A Study of Emergent Computer-Assisted Language Learning Techniques in Second Language Acquisition

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Abstract

Computer technology has brought learning and education out of the confines of the classroom into our living rooms and public transport; off of the white board and notebooks into our hands. Alongside games and entertainment, education has also become mobile. With the process of learning no longer being the sole prerogative of institutions, research needs to focus on enhancing the quality of mobile education to match up to classroom instruction. Technology needs to work in close collaboration with language studies to explore alternate avenues as well as improve upon existing techniques to impart second language training. As such progress in Computer-Assisted Language Learning needs to align with the struggles of Second Language Acquisition to cater to the different needs of individual language learners with disparate educational, social and cultural backgrounds; playing such differences to the instructor's and learner's advantage rather than have them function as obstacles.

Introduction

For this paper, I revisit literature from the last two decades of research in the field of Computer-Assisted Language Learning (CALL) with regards to Second Language Acquisition (SLA). By the end of it, I wish to, hopefully, shed some light on existing issues and how they may be tackled from a computer scientist's point of view. We will be discussing how technology has been used to aid research in SLA processes as well as how technology has faired in acting as a facilitator and mediator in those processes.

Evaluating the present day involvement of technology in education, we can see truth in Bax's[2][3] *notion of normalization* i.e. the eventuality of technology becoming integrated into the process of language teaching. It is reasonable to say that going ahead, technology will only increasingly secure its place as an important tool in the process of SL (second language) instruction and learning. Chun and Plass[10] proposed that - *the primary research question is not whether multimedia instruction is effective, but rather under what conditions and for whom.* This refers to the fact that research should take into account, individual differences in order to gauge the impact of particular features of software-based instruction on particular types of L2 learners and particular learning tasks that they face. This, at present, is the primary point of contention. So far technology has largely been a medium of storing and retrieving educational information rather than an interactive tool to facilitate education. Moreover, technology in a classroom setting, tends to be used as tool of mass communication rather than as a tool for the individual's needs. Language training in particular, focuses on using technology merely as a tool for textual retrieval and practice. While recent years have seen a shift to more interactive educational tools, especially in the sphere of language studies, we still have a long way to go[6].

A number of articles in the *Language Learning and Technology Journal* discuss this

very same fact: that technology in the arena of language studies has a two fold purpose. It serves as an aid to SLA research as well as a facilitating device to the SL instruction process. A number of researchers seem to agree that while the use of computer software in language learning has had a positive impact thus far in training learners in English as Second Language (ESL), technology-assisted learning does face issues on fronts such as finance, isolation from interaction and context-based language instruction[16]. Most authors can be seen emphasizing the fact that we need to recognize both the strengths and weaknesses of using computers in the teaching process to extract maximum benefit from technology in enhancing SLA.

In this regard, Garrett[12] draws attention to the fact that the adoption of software in education is part of a much larger phenomenon he calls *new humanism*. In this he contends that the adoption of technology in various disciplines across the humanities will allow researchers or *humanists* to pool their resources, share expertise and data across disciplines and attack existing problems from a novel angle. He emphasizes that through exploitation of the full potential of technology, will we be able to establish connections across the different disciplines under humanities, which until now has been a hard task.

This article therefore attempts to explore a) some of the major issues SLA researchers have tried to tackle over the past two decades with the help of CALL and CALL research b) create a visual for some of the existing issues with SL instruction by correlating a popular mobile language-learning application named *Duolingo* (available on all major operating systems such as Windows, Android and iOS) as well as a few other applications used in institutions and by researchers, and, c) come at those problems from the viewpoint of technology and present a few plausible avenues to explore for solutions.

Technology in SLA over the last two decades

In 2008, Smith[23] contended that text-based chat transcripts were insufficient in tracking and gaging an L2 learner's progress and fluency. He further contended that through analyzing the end product of textual chats, the instructor can only gather information about the finished "product" and not about the "process" of chatting. Thus the intricacies of an L2 learner's process of negotiation, interpretation and drawing conclusion was lost to the instructor. He proposed to employ video-enhanced chatscripts to study language fluency and efficiency of an L2 learner. His results were persuasive but future research along the same lines didn't conclude hard evidence of the advantage of one over the other i.e. spoken discourse over textual conversations or vice versa. For instance, Sauro[21] compared results from experiments involving L2 students engaging in both text-chats and spoken discourse and found inconclusive evidence. On some occasions, individuals produce more complex matter, lexically and syntactically, over text than verbal communication and in other cases, vice versa. Further in 2010, Park and Kinginger[18] conducted experiments on L2 learners in verbally and textually communicative environments, to study the composing process, corpus search queries and instantaneous interpretive and conclusive abilities, only to come up with the conclusion that both modalities are more or less equally instrumental in helping the L2 learning process.

Golonka et al.[13] reviewed over 350 different studies about the effectiveness of technology in aiding foreign language teaching and learning against the use of traditional tools and methods. Limited evidence was found in support of technology being a major driving force in L2 learning. Technology had a strong impact in primarily two areas: a) Automatic Speech Recognition (ASR) for pronunciation practice (but that too with detection flaws), and, b) Chat (textual and video discourse) for written and spoken language

practice and enhancing complexity in language usage. Moderate evidence was found in support of technology aiding the more important cognitive processes such as vocabulary learning, analytical abilities, focus on form and output and speaking proficiency. Technology was mostly unable to provide intelligent feedback to students regarding the learning process.

Technology does allow for unlimited input and repetitive practice. Studies show that the ease of access with software being available on multiple platforms, both stationary and mobile, aids in reinforcing the learning process. While vocabulary retention can be enhanced through repetitive practice, the context-based usage of vocabulary is not necessarily enhanced in the student. Examination of collaborative and individual writing produced results in support of technology aiding in enhancing grammatical accuracy, however, with limited improvement in form or usage of complex language.[14][17][15]

A special issue of the *Language Learning and Technology Journal* focused on game-driven practices of L2 instruction in and outside of classroom. Chik (2014)[7] analyzed data from studies on L2 learner interactions during online multiplayer gaming sessions, chat rooms, discussion forums and fanfiction sites. Allen et al. (2014)[1] created an intelligent tutoring system that reinforces interest outside of classroom through a suite of educational games. It provides valuable input regarding writing strategy and allows room for plenty of communicative practice. Similarly, Thorne et al. (2009)[25] discuss how freely chosen interaction outside the pressures of a classroom setting via digital media (gaming, blogging, social networking, fanfiction sites, messaging boards, wikis and question-answer sites etc.) can be healthy for a language learner and propel a natural progression of sophisticated usage of language and complexity of form and output.

Chun and Plass (1996)[9] underline that integrating the learning process with differ-

ent types of media helps nurture better recall abilities and enhances the likelihood of retention. The logic behind the conclusion is that when words are coded in the mind via more than one medium, it also creates more than one medium for recall of the said words. Furthermore, this aids in reconstructing sentences in a contextually and semantically correct manner. A combination of audio, video and textual cues helps reinforce the material the learner is trying to retain.

Cedric Sarre[20] investigates and compares the potential of three modes of computer-mediated communication media, namely, discussion boards, text chat and videoconferencing, with regard to their impact on fostering negotiation conversations. The study yielded significant results in favor of videoconferencing being the most suited to enforcing negotiation and context based communication skills, followed by text chat and consequently discussion boards. Discussion boards ranked the lowest in terms of providing corrective feedback to the participants of the discussion due a lack of real-time communicative capabilities.

Warschauer (1996)[4][26] observed that most CALL were limited to dealing with listening, reading and writing skills. Although some amount of speaking software was developed, none of them were foolproof and were only restricted to detecting pronunciation correctness. He pointed out that a program should ideally be able to take user's spoken input and analyze it not just for accuracy and correctness but also for aptness and appropriateness. It should be able to evaluate a student's vocabulary usage, pronunciation problems, grammatical syntax and then provide intelligent feedback.

One persistent problem has been a computer's lack of *intelligence*. A language learner's learning environment and skill levels are constantly changing. Due to its limited inherent *intelligence* computers were mostly unable to deal with learners' unexpected

learning problems and provide feedback or solutions as a human instructor would. The reasons behind this incapability were attributed to the fundamental difference between humans and computers in the way each utilizes and processes information. Researches till the late nineties didn't expect for computer systems to reach that level of intelligence anytime soon.[4][11]

There exists investigative literature on the effects of electronic glossing on L2 language acquisition, particularly vocabulary. LymanHager et al. (1993) conducted a study with two groups: one comprising students who read an excerpt from a story via a computer, and another comprising students who read the story from a printed textbook. Both groups had access to identical glosses with the computer-group having access to multimedia glosses and the textbook-group having access to a side text identical in content to the electronic gloss. After the session the students were asked o participate in recall tests immediately after and again after the course of one week. Students utilizing computerized glosses performed significantly better than students utilizing solely printed textbooks. In order to further validate the efficacy of multimedia annotations in aiding vocabulary learning, Chun and Plass (1996) ran studies involving their second-year students learning German using a multimedia program called CyberBuch[24]. The software provided annotations through pictures, printed texts, and video. After the session, the students took recall tests immediately and in the interval of a few days and a few weeks. The results clearly indicated that retention and recall capacity for visual annotations surpassed that for words annotated with text alone, along with a higher success rate for incidental learning of vocabulary.

Chomsky argues that cognitive approaches to language learning and teaching are necessary, due to the view that language learning is a psycholinguistic act as opposed to

a simple linguistic act. Following this perspective, he emphasizes that learners can build a mental model of a language only through a cognitive knowledge of a language's system and meaningful construction. Text Reconstruction – a common category of linguistic software allows teachers to setup text practices for students where parts of sentences are mixed or jumbled up. Students may be required to work alone or in groups, thereby internalizing a language system through mental construction and reconstruction. While one may argue that such a process can be reproduced using pen and paper too, there are clear advantages of a computer over such an old school system – teachers can build up practice exercises a lot faster using software than paper and pen, students can utilize hints and prompts from a software to help the learning process, students can re-attempt unlimited number of times till they get the answers correct without requiring the teacher to check them at each point. Similarly, another category of software – Concordancing software allows learners and instructors to search large text corpuses for relevant occurrences of specific words. Concordancers thus compliment and supplement dictionaries in that they provide the usage of a word over the mere definition of it. Concordancers are also effective in exploring collocational meanings *(e.g., "large box" vs. "huge box," or "think about" vs. "think over")* or grammatical features *(e.g., "was going" vs. "used to go").*[8]

Schieffelin[22] points out that in contrast to cognitive approaches, sociocognitive approaches focus on the social aspect of language acquisition. The difference between acquiring a language and merely learning it is the aspect of internalization. For this reason learners need to be provided with ample opportunities for authentic interaction in the requisite cultural context so that they may be able to engage in real world conversations outside the classroom. Prabhu[19] emphasizes that this can be achieved through involving students in group tasks and collaboration with the appropriate cultural backdrop.

The Internet in this regard is the most powerful software tool. Connecting the world into a single global village, the Internet allows opportunities for real time interaction maintaining the social and cultural integrity of conversations.[5]

Technology in Linguistics as of 2017 (where we can go from here?)

Majority of the research in SLA occurred during the 80s and 90s. Standing in 2017, technology has progressed to overcome a lot of doubts and obstacles that the SLA researches faced while dealing with technology at the time. For instance, multiple researchers spoke of how they did not see computer systems developing the kind of intelligence as to give corrective and adaptive feedback to language learners, at least not anytime soon. Well, now we have such intelligent agents. Looking at the issues plaguing second language training and learning from a computer science graduate's point of view, I see problems falling under four primary branches of technology: *Mobile Technology (MT), Gamification, Machine Learning (ML) and Artificial Intelligence (AI).*

Technology has brought the convenience of a lot of stationary activities into the comfort of our hands. We can today access everything from entertainment to food delivery to booking tickets, all at the tap of the screen of our mobile phones. So why should education be left behind? With the advent of Massive Open Online Courses (MOOCs), the Internet became a hub for affordable-to-free education. Right from technological blogging to lesson podcasts and tutorial videos, education is accessible to anyone with a hand held device with decent technical configurations. Learning a language is a continuous processes. Unlike Math and Science where you can work intermittently or even rote learn

for that matter, acquiring a language requires one to internalize the language system. As such learning a language requires us to have daily and as much as possible contact with using the language in terms of content and context. A popular mobile application called Duolingo was a pioneering move in the world of mobile and language education. What was even more impressive that it dealt with the difficult subject of learning foreign languages - a feat hard to achieve even within a classroom environment and institutionalized discipline, let alone via an app on a phone. So how does Duolingo do it?

Duolingo started as a free language learning platform launched in 2011 and moved on to include a digital language proficiency exam by 2014. Their test scores are now accepted as a standard by multiple multinational firms in the United States of America as a measure of language proficiency in languages such as English, French and German. Doulingo is the baby of Professor Luis Von Ahn (the same man behind the CAPTCHAs we see on websites on the Internet) at Carnegie Mellon, who being a non-English speaking native, realized the expense of learning a new language for most communities. Duolingo employs a simplistic learning model, a user-friendly and easy to understand user interface and most importantly is absolutely free of charge. It makes the user start off with the most basic figures and words in any language such as man, woman, articles, tree, how to say hello etc. It uses a *reinforcement-learning* mechanism, a common phrase in the world of ML. This refers to the concept of iteration through already traversed paths in order to familiarize an agent with the said paths. In the case of language learning this translates to repetitive practice of the fundamentals of a language system so that a learner may slowly internalize them.

But when we talk of mobile education there is some instant criticism: other features of a phone may be distracting to a learner, there is little scope of real time interaction,

corrective feedback is limited and that studying in isolation can sometimes be not-so-fun. In a study done in the UK on newly arrived international students from non-English speaking countries, trying to learn English, statements like these were recorded: *When we work with our mobile phones we are isolated, like I am isolated when I am in the Accounting courses because my English is not so good; but when we meet once a week and do team assignments, we feel part of the group... I don't know if that can be done through the phone, but belonging is very important.* But technology has found ways to work around most of these problems.

Duolingo incorporated a feature in early 2015 that allowed users to engage in a text-conversation with a chatbot or an artificial agent built into the software. This chatbot is similar to Google's Allo or Apple's Siri. Such a software is built on the foundations of Machine Learning and Artificial Intelligence. While ML houses algorithms to create AI: these algorithms process the data required to create systems that are self-learning, self-correcting and are capable of making decisions, drawing inferences and matching criteria on the basis of a nonstop influx of data. The chatbot in this case aims to have a conversation with the user on a certain topic (example: the weather) and provides corrective feedback regarding the grammatical structure and semantic appropriateness of the statements the user enters. For every correct answer user gets points which are called *experience points (XP)*. On reaching a certain amount of experience points, learners get to level up and earn what Duolingo likes to call its own personal currency - *lingots*. Users can spend the lingots to buy additional practice exercises or special features of the language system such as "flirtatious phrases" or "witty sayings". Now, this brings us to Gamification.

Gamification has been around for ages. It is the idea of attaching a virtual reward

system to gaming activities. Needless to say, over the years the concept has bled over into other areas such as education, shopping etc. For instance, if you finish a course on a certain MOOC website within the specified time period you will get a certain amount of cash back as a reward. Or, if you order for more than fifty dollars worth of food from some popular food joint, they may offer you free movie tickets. As we can see, what was previously the prerogative of a gaming enthusiast to indulge in new releases, today, has become a simple psychological trick to drive the common man into "doing things". The positive psychological impact of Gamification comes from the fact that we know it's all "fake money" or "virtual currency" but it gives us a sense of achievement - *gain* something on completing a task. Even better, that while we don't pay any actual cash for it, we can use this "fake money" to buy extra features or products off of the respective platforms. Duolingo makes it a point to keep small rewards all along the way with big bonuses awaiting learners when they finish major exercises or tests. This is contrary to a traditional classroom setting where the sense of achievement comes at the very end of a term of studying for a stretch of three-four months. Naturally, there tends to be a lack of daily motivation. Instructors can incorporate the use of such apps into the curriculum. In 2015, Duolingo launched *Duolingo for Schools*, to allow teachers to maintain a central dashboard monitoring each student's individual progress. The app takes care of tracking the strengths and weaknesses of each student so that the instructor can focus on optimizing the curriculum to suit the students' needs. Language instructor in classrooms can also incorporate Gamification techniques into the curriculum. Who wouldn't enjoy an extra ten marks for being the first to complete ten levels of Duolingo's Expert level exercises? Serves two purposes - there comes in a playful angle to the whole process of learning, and, the student has the freedom of doing it at his own pace, at his

own convenience over the course of the term.

Another psychological factor that we often tend to overlook in the conventional classroom environment is the presence of introversion. Not all students are outspoken and interactive. More often than not a few students take center stage and that makes reclusive individuals conscious of themselves or too intimidated to take active part in the class proceedings. With an increasing number of students in class it becomes difficult for the instructor as well to attend to every learner individually. This is where mobile education comes into play again. Individuals face no pressure of performance or fear of criticism when learning in the privacy of their rooms and the comfort of their favorite plush toy. Fear breeds contempt and nowhere is it more prevalent than in education. Apps like Duolingo succeed in bringing a classroom standard of education into the personal space of an individual. However, am I trying to say such apps can replace the need for classroom discourse or a chatbot can replace a teacher? Certainly not.

While mobile apps make it convenient for us to access learning at our own pace and time, it also breeds isolation. While learning has an individual aspect to it, it is at the end of the day also an interactive process. Especially in an area such as language learning. Conversation breeds fluency. Interaction opens doors for constructive feedback. Collaboration between learners makes the process of learning a lot more enjoyable than sitting in one room for hours trying to cram vocabulary. This is where we can harness the power of the Internet. Apps such as Duolingo can create chat rooms and discussion boards where learners can come together to learn. The excitement of talking to new people from around the world but from behind the curtain of anonymity, can work as motivation to interact more, learn more. Also, the aim to learn a language is to be able to communicate out there in the real world. What better way to do so than practice from

the comfort of your home or on a public transport or at a sauna?

The focus of language training needs to shift from using technological devices as mere tools of information exchange, to, tools that can make our learning process a lot more interactive and at our own convenience i.e. from Computer-*Assisted* Language Learning to Computer-*Adaptive* Language Learning. After years of language studies and SLA research we have vast amounts of data that can be put to use to create agents that can function as substitutes for language instructors. It's a fact that the instructors are far less than the number of students. In order to bridge the gap this causes in the pace of imparting knowledge, we can utilize expertize from areas such as Machine Learning and Deep Learning (DL). As one of the pioneers of the field, Arthur Samuel defines Machine Learning in the simplest way possible - the subfield of computer science that computers the ability in a machine to learn without being explicitly programmed. Following up to that, Deep Learning is a class of Machine Learning algorithms that focus especially on pattern recognition and learning via feedback loops. Twenty years ago the issue was that there is too much useful data but no way to process it and put it to use. Now we do have a way. We can create agents that can undergo supervised learning to process data collected from years of language studying and teaching and grow to become an adequate feedback system. For instance, years of examination data from schools and institutions can be fed into a DL algorithm to analyze common patterns of mistakes: difficult words, commonly confused words, common syntactical errors etc. Such an analysis can help instructors and students alike. It can help the instructor to tailor the curriculum to specifically attack the common areas of weakness in the class. It can help the student in the absence of a teacher: chatbots such as Duolingo's employ ML and DL algorithms to learn and re-learn from mistakes that people make and incorporate it into the practice-exercise

generation and adapt themselves during text-chats. Furthermore, these agents not only cater to the mass' mistakes, it can also learn an individual's patterns of mistakes. These agents *adapt* themselves to the individual's needs and skill level and the algorithm works to accommodate each individual's data separately. Algorithms unlike humans are not dependent on language. It can analyze research data in English, Spanish and Japanese and come up with patterns of mistakes that prevail throughout the entire spectrum. Similarly, the same algorithm that tracks patterns for a group of people can do so for an individual person. We can take it up a notch but building Siri-like software to interact with learners much like a chatbot, but in this case, with actual spoken discourse and not mere pronunciation correction. This is AI at a small scale. The accuracy of such AI software can often be a point of contention, but with increasing advents in ML and Natural Language Processing (NLP), the accuracy of such software to recognize words correctly and have an increasingly realistic conversation isn't impossible at all.

The focus of language training needs to shift from *content*-based to *context*-based learning i.e. from trying to give out as much information as possible to giving out as relevant information as is possible. What is the point of trying to teach someone Japanese by having a conversation about the Madison Square Garden? The whole purpose of learning a language should ideally be to be able to interact in a socially and culturally relevant context. If the learning process does not include contextually relevant exercises, then the whole experience is left incomplete.

Due to lack of expertise in the field of cultural and language studies, I personally might not be able to offer much insight into this matter but I would like to ask a few questions, hopefully, worth exploring in the future.

What if we can tailor second language instruction on a thorough knowledge of the

learner's first language? For instance, how to go about teaching someone with a gender-neutral mother tongue, a gender-inclusive second language?

How can we go about teaching languages that share origins or sound similar? Like Spanish and Italian? or Indo-Germanic languages such as Hindi and German?

What if we could incorporate elements of culture into the process of learning. For instance, Japanese Anime is a worldwide phenomenon. Would it make sense to incorporate the audio-video elements of Japanese Anime to teach Japanese in a classroom environment? Would it be more engaging for the student population?

Google Art Project offers a world of rich material on Renaissance Art and Architecture. Again, a ML device could gather data from Google Art and frame text corpus from it for a "Text Reconstruction" exercise. Wouldn't a college or university level student find that more interesting than trying to fill in the blanks for mundane context-less sentences?

Conclusion

Mostly what I gathered from reading two decades worth of research, language learning has problems but problems which are not difficult to resolve; rather difficult to find motivation to resolve. While some may disagree, research in any discipline is funded on the basis of its end product. Criteria such as commercial value, social importance etc. govern largely the investment of funds by governments and institutions into a research project or into the field on an average. As such language studies often fall outside of the purview of such governing factors because of presumptions against its commercial usefulness. Without funding it becomes difficult for disciplines to work together; in this case language studies working with world of technology. As to what an extent monetary funding is an issue is debatable and I might even be entirely incorrect. Regardless, as

an aspiring computer scientist I see plenty of scope for some very interesting work to be done in the area of Second Language Acquisition particularly for a Machine Learning enthusiast like myself. The amount of data collected over the sheer volume of studies conducted, can be a rich source of invaluable information that can help instructors and learners alike in the processes that inform acquiring a second language.

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