the words red, soft, and twelve (shown from left to right). (Chen, Yang, Pan, Vazirian, & Westland, 2020)

Active	积极的	Married	婚姻的
Bad	坏的	Medical	医学的
Clean	干净的	Modern	现代的
Cold	冷的	Natural	自然的
Cultural	文化的	Old	年老的
Dangerous	危险的	Poor	贫穷的
Dead	死亡的	Powerful	强大的
Female	女性的	Religious	宗教的
Fresh	新鲜的	Rich	富有的
Future	未来的	Safe	安全的
Good	好的	Sweet	甜的
Healthy	健康的	Traditional	传统的
Hot	热的	Unlucky	不幸的
Lucky	幸运的	Urban	城市的
Male	男性的	Young	年轻的

UK   CHINESE
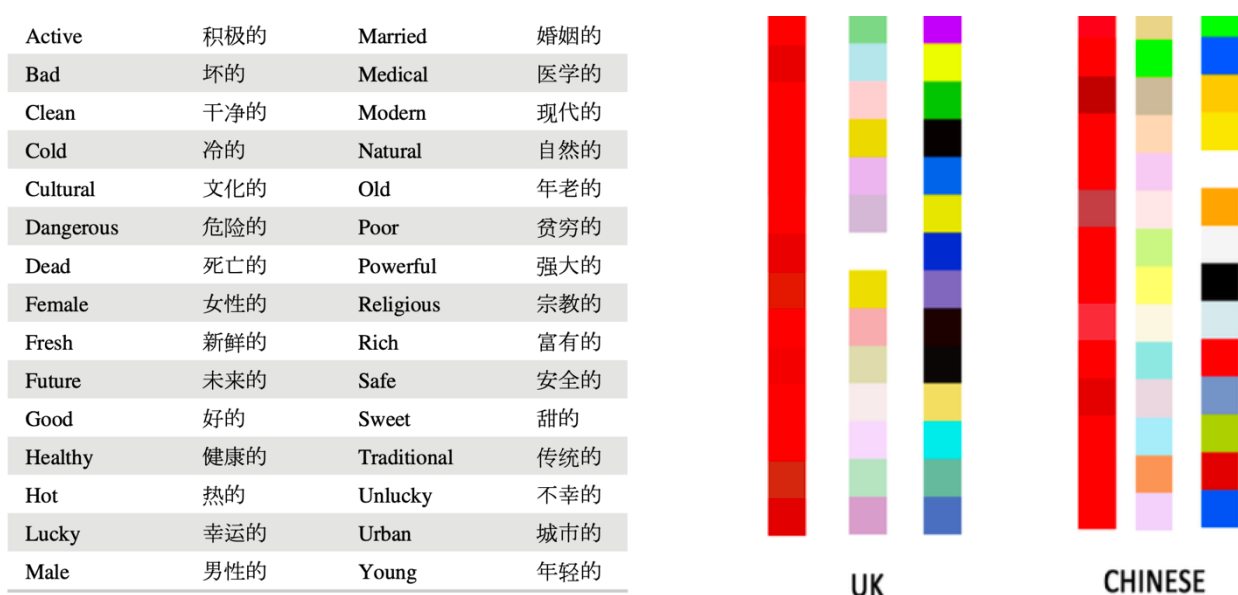
2.4.3 Culturally Sensitive Visual Approaches.

What can be drawn from this research for a UX designer of CALL is that one must consider the cultural background of the language learner when designing. This may explain why some apps, although they support many of the same languages, differ in popularity in various regions of the world. Some application designs and methods may work for western language learners, while eastern language learners prefer design mythology that suits their culturally related positive associations.

An example of an English learning app that specifically is designed for a Chinese demographic is '*BaiCiZhan'* which uses dual coding in a culturally sensitive way. It combines verbal and non-verbal displays, replicating the nature of the Chinese alphabet, to teach English vocabulary dual coding text and visual multimedia. As seen in figure 9, a word is presented firstly via verbal communication, then through image media, and then a unique combination of the two. The Chinese writing system is logographic, meaning that it uses visual symbols to represent entire words (Olson, 2014). This visual approach to writing that is used within the Chinese alphabet and not the Latin alphabet means "Dual-Coding theory has important implications for reading in Chinese because radical evoke verbal and non-verbal activations quite differently from patterns in alphabetic languages. Other things being equal, Dual-Coding assumes that Chinese characters with a radical are more likely to evoke verbal and non-verbal activation compared to activations without radicals" (Kuo, et al., 2015, p. 2). The design of the

Figure 8: Baicizhan, a CALL application for a Chinese - English learner.

application approaches dual-coding in this culturally aware method by making English characters similar in nature to that of logographic Chinese characters.

The colours used are consistent with the previously established knowledge of Chinese culture preferring soft positively associated colours close to blue, its associations with positivity making it a reliable choice for designers to make a CALL application that maintains motivation in the user. This might explain why the app had over 80 Million users, leading other online education start-ups "Among the education apps in Apple's app store in China, English learning apps make up half of the slots of the top 10 paid-for apps, and four slots of the list top 20 free apps. BaiciZhan, which helps people remember words, is the most popular free app in the Apple store, receiving 15,800 comments from users" (Yijing, 2018). This shows that the app's approach appeals to Chinese users objectively through qualitative data of high app downloads and comments.

2.4.4 Chinese cultural attitudes and Academics

In China, the attitudes toward studies of academics and languages differ from that of the west. This is due to cultural differences in approaches and expectations of learning within Chinese Society. Studies of Chinese parents indicate that Chinese parents have higher expectations for their children's academic achievement than western societies and also place a higher premium on their children's education and academic achievements (Chao & Tseng, 2002). A questionnaire with 322 respondents plus 30 face-to-face semi-structured interviews analysed if Chinese parents value education as crucial for their child's whole life as well as enhancing social status. "Closely related to their philosophy of education, more than two-thirds of parents expected their children to complete at least university-level education, and almost all parents wished their

children work as professionals, business managers or civil servants" (Zou, Anderson, & Tsey, 2013, p. 1848). This data in conjunction the fact that "according to UNESCO, China has the largest number of students pursuing academic studies outside China (993,367 in total in 2019)" (Gao & Hua, 2021) and "an increasing proportion of Chinese High School students now choose Western universities instead" (Qiang, 2011, p. 16). These patterns of academics in recent years show that the English language for some language learners might be of pivotal importance to entering their desired educational institution which itself is motivated by Chinese societal factors.

Chinese students who need English to study abroad may use this as a form of motivation to learn a language, hence the cultural attitudes towards academics are in direct connection with language learning motivation in these situations. The exam taken for university entrance is the College English Test (CET) with the CET-4 being the level of proficiency required for most universities (Quin, 2017). The Chinese culture's emphasis on high achieving within education as a form of social status can be used within the design of CALL applications to further increase motivation. To integrate this cultural characteristic of China, learning targets are often integrated into the design of CALL applications. For example, in the application '*APEuni*', as shown in figure 9, the user decides their target learning goals by choosing the level of proficiency required in the exam and the date of the exam. This 'Target' allows the app to adapt to the user's academic goals and
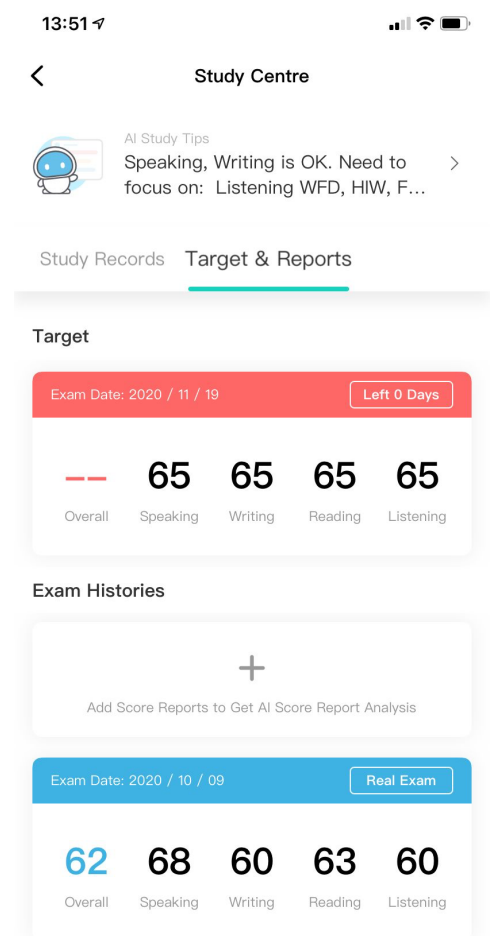
Figure 9: Screenshot of CALL application with user's targets.

integrate this with the design principles previously discussed to further enhance user motivation. This includes a challenge of a set number of words to learn every day to reach this target, adding gamification in a culturally specific fashion.

2.4.5 Culture and CALL Conclusion

To conclude, the culture of China differs vastly from that of the west and to design the most effective CALL application for this demographic cultural factors must be taken into account. The colour blue in China, as previously discussed, has the most positive associations within that culture, hence the use of blue as a main / background colour within CALL will maintain the most positivity in the learner. With a culturally sensitive approach to visual design, the user is more likely to not be overwhelmed with the new information presented by the likes of dual coding techniques and cognitive load can be avoided. Furthermore, motivation can be increased and maintained in the user by appropriating what is common in the education culture in China by setting targets and goals for exams within the design that can be gamified. This aspect will be a common reoccurrence in the interview section.

2.5 Literature Review Conclusion

From the previous sections in this Literature Review, one can draw a conclusion that lays the foundations for design. There is an intersection within the three topics discussed concerning UX fundamentals, the cognitive learning process and cultural implications within the design choices of CALL. Jakob's law states a product must have familiarity for the user to not be discouraged and confused with the software. As a learner is more likely to be deterred from using the product, this rule is just as important in CALL applications. Guidelines of accessibility followed correctly along with Hick's law prevent cognitive load leading to users potentially being overwhelming, which leads to less learning. Further design choices such as gamification which serves in working towards learning becoming less tedious and more fun again show UX being used to maintain motivation to use the application. All of these are affected directly by cultural influences a user may have on visuals within a UI. This will further develop these guidelines into the paper's conclusion. To further explore these issues, data from primary sources will be used in the next chapter to find out what are considered by users to be the most effective applications

Chapter 3: Interviews

3.1.1 Overview

This chapter will explore the qualitative data gathered from the interviews conducted for this paper and then compare this to prior research discussed in the Literature Review chapter. The author of this paper conducted the research which consisted of 6 semi-structured interviews. By means of directed content analysis and triangulation this data serves to further enrich the strength of this paper's argument to establish guidelines for a designer.

The following section will display the data gathered by participants in relation to CALL applications in order to explore what are the best design practices from the point of view of primary sources. To direct the data discussed in these interviews, the focus was placed on what app was used more than other apps by the interviewee, why the app was used more frequently, and what type of design principles this app was used. This allowed for directed content analysis in relation to design guidelines.

These guidelines include UI design such as colour and layout, gamification and dual coding. The semi-structured style allowed for participants to voice concerns and preferences in relation to CALL design further adding to the data.

3.1.2 The Participants

Participant Number	Age	Years using CALL	App of preference
Participant 1	24	10	Bancizhan
Participant 2	21	3	Momo recite words
Participant 3	24	5	APEuni
Participant 4	26	2	Momo recite words
Participant 5	24	5	Bancizhan
Participant 6	25	6	Scallop Word

Figure 10: Table of participants

Six students were invited to participate in the study based on a convenience sample, this meant a sample of participants was drawn from a source that was conveniently accessible, in this case, fellow students of the M.Sc. in Interactive Digital Media at Trinity College Dublin. This had the benefit of ease of access for the researcher and consistent quality of data from interviewees. However, the potential downsides include skewed data as all participants are of a similar study situation with another potential downside being that participants knew the researcher which could have led to a potential risk of bias. All of these participants passed the CET-4 in order to prove English proficiency for Irish university entry requirements, all users studied with the help of CALL. Hence this sample is not representative of the English learning population from China at large, but more so representative of those who have pursued third level education internationally from China and needed English to do so.

3.1.3 The Researcher

The researcher, in this case, was a Master's student of Interactive Digital Media at Trinity College Dublin, completing this study as a part of a research paper worth 10 credits of the 90 credits program.

The researcher received academic training and support with access to documentation that provided them with the knowledge and skills necessary to carry out the study. This was further helped by this paper's supervisor who is a lecturer in the School of Computer Science and Statistics at Trinity College Dublin and has conducted many research projects which also contain similar interview techniques. One of these being written at the time of this paper.

The researcher comes from a background of fluent English and is approaching the issue with no past experience bias in relation to using CALL services and learning English. This works as a positive factor as data will not be affected by bias, however, it means the researcher will lack the same understanding of the content that the interviewees have.

3.1.4 Methodology

This section will outline how data was collected, created and analysed for this research paper.

The set of 10 questions asked to participants included the following:

- What is your first language?
- When did you start learning English?
- Have you ever used an application or website to learn English?
- When did you first start using CALL to use English?
- What CALL service worked best in your experience?
- What did you prefer about this form of CALL to the others you have tried.
- What motivated you to keep using the application.
- What aspects of the design were effective? Did it combine visuals/ use colour effectively?
- What aspects of culture affected your learning how did the application help you overcome them.

These interviews took place in a semi-structured style which allowed for occasional extra moments of dialogue which broke the chain of questions but allowed for extra and welcome pieces of data in relation to using CALL. Four of these interviews took place face-to-face in person and the other two took place via the online communication platform *Zoom*. These were recorded via professional audio applications on a mobile device or else within the *Zoom* platform itself with the permission of the interviewee. These interviews were later transcribed for research purposes and comparison using otter.ai. (Otter.ai, n.d.). A semi-structured qualitative approach was chosen because it provides a flexible technique for small scale research of this kind (Drever, 1995). The

sample size was small, another reason for the semi-structured interviews as this method usually provides more useful data when the sample size is relatively small and "it also allows thematic analysis of the qualitative data" (Pathak & Charatdao, 2012, p. 4). The personal nature of face-to-face interviews is "well suited to the exploration of attitudes, values, beliefs and motives" (While, 1994, p. 329),. Learning itself, as previously established by this paper, is heavily linked to attitudes and motives, hence face-to-face methods of research were especially beneficial given the topic.

The opening three questions served as 'ice breakers' while also building a rapport with the interviewee. This was done while sharing common ground and common experiences with the interviewee, helping to gain perspectives and counter perspectives on the issues before critically specific questions began.

The following questions would serve as an exploration of the candidate's ideal CALL application based on their experiences, with the researcher asking interjecting questions relating to specific design approaches and how they were experienced by the candidate's past usage of CALL within these ideal applications. This was achieved by the method of directed content analysis, using the existing prior research to identify key concepts or variables. The positive of this approach was data was conclusive and correlated with research heavily allowing for sufficient conclusions for the paper. However, it has "inherent limitations in that researchers approach the data with an informed but, nonetheless, strong bias. Hence, researchers might be more likely to find evidence that is supportive rather than nonsuppurative of a theory" (Hsieh & Shannon, 2005, p. 1283). It worked as an appropriate approach to the qualitative analysis given that the data is being used to add further description to an existing phenomenon that is incomplete. The technique of Triangulation was used to

conclude the analysis. This technique "emerged from navigating and surveying professions in which it is used to describe how two known points are used to find the location of a third unknown point" (Humble, 2009, p. 37). In this case, the two known points are the Literature Review findings and the Interview data with the third unknown point being the guidelines established from the two.

The rest of the interview chapter will break down each topic and cross-reference the data discussed by participants.

3.1.5 Establishing Context

The initial questions were asked to gauge the audience of this sample by establishing context while also allowing the interviewee to become comfortable and relaxed within the interview process itself. Participants ranged from the ages of 21-26, starting to study English in primary school between the ages of 6 and 7 and using CALL to facilitate their learning at an older age in high school. Due to this being a convenience sample, the data set all came from similar situations of moving to an English speaking country, Ireland, to study at a university which required English. On why they used CALL applications candidates said the following:

Participant 1: "A lot of things like grammar could be easily understood in classes. But vocabulary is something that you have to keep refreshing and refreshing. An app is a good way to do it so that was my reason for using CALL".

Participant 2: "I use different apps for different reasons. Especially because in China we always divide English into four parts. Speaking, writing and reading and listening so we're always you know, separated and CALL applications follow this suit. Vocabulary was always the most effective use".

With every participant stating the same reason for using a CALL application, to help reinforce their studies of the language and prepare for CET exams, it is clear what the data from this convenience sample represents. All participants stated to have started learning English at a young age in school but needed the help of CALL to maintain and improve vocab and other aspects of their English ability.

3.2 Gathering Data

In regards to design, the group of interviewees revealed several reoccurring design choices that they felt were especially effective in maintaining interest and motivation in using the software and overall learning. These conclusions were drawn from their responses to the researcher's question as to what application was preferred and further follow up questions to reveal more specific data on the design elements of the apps that worked well.

When participants were asked to describe elements of UI within the application, many elements were consistently prevalent across participants and the various applications discussed. This included what colours were used and layout choices, gamification and integration of dual coding.

3.2.1 Gamification

All applications discussed featured gamification in their design in some form to help increase user interest and motivation, some users felt it to be more effective than others depending on what their preference of application was.

A consistent example of gamification across the apps was the use of a daily insensitive or 'streak' to help keep consistency in the user's use of the application.

This was usually used in combination with the user's personalised target goal, this being a method of culturally integrating Chinese society's approaches to learning and academics.

For example, Participant 3's use of APEuni to prepare for college entrance exams had most of their learning turned into statistics for constant daily reminders of their academic progress.

"It will record how many days you have used the application and how many times you practised, along with a target timer for passing the eventual exam. The application will dynamically adjust my learning based on how much I meet my small goals in anticipation of the overall target goal, which is the exam. This feels like a scoring system similar to that of a game, if I don't meet the daily targets, I am losing."

Participant 3's experience with gamified learning used to break down progress and increase motivation through numerical goals shows the effectiveness of gamification in the realms of academic motivation. The gamified learning hit a certain psychosocial niche of wanting to win and therefore wanting to learn.

Gamified learning is shown by multiple participants to take advantage of how we feel toward games and our relationship with them. One app popular with participants called *Baicizhan* roughly translates to 'Cutting 100 Words' specifically targets vocabulary integrated with gamification by setting a target for each day. Participant 5 stated, "I could kill time waiting for the bus as if I was playing a game, but while being productive and not wasting time playing games. That's the best part of the app".

The most extreme side of gamification was shown by Participant 6 in the application 'Scallop Word'. This application allows users to practice their English ability by targeting exam-specific material and sentence vocabulary testing. Integrated into this learning application was the most gamified learning shown by any interviewee. When asked what helped motivation when using the application, Participant 6 stated:

"There is a unique feature to this app that's a small game with online competitions, it's called 'Word Battle'. You are pitted against another English learner and shown English vocabulary with options of the Chinese translation. The first person to input the right answer scores a point. The best feature of this is that you can interact with your friends: you and your friends can be set up at the same table for memorizing words, check in every day and then supervise each other; or play word memorization games. It's been the best way for me to learn and kept me coming back".

This is an example of gamification using social integration while taking advantage of gamified learning at the same time. This participant revealed gamification when used in tandem with social integration and developed dynamically into the design of the app, can establish a relationship with the learner that incentivises them. Participant 6 mentioned a similar approach to gamification when asked what motivated them to keep using *Baicizhan* "There is a leader board system with other players and I can rank up by memorizing more words which makes English learning more interesting for me". The data here reveals directly how gamification infused with social competition can increase motivation to use CALL.

Figure 11 'Word Battle' Game Described by participant 6
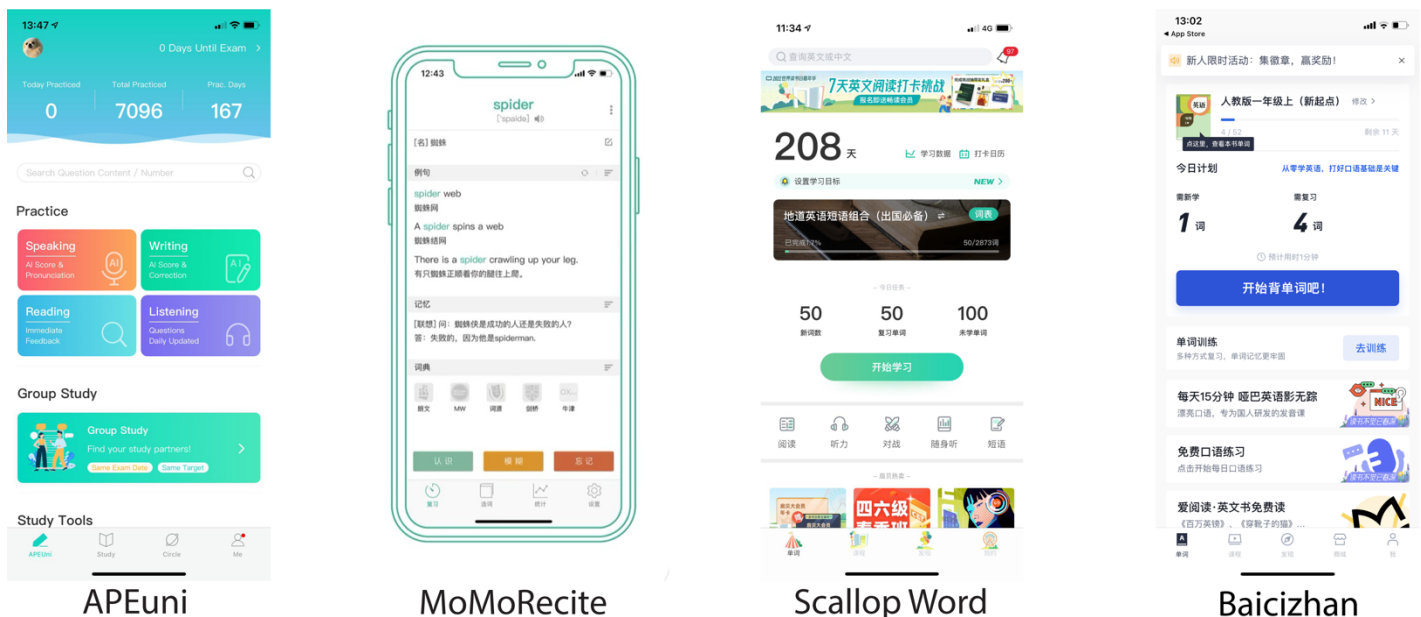
3.2.2 Colour and UI Navigation

Figure 12 – Screenshots taken by the researcher of the various apps discussed by Participants. MoMo Ricite image taken from app store (MaiMemoInc., n.d.)

When it came to UI, the participants were not familiar with advanced graphic terminology, so follow up questions based on UI had to be kept linguistically straight forward The participant would send a screenshot of their preferred CALL application to the researcher to supplement their description of its user interface effectively.

Various consistencies within UI reoccurred throughout applications, showing that there was a pattern within the most acclaimed CALL applications in the sample. The four applications discussed by participants are shown below in Figure 12.

Across the applications, colour can be seen to follow a similar design choice. This paper previously established that blue had the most positive associations with the psychology of Chinese users. This is reflected in the consistent use of blue-

based colour accents across all applications discussed, as seen in Figure 12. *MoMoRecite* uses the accent colour to outline where the target word is present within the text, the UI colour choice serving purposely to notify the user as to what they are learning. When asked how this made the learner feel Participant 2 stated "The bright colours consistent throughout the app made it feel much more like a natural learning environment that was encouraging, with dark colours never really appearing from my experience". This reflects research on the importance of the learning environment as discussed in the Literature Review. These apps consistently used bright, blue and white contrasting colours to facilitate a positive learning environment and therefore enhanced the quality of learning and efficiency of the app.

Participant 1 spoke of how the *Baicizhan* UI made them feel, comparing it to another app "It's a very peaceful app, it's blue and white. It doesn't blink fireworks and stars like other apps. It makes me feel warm. I feel more academic. I feel like I've been spending 30 minutes studying instead of playing games. It makes me feel like I'm achieving something". This reveals that the UI choice for this participant reflected their own intentions while using the applications, the simple clean style made them feel academic and reflected the learning environment they wanted. They compare the app to others with a more expressive design's such as *Duolingo*, preferring the more calming straightforward UI within *Baicizhan*.

The next point when asked about UI design that was discussed by participants was how they navigate the application. All these applications follow a similar approach with a nav bar at the bottom of the screen which will direct the users to pages within the app such as a home page, explore page, social page, and a personal account page. Participant 6 stated, "I never really took notice of how I

navigate the app probably because it works the same as how I navigate other apps, on my phone like Facebook, anything different would probably just serve as a distraction for me". On the matter of using the app Participant 4 said "When I first downloaded the app it worked pretty seamlessly, there wasn't a bit learning curve to grasping how I use it. I just started using it and it worked". These comments reflect how efficient and familiar UI design works in favour of the application's UI. As previously stated in this paper's research by Jakob's law, the familiar design allows the user to understand how to use the application as quickly as possible. This is all the more important with a learning application as the user is more likely to be discouraged from using it compared to other applications such as social media platforms.

Hence, the data reveals that the use of user-friendly design involving both a familiar layout and sensitive colour choices, based on the intent of the application and the user base, allowed the discussed apps to stand out for participants.

3.2.3 Dual Coding and Cognitive Overload

A point of concern for the researcher during the interviews was how the applications discussed took advantage of dual-coding and if the participants noticed or appreciated it. The data revealed many different approaches to dual-coding and what approaches users felt were more effective than others. To start, visual dual-coding was the most common across the applications discussed. This would usually involve the use of a picture to demonstrate the word being asked of the user, forcing them to not think in Chinese but instead to associate visual activities. The data pointed towards *Baicizhan* as the most active use of dual-coding for the user. Participant 5 stated,
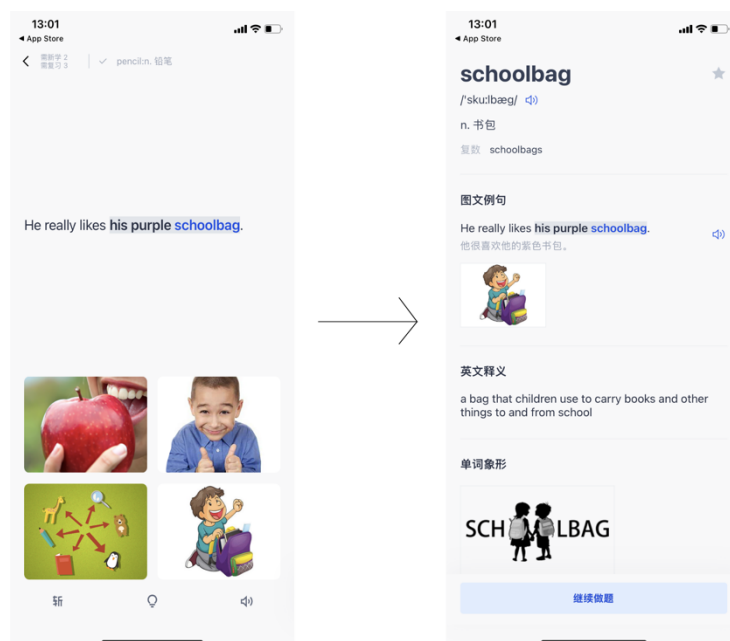
Figure 13: Baicizhan Dual Coding

"For each word, it provides an image and examples of how to use it in sentences. In this way, I can associate the word with real-world examples and hence memorize it faster". The researcher was then sent a demonstration of this technique as shown below in Figure 13.

Discussing the same application, Participant 1 stated "When you see the picture, you hear the computer's voice saying the word, you can correlate it with what you know and figure out the word. I find it very helpful and still use it today to practice vocabulary". The data revealed that participants found the use of dual coding with visual and audio signifiers of meaning, along with context, provided them with support in memorizing the word efficiently. The use of four images as options for the user to pick for each word correlates with the research presented on Hick's Law, for cognitive overload to be avoided approximately 7 pieces of information should be presented at a time.

Dual coding was not only demonstrated by visuals within the data but other participants found audio to be just as valuable of support when learning new vocabulary. Participant 2 stated that "the reason I kept using MoMo Recite was

its repeated use of audio through my use of the app. It's helped my memory of the words dramatically, as I personally prefer to listen to podcasts to supplement my learning. So hearing the words was important to me". Here we see a user who personally finds that audio supplemented with text in the style of dual coding is what they find most effective. Hence, although visual stimuli are common and shown by the data to be effective for memory, other users may disagree and find other methods more effective for them. Therefore the safest approach for a CALL application is two include both and therefore cater for both possible demographics of learners. Participant 6 argued "I find the most crucial problem in this kind of application is that sometimes I know the meaning of the word. But, when I need to choose the right image it's tough because I don't know what image is exactly right. It doesn't work for complicated vocabulary in my experience". When comparing this data with the examples of previous participants it can be understood that visual dual coding may not be as effective for everyone, depending on learning preference and level of proficiency.

3.2.4 Chinese Cultural Impacts on Design

When asked about aspects of culture-specific to China and their impacts on applications, the interviews revealed many consistent reoccurring pieces of data occurring across all mentioned applications. The most consistent response when asked this question was concerning Chinese society's attitudes towards academics and learning. Frequently a 'Target' or 'Goal' was mentioned as to why the CALL application was used in the first place,

Participant 4 stated "In China, there's a CET-4 and a CET- 6 for college students, these are English examinations. For example, if your target is the CET 6 you are given maybe 4000s to learn. You can set the course though, and the app itself

and it will automatically make a plan for you. You can also choose how many days you want to finish all the recoveries, like 60 days. So really, you have to like maybe do 200 words a day. This approach is reliable and structured and it played a big reason as to why I used MoMo Recite words over other apps". Here we see that for this participant the application's dynamic design which allowed for personalised experiences based on the learner's academic goal would change. Participant 1 also mentioned this aspect of a "personalised" experience in Baicizhan and how the dynamic approach to the application was beneficial as opposed to a more general learning experience, the Participant referenced the app *Duolingo* in relation to this issue.

Participant 2, who also used Momo Recite words, stated: "I think a Chinese company always make more targeted learning. Target learning, because we all have a reason why we learn English. If you want to get hired or to enter a better school, or for example in my case, I wanted to apply for a master's degree. So I'm going to track learning, I don't want to learn it naturally. I know it's not technically the best way to learn the language for fluency. But other more natural approaches are very consuming time. I just want to learn quickly and need to remember these words for my exam".

The data here suggest that in an environment such as China where there is a heavy emphasis on academics and goals as to the reason for learning, they tend to gravitate towards applications that reflect this. The application *Duolingo* was referenced by multiple participants as a lower form of learning that they didn't gravitate towards. Criticising its approach as basic, not specific enough or efficient for their needs in a learning application. This application was made by an American company and is more popular with western demographics as it is the most popular learning application in Europe and America which can be seen

by their leading IOS revenue markets in the 4th quarter of 2021 as shown in Figure 14. Duolingo's failure to grasp the Chinese market as well as its western counterparts is suggested by the data to be because of its lack of personalised and targeted academic learning.
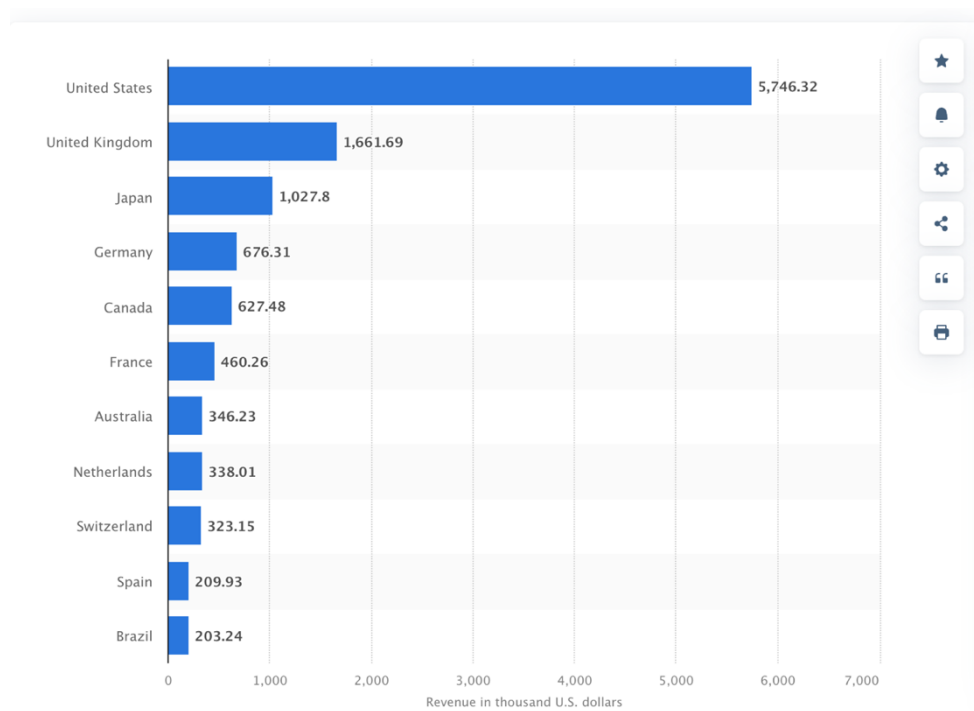
Figure 14:Leading markets based on Duolingo iOS revenue in 4th quarter 2021 (L. Ceci, 2022)

3.3 New and Unexpected Data

To conclude this chapter, new and unexpected data that differs from the expected outcomes from the expectations of the directed content analysis will be discussed.

The nature of personal semi-structured interviews is that participants tend to go astray from the direction of the interviewee. This was especially prevalent from participant 2 who stated "I use the Chinese app for vocabulary but I also use a chatting app, a language study platform. It's like a language exchange, you can talk to another person who is a native speaker, for example, someone who lives

in Ireland. For me, it's better learning and much better for improving general speaking ability".

Across the research into CALL technologies across academic resources, there was little mention of these platforms that practice direct communication as a form of CALL. Participants also would consistently mention using YouTube and other passive forms of language learning, usually to maintain personal interest while learning. Participant 3 stated "I watch English videos I am already interested in so when it comes to a word that I don't know I will look it up by myself. Because I have an interest in the end. This is something that rarely happens when using standard vocabulary learning applications".

This concept of personal interest serving to maintain the learner's motivation was consistent across every participant. Research on CALL technologies didn't correlate with this data. This could indicate that more research needs to be made in the area of supplementing language learning by a means of independent media consumption and the use of CALL.

Chapter 4: UX Guidelines

4.1 Overview

This chapter will seek to draw the paper to a close, doing so by comparing directly the conclusions that can be reached by interview data and research together. This information in conjunction can be used to explore some guidelines which may be followed by a designer involved in a CALL application.

4.2 Guidelines

There are many considerations a designer must face when approaching the task of designing a language learning application, these considerations change depending on the language intended to be learnt and what the user demographic is. The following guidelines target the demographic of Chinese language learners seeking to learn English.

4.2.1 UI Choices

The user interface should follow the laws of UX as outlined by Joe Yablonski (Yablonski, 2020), in regards to CALL specifically Hick's Law and Jakob's law. As this paper previously discussed, familiarity is key to maintaining the user's encouragement in using the application. The data from the interviews showed how familiarity with design allowed users to become comfortable quickly with the application thanks to prior knowledge of other applications such as social media. This prior knowledge means that the user does not have to learn new skills on top of the new language that is being attempted to be learnt. Hence, the safest choice with UI in terms of layout and navigation is something which bears resemblance to other applications. This can be seen in the examples

discussed by participants where an almost identical navigation UI was used across the applications.

Another important approach to UI design is Hick's law. Hick's law prevents the possibility of cognitive load for the user, leading to confusion and possible errors when using the application. Cognitive load is especially important when it comes to learning as it prevents the acquisition of new information due to an overload of information, such as new vocabulary etc. This is further expanded on in millers law where it states no more than 7 pieces of new information to be displayed for the user at a given time. This can be seen within the data from the sample set, preferred applications such as *Baicizhan* would usually show 4 images at a time as possible inputs for the user. The app being so popular and commended by participants in the sample set attests to the efficiency of implementing Hick's law within the UI of a CALL application. The designer should take Jakob's law into account and design with familiarity in mind. The designer should also take Hick's law and Miller's law into account and avoid cognitive overload in learning by resenting no more than 7 pieces of new information at a given time.

4.2.2 Gamification

Gamification can be defined as "the use of game design elements in non-game contexts" (Deterding, 2011). This can be done within CALL application design in an attempt to increase motivation and serve the purpose of making learning a language fun. "It's hypothesised motivational power has made gamification an especially promising method for instructional contexts" (Sailer & Homner, 2019, p. 73). Motivation being the keyword here, the data from Participants 6 and 5 both felt strongly that the social elements within gamification such as leader boards and competitive word games effectively improved their drive to learn.

These strong examples are further backed by consistent use of gamified elements across all the data gathered. These include daily streaks, learning being ranked and valued similarly to that of a score in a game and sounds that mimic that of success when winning in a game. Hence the designer should keep gamification in mind during the design process by implementing game elements such as daily trackers and socially competitive features.

4.2.3 Dual Coding

Dual coding is the presentation of new information through two sensory systems. The first sensory system is logogens which are verbal processes, in the case of language learning, the text itself displays the new words to the user. The other sensory system takes place in images, working in how we understand information through non-verbal processes. The combination of these two sensory systems according to the research discussed above provides a more effective learning experience than single sensory system based learning.

If we correlate this research with the data of the convenience sample, applications that were most highly regarded by users consistently displayed usage of dual coding in different forms. Users leaned towards different applications based on their preference of learning, if they are more visual learners or prefer audio-based supplementation of their learning. For example, if a learner is especially keen on visually assisted dual coding *Baicizhan* stands out as a prominent example of visual dual coding integration. The application's continuous use of different forms of visual representation to assist the learner has been revealed by
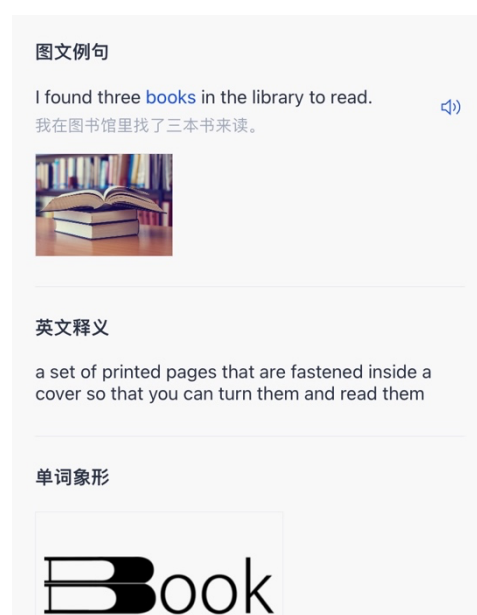

Figure 15; Dual Coding in Baicizhan

the data to help memory and user opinion of the application. This is done through testing the user by asking questions based on visuals alone, with the answers providing contextual visuals integrated with the word. This is shown in figure 15, where a unique form of symbolic dual coding replicates that of the Chinese alphabet teaches the word 'Book'.

However, this approach while effective for some is not ideal for every learner. Certain learners can be defined in their type of learner as a visual or auditory learners (Fleming & Mills, 1992) where "visual learners prefer diagrams, flowcharts, and graphics" and "auditory learners prefer hearing directions, lectures, or verbal information" (Bonk & Zhang, 2006, p. 249). The two users who preferred the application *Momo Recite Words* could be considered auditory learners as they noted the significance of audio when using the application. Participant 6 indicated that the completely visual approach of *Baicizhan* can sometimes lead to confusion and less than effective learning.

Hence, this paper recommends for a designer that an ideal approach to dual coding is to allow the user to choose a preferred dual coding method. This would allow a CALL application to appeal to a broader market of learners as every type of learner would be effectively catered for in this manner. Non-visual learners, such as participant 6, will not be discouraged from continuing to use the application if they can effectively set a preference for how the information is taught to them. A designer should therefore design for both auditory and visual learners for dual coding to be effectively implemented into the design.

4.2.4 Personalised Target Learning

For the final guideline of this study, it is logical for a designer to allow personalised target learning where possible when designing a CALL application. If the intended user base of the application is that of China, the research and data gathered in this study suggest that the user's end goal must be integrated within the application to allow for dynamically personalised learning. The interview participants all came from a similar situation when it came to learning English, and the need to pass language university entrance exams. However, as China's population features a large number of students pursuing academic studies, especially internationally, as discussed in the literature review, this sample represents a common ground for Chinese language learners.

When designing an application, avoid an over gamified flashy design as participant 1 outlined this can deter a user who is serious about learning. Instead, with the previous UI considerations in place, allow the application to receive input from the user deciding how their learning will progress as they use the application. This will allow the application to appeal to a vast majority of English learners, the majority of whom learning English is intended for business, school and other professional means.

A designer could also take into account the new and unexpected data which seems to point toward personal interests within the learning process helping the user. If personalisation could be further integrated into the UX in a new way, designers may open their application to a whole new market of learners from other platforms.

Examples of personalised target learning include setting vocabulary goals which adapt to the user's personalised preference. This can be integrated into the UI

via consistent reminders of where the user is concerning their progress towards their targets, which can correlate with a gamified approach where values are treated as scores which reward the user. This will serve in increasing motivation for the user and allow the application to appeal to markets in China where students have goals which may, as data has suggested, benefit from structured personalised learning. Hence. the design should take personalised learning into account by allowing an adaptive and personalised experience through the establishment of the learner's targets to create a dynamic experience.

Chapter 5: Conclusion

This paper explores how elements of design correlate with the effectiveness of a computer-assisted language learning application. Based on research and data gathered by the researcher, guidelines were established to help future developers of CALL applications make the most effectively designed product for learners. The perspective of a Chinese language learner is one of the largest markets for CALL, as previously established by this paper, with many design issues specific to this niche of learners.

The initial research expressed the essential UI design fundamentals when it came to creating a CALL application. This referenced the ideas presented in Laws of UX (Yablonski, 2020) such as Hick's law, along with gamification, and user-centred design. Following this, psychological aspects of the learning process when using CALL were discussed such as dual coding and cognitive load. Finally, culture-specific points were brought into the research such as UI choices such as colour, visual style and finally the impacts of Chinese society's approach to academics. All of these combined give a picture of what considerations a designer should make to create the ideal computer-assisted language application for an English learner from a Chinese background.

The combination of the research and data gained from the interviews allows this paper to triangulate new guidelines which serve as the climax of this study's argument. These include the UI approach, gamification, dual coding and target-based personalisation for the user.

To conclude, a designer can consider these points in different ways. If they are seeking to make an application which holds the most potential to dominate the

market, catering for as many users as possible is essential. The data revealed that users will use different applications depending on their learning preferences. A dynamic personalised experience with UI elements consistent with clean blue tones, user-centred design and familiar navigation layouts seem to be the most likely UI choices to guarantee an effective user experience. This should be used in conjunction with gamified learning and UI elements to help maintain user interest and motivation to use the application. Social elements are proven by the data to be some of the most effective methods of gamification along with daily streaks and scoring depending on user input. Following this the learning itself is backed with multiple forms of dual coding, catering to the needs of different types of learners within the user base. Finally, a dynamic personalised experience where users can choose the final destination of their learning goals allowing for the application to adjust and suggest what will be learnt by the learner as they continue to use the application is a big draw for a Chinese language learner. If these design guidelines are considered when the UX of a CALL application is designed, future users in this demographic may be less divided in their choice of most affective CALL application.

This study was limited given the fact that a convenience sample was used and hence the data was prone to potential bias and being skewed. Future research is needed into this area with perhaps a broader sample group of different age groups and reasoning behind learning English. This data could enrich this area and help create more concrete data to felicitate more validity to guidelines. This is way this paper's guidelines serve not as strict rules to follow but instead they serve as considerations for a UX designer. This will hopefully lead to new applications being developed that have a design that benefits learners to their maximum potential of learning.

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Appendices

Appendix A – Ethics Committee Approval

R

rec-app-help@tchpc.tcd.ie   14 February 2022 at 15:35

TCD REC WebApp: The status of 'What UI/UX Factors Contribute To The Limitations And/ Or Benefits of Compute...

To: byrnec85@tcd.ie   Details

The status of 'What UI/UX Factors Contribute To The Limitations And/ Or
Benefits of Computer Aided Language Learning Technologies (CALL) for English
Language Learners of East-Asian Language Origins?' has been updated by the
Committee.

Title: 'What UI/UX Factors Contribute To The Limitations And/ Or Benefits of
Computer Aided Language Learning Technologies (CALL) for English Language
Learners of East-Asian Language Origins?'
Applicant Name: Cian Byrne
Submitted by: Cian Byrne
Academic Supervisor: Nina Bresnihan
Application Number: 20211207

Result of the REC Meeting: Approved

The Feedback from the Committee is as follows:
Hi Cian,
Your application has been approved.
Kind regards
Elaine

The application can be viewed here:

https://webhost.tchpc.tcd.ie/research_ethics/?q=node/1010

If amendments are required, please use the following link to edit the
application and upload the changes:

https://webhost.tchpc.tcd.ie/research_ethics/?q=node/1010/edit

Appendix B – Information Sheet for Prospective Participants

TRINITY COLLEGE DUBLIN

INFORMATION SHEET FOR PROSPECTIVE PARTICIPANTS

You are invited to participate in this study on what UI/UX factors contribute to the limitations and/or the benefits of computer aided language learning technologies for English language learners of East-Asian language origins. This study aims to improve the development of computer aided language technologies within the field of Education and Technology.

This study is being carried out as part of the requirements for a M.Sc. in Interactive Digital Media at Trinity College Dublin. We are seeking participants who have used computer aided language learning technologies.

You will be asked to partake in an interview to explore your experience of using computer aided language learning technologies. The interview will take place in person or over Zoom.

We will audio record the interview, and afterwards transfer it to a secure server in the School of Computer Science and Statistics, at which point it will be deleted from the portable recorder. Only the researcher and their supervisor will have access to the original recording. The interview will then be transcribed, and all personal details removed after which the recording will be deleted. Only members of the study research team – Cian Byrne, Nina Bresnihan at Trinity College Dublin will have access to the transcription.

We will retain the responses for 10 years for research integrity purposes, after which point it will be deleted.
We will be storing and processing this data in order to conduct research and improve CALL technologies through evaluating data.

We expect the interview to take roughly 15-20 minutes.

We do not anticipate any risks to participants. [1] We will take the following measures to ensure your privacy: The participant's data will be anonymized upon transcription of data and thereafter original identifying audio recordings will be deleted. As a token of appreciation, participants will

be provided with a €10 gift voucher. While participation will not benefit the participants directly, the research will support the development of better tools for CALL technologies, which will benefit future learners of English.

This study is completely voluntary, and if you choose to withdraw and/or not consent to this study there will be absolutely **no adverse consequences**. If you decide later that you would like to be withdrawn from the dataset of this study that is no problem at all up until the data has been anonymized and the audio recordings deleted as there will no longer be any way for us (or anyone else) to identify an individual participant. Consent can be withdrawn up until this time by sending an email to my contact byrnec85@tcd.ie and/or contacting my mobile at (+353) 83 857 7260. When opting out, there is no reason required or further detail into any detail behind the matter.

Each question is optional. Feel free to omit a response to any question; however, the researcher would be grateful if all questions are responded to. As the purpose of the experiment is to assess the effect of experience on task performance, a question on experience is required to be answered in order to participate.

At the end of the interview, we will explain more of the reasons behind the interview and give you a chance to ask questions. If the participant would like, the audio recording/ notes made during the interview can be reviewed after the interview takes place, but before the data is anonymized, to assure they are comfortable with all the data that has been taken. We will email the eventual research paper which contains the data to all participants.

The data will be analysed in order to reach a conclusion as to what UI/UX factors attribute to CALL technologies for English learners and furthermore how to improve CALL technologies as a whole. The research results will be published in a M.Sc. research paper at Trinity College Dublin. This will be done in a way which does not identify you, or any other individual participant. No audio or video recordings will be made available to anyone other than the research team comprising of Cian Byrne and Nina Bresnihan, nor will any such recordings be replayed in any public forum or presentation of the research.

While it is unlikely that illicit activities would be disclosed, if you do so, we would be obliged report them to the appropriate authorities.

If you have any queries, feel free to contact Cian Byrne at byrnec@tcd.ie, and we will be happy to

answer questions about the study.

Data Controllers: Trinity College Dublin

Data Protection Officer: Data Protection Officer, Secretary's Office, Trinity College Dublin, Dublin 2 - dataprotection@tcd.ie