Mobile-Assisted Language Learning tool for Second Language Spanish Grammar Practice in the Montessori Elementary Classroom

CS6460 Spring 2020 Semester

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***Abstract*—*While educational technology **(EdTech)** has become a staple in most public and private elementary schools, Montessori elementary schools often struggle to incorporate it into their classrooms in a way that is consistent with their pedagogy. This leads to the conspicuous absent of EdTech from many Montessori lower elementary classrooms. At the same time, the last decade has seen incredible growth in the mobile-assisted language learning **(MALL)** arena. Despite that growth, studies show considerable room for improvement when it comes to incorporating effective second language **(L2)** pedagogy that help users become independent, self-guided and self-correcting learners. It is the goal of this paper to outline the development of a MALL application that can leverage the framework of the Montessori language pedagogy, and extend it to include L2 instruction; in order to create a tool that can easily be incorporated into the Montessori elementary classroom. This will hopefully pave the way for the development of other Montessori EdTech tools.*

1 INTRODUCTION

This paper will outline the **development of a prototype MALL tool that can be used to facilitate self-guided Spanish L2 practice in the Montessori elementary classroom**. We will first examine three problem areas that this tool is attempting to address. (1) The problem of low adoption rates of EdTech tools in the Montessori elementary domain. (2) The problem of delivering L2 content that fits within the Montessori pedagogy. (3) The problem of creating a MALL tool that fits well within the framework of traditional Montessori materials.

This paper will briefly examine these three problem areas in more depth and explain why current MALL solutions do not adequately address these problems. It will use two popular MALL tools, Duolingo and Rosetta Stone, as small case studies to provide some anecdotal backing as to why this is the case.

The next section will walk through the development of a single-sentence prototype of the MontessoriSpanish Grammar App and point out how it attempts to address the three problem areas outlined above. Finally, this paper will examine the tool's pedagogy, activity structure, and workflow.

1.1 Montessori and educational technology

Montessori Schools often struggle to effectively implement educational technology in the classroom environment. (Bayer, 2018; Hubbell, 2006; Prosper, 2018) Even when integrated into the classroom, many lead guides fail to implement educational technology in a way that supports Montessori learning paradigms. Sarah Jones' 2017 paper referenced the idea of TPACK (technological pedagogical content knowledge) to highlight "the importance of teachers having an integrated understanding of how technology, content, and pedagogical methods work together to increase learning within their particular content discipline". (Jones, 2017, p. 17) Jones also mentioned that teachers who already have well-developed pedagogical content knowledge "had difficulty integrating technology that conflicted with those beliefs and preferences". (Jones, 2017, p. 17) Looking at Montessori through these two filters, it becomes clear why many Montessori elementary teachers are hesitant or struggle to implement EdTech in a meaningful way in their classrooms. They have a very well-defined pedagogy that is inexorably connected to the content (the physical materials) that is used to teach most academic concepts. This paper will attempt to show how this challenge is not necessarily a weakness. In fact, the hope is to demonstrate how this strong attachment to a pedagogy can be leveraged into a strength.

The Montessori reliance on physical materials guarantees that children learn topics through kinesthetic means. The advantage here comes from the fact that interacting with tangible objects creates a stronger connection between abstract concepts and the physical world. (Montessori, 1995) This can be a contributing factor for why many Montessori lead guides feel an attachment to their physical materials and are slow to adopt educational technology. However, as students enter higher grade levels and concepts become more abstract, there is an increased difficulty creating physical materials to teach those concepts.

If an EdTech solution can be found that leverages many of the strengths of the physical Montessori materials, and those strengths can be properly

communicated to Montessori lead guides, then the adoption of educational technology solutions in the classroom may be more readily accepted.

1.2 Montessori materials and integrating existing MALL tools

Off the shelf computer assisted language learning (**CALL**) [i] and MALL tools often fail to address the specific needs and advantages of L2 learning that exists in a Montessori classroom. Currently, there are no commercially available CALL or MALL tools that leverage the Montessori language pedagogy. [ii]

Corrective feedback in the Montessori environment is often implicitly delivered through the materials and is self-guided and graduated in nature. (Lillard, 2005) This is often achieved through the process called *control of error*. (Montessori, 1995) Modern studies show the benefit of correction being handled in this manner. (Lang, 2019; Kim, 2001) Feedback given by the language guide is formative. No reward is given for excellent work, as this is felt to be a distraction from the primary reward of learning the material. (Lillard, 2005) Studies have shown that off the shelf MALL programs can struggle to give meaningful implicit or graduated feedback. (Heil et al, 2016) The increased focus on gamification in many of these apps is appreciated by their users, but studies have found unclear correlations between the rewards of gamification and an increase in true learning. (Crowther, 2019) This would seem to support the Montessori philosophy against providing rewards outside of the simple joy of continued learning. (Montessori, 1995) Prosper points to pedagogical problems with labeling digital games as educational technology in the Montessori space (Prosper, 2018), but these problems are not necessarily insurmountable.

Some Montessori schools are trending towards a bilingual approach to teaching L2. (Winnefeld, 2012) This in and of itself can be a huge challenge. Achieving parity between native language arts materials and L2 materials can be incredibly expensive and overload already cluttered classrooms. The staffing costs to provide this type of education can also be prohibitive for smaller schools. Additionally, the Winnefeld study showed that Montessori schools with bilingual programs tend to struggle promoting L2 verbal communication between students during work cycles.

This paper proposes that these problems could be alleviated through a well-designed MALL tool. However, existing MALL and CALL tools do not offer

pedagogy that explicitly works in concert with Montessori materials. And while some apps attempt to offer opportunities for social interaction between learners (Aguilar, 2018), these apps do not offer a way for that to happen safely within the self-contained Montessori environment.

1.3 Pedagogical shortcomings of existing MALL programs

Another area of concern are the shortcomings in MALL L2 pedagogy. Recent advances in the MALL tool space seem to focus more on innovative technology (like NLP to evaluate pronunciation) or ancillary program features (such as gamification elements) over pedagogical innovations. (Heil, 2016) When grammar pedagogy is addressed, these tools tend towards weak or outdated L2 pedagogy. (Lotherington, 2018) To solve this problem an effective MALL tool should have a strong L2 pedagogy; one that stimulates the child's unconscious language learning and metacognition. (Soundy, 2003)

There is no lack of commercial MALL tools available to the L2 learner. As of April 20th, 2020, a simple search for "language learning" apps on the Google Play store or Apple's App store return dozens of professionally developed language learning apps; each app claiming to help the user learn another language quickly and effectively. Unfortunately, a relatively small number of these apps are designed for use in the classroom, and even less for elementary aged students. There are currently no MALL apps that specifically target teaching L2 concepts in the Montessori classroom. The MontessoriSpanish Grammar app's aim is to be the first.

With that in mind, this paper will now briefly critique some popular MALL apps to see if any exist that have a pedagogy or feature set that could possibly be incorporated in the Montessori elementary classroom, even if they were not specifically designed or advertised for that use.

1.4 Commercial MALL apps

There have been several broad studies on the overall effectiveness of popular MALL tools. These studies tend to find significant room for improvement in efficacy and pedagogy. (Lotherington, 2018; Aguilar, 2016; Aguilar, 2018) One study examined 50 of the most popular commercially available MALL apps and found that they "tend to teach vocabulary in isolated units rather than in relevant contexts… [and] rarely offer explanatory corrective feedback to learners." (Heil, et al, 2016, p. 37) Research suggests that this lack of effective corrective feedback is a

significant problem. Ai underlined the importance of corrective feedback (CF) and graduated corrective feedback (GCF) in his research. (Ai, 2017) Specifically, he stated how GCF "is effective in helping learners to self-identify and self-correct a number of grammatical issues". (Ai, 2017, p. 330) The MontessoriSpanish Grammar App differs from many of the MALL tools available in that it offers an implicit form of corrective feedback that is built into the L2 pedagogy as well as the framework of the digital materials.

Since there are currently no MALL tools designed for L2 learning in the Montessori classroom, this paper will examine two popular MALL tools that, in this educator's estimation, come the closest to providing the feature set desired in a MALL tool for the Montessori elementary classroom.

1.5 Duolingo

Duolingo is a commercial MALL app available on Android, iOS and Windows devices. It attempts to teach L2 vocabulary and grammar concepts through short activities that revolve around translating, word matching, speech recognition, and sentence forming. These short activities are grouped together into thematic modules that the user progresses through in a linear fashion. Gamification elements are used to drive engagement and maintain interest.

While the creators claim Duolingo is an effective stand-alone L2 program, some studies suggest it is more effective as a supplement to an already existing course. (Crowther, 2019; Munday, 2016) One study pointed out that Duolingo's pedagogy does not promote subconscious learning, and lists that as a major drawback to its potential for instilling true language competency in its users. (Krashen, 2014) The app seems to prioritize language acquisition over language competency. When it comes to corrective feedback, Duolingo tends to offer explicit, non-graduated feedback.

The MontessoriSpanish Grammar App differs from Duolingo in some significant ways. First off, it is designed to specifically work as a supplement to a class rather than a standalone course. Studies have shown that MALL tools used to supplement classroom instruction can measurably increase learning gains. (Marzban, 2011) The tool also focuses solely on sentence composition and grammar analysis. This singular focus can be used to demonstrate how a deep self-guided learning framework designed around a single activity can promote subconscious learning

and drive implicit corrective feedback. Also, motivation and continued engagement are not driven from gamification elements within the tool. The focus here is to create meaningful interactions between students in the target language and have the motivating factor for continued engagement be the satisfaction derived from L2 growth. as per the Montessori philosophy of education. (Lilard, 2005)

1.6 Rosetta Stone

Rosetta Stone is a L2 tool that relies on a process called "Dynamic Emersion" to teach the target language. It "involves gradually introducing sights and sounds, words, sentences, conversations, and concepts in a way that's supposed to accelerate the learning process"[iii]. While Duolingo is free, Rosetta Stone can become costly, especially in schools where subscriptions are sold on a per student basis. Academic studies have received mixed results from students using this program. One study found that students learned new vocabulary using Rosetta Stone, but struggled to understand how the vocabulary fit together to form ideas. (Lord, 2015)

The MontessoriSpanish Grammar App differs from Rosetta Stone in a significant way: language is learned through a pre-existing framework that the students are already familiar with. Students do not use words without understanding how they fit together within the language framework. Yes, some grammar concepts will be learned subconsciously at first, but over time students will be able to explicitly state what grammar rules were used to form an idea, and why they were used. This is important for self-guided learners who will eventually need to take full ownership of their L2 learning.

2 THE MONTESSORISPANISH GRAMMAR APP

2.1 Overview and Pedagogy

The tool that was developed is a simple sentence forming mobile app for Android. It was developed for lower elementary aged Montessori students and will be used for self-guided, self-correcting grammar practice during work cycles.

This tool leverages the use of Montessori grammar symbols that represent parts of speech (Crane, 1986) that comprise an "activity board". That activity board provides the basis for control of error (Montessori, 1995) during sentence forming grammar exercises. This promotes subconscious learning as well as provides a

foundation for implicit formative feedback. These are all techniques that studies show are important for developing true learning competency. (Krashen, 2014)

The layout of these symbols with their corresponding card outlines fill up the top portion of the main activity window and provide structure to the sentences, as well as a basis for the formative corrective feedback. Figure 4 contains two screen shots of how the single sentence activity for adjective agreement looks.

In its final form, the app will allow teachers to choose from a pool of vocabulary cards for different parts of speech. It will also allow teachers to choose from a set of ten sentence types. In the current prototype the vocabulary cards are pre-loaded and there is only one sentence type available. That is sentence 2e from figure 2 below.

Each card has a set of Grammar Agreement Symbols[iv] designed to facilitate self-checking in the following areas: perspective agreement, number agreement, and gender agreement. After the student creates a sentence with the available cards, she will check her work against the Montessori grammar symbols and the Grammar Agreement Symbols. Once the sentence is determined to be grammatically sound, the child will write the sentence out in her language journal and then read it out loud. Writing is always used to facilitate reading in Montessori. (Montessori, 1995) This activity can be done alone, or with a partner; taking turns checking each other's work.

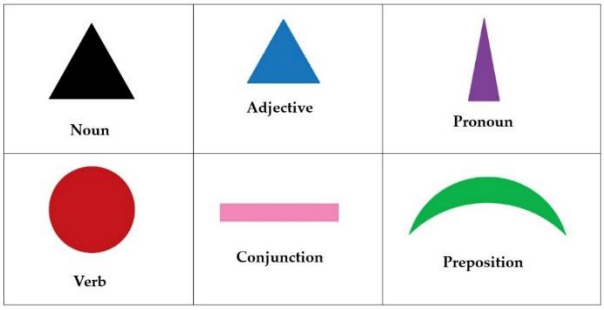

Figure 1 – Montessori grammar symbols

Details of how this learning system will work as well as the self-guided, self-checking nature of this program will be described in detail in the following sub-sections.

2.2 The Boards

The Main Activity space will be comprised of two parts: the board and the cards. The board contains three to five Montessori grammar symbols that combine to form different sentence structures. Figure 1 contains a key of these grammar symbols, and the parts of speech they represent. Articles are not covered here because the choice was made to abstract them out and associate them with the noun symbol. Articles can be broken out into a separate symbol in later revisions of the tool.

Figure 2 lays out some possible sentence structures that can represent single sentence layouts within the main activity. Prepositions and conjunctions will be hard coded into the sentences, while all other parts of speech are represented by cards that will be dynamically added by the students.

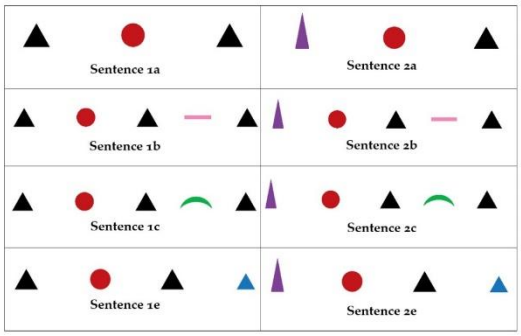

Figure 2 – Possible sentence structures for the MontessoriSpanish Grammar App

2.3 The Cards

Digital cards are selected and placed onto the main activity board. These cards will contain four components: (1) Images (2) Text (3) Grammar Agreement Symbols (4) Colored borders that represent parts of speech.

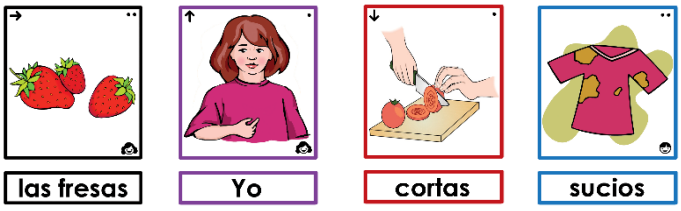

Figure 3 – Sample cards for noun, pronoun, verb, and adjective

Figure 3 contains four example cards (noun, pronoun, verb, and adjective) to show what the grammar agreement symbols look like on the digital cards. The noun card contains three symbols representing third-person perspective, plural

number, and feminine gender. The pronoun card contains three symbols representing the first-person perspective, singular number, and feminine gender. The verb card contains two symbols representing second-person perspective and singular number. No gender symbol is necessary for the verb card. The adjective card contains two symbols representing plural number and masculine gender. No perspective symbol is needed for the adjective card. While nouns and most pronouns will have one card per vocabulary term (i.e. one card for 'banana'), verbs will have five cards per term (i.e. five cards for 'eat'), and adjectives will either have two or four cards per adjective (i.e. four cards for 'dirty'). That variation is because some adjectives can be used for either gender.

2.4 Main Activity Structure

Figure 5 contains screen shots of the 2e sentence activity before and after a sentence is formed by the student. The top section is populated with cards that are selected from the pool of cards available in the RecyclerViews below the black horizontal line. The orange "check work" button on the bottom of the screen changes to a green "read sentence" button once the student has created and verified a grammatically correct sentence.

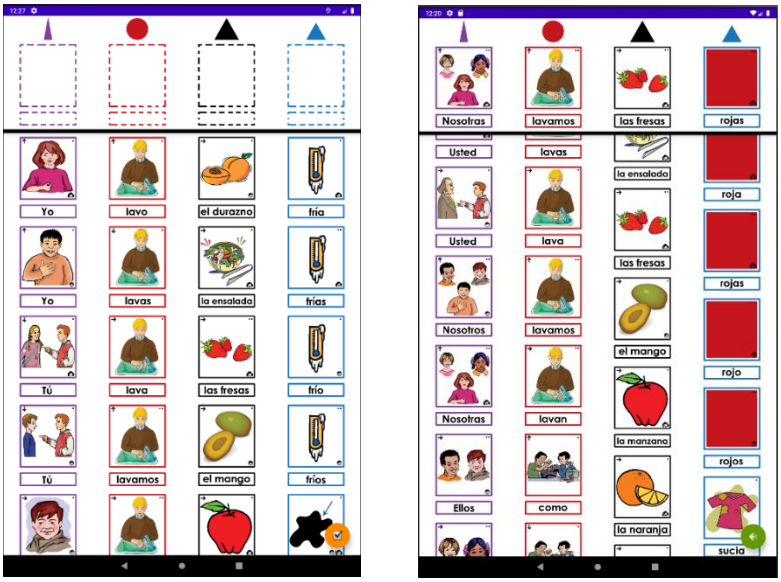

Figure 4 – Sentence forming exercise in the MontessoriSpanish Grammar App

The "check work" button provides graduated formative corrective feedback that gives increasingly explicit help depending on how many unsuccessful attempts a child makes in forming a given sentence. A simple rule-based system was used

for this feedback because the limited number of possible fail states in the activity did not warrant anything more complex. All feedback and praise given is consistent with the Montessori precepts discuss in earlier sections. The "read sentence" button simply reads the sentence for the student to aid in listening and pronunciation. No internal navigation buttons are present as the child is encouraged to remain on the activity screen once there.

2.5 Proposed Activity Workflow

At this point it would be helpful to give an example workflow to see how this grammar tool could be integrated within the Montessori elementary classroom.

Something to keep in mind is that basic Spanish reading skills should have already been taught in primary (preschool) and first year elementary. This can easily be done using two simplified reading lessons that cover vowels, special letters and reviewing vowel-consonant blends. By second grade nearly all students should be able to read the vocabulary cards contained in the grammar tool with little to no problem, even if they have never seen the words before.

Let us now examine the follow-up workflow for a grammar lesson covering adjective and noun agreement. The lesson would last 10-15 minutes. Students are told that in Spanish the adjective symbol comes after the noun symbol, instead of before. This difference should be apparent from the moment they see the sentence layout in figure 4, as they probably have been doing grammar analysis with adjectives in English for some time. They are told that when using an adjective to describe a noun, the *dot* and the *face* symbols must match for both cards. That is all the instruction that is required for the student to begin self-guided learning of adjectives in Spanish. By leaving the lesson short and simple with minimal amount of teacher input, the teacher allows the child to learn through self-guided exploration of the tool.

Now the teacher can assign the activity. She will instruct the students to choose some time during work cycle within the next week to practice adjectives in Spanish with a friend. More specific instructions can be given here. For example, the L2 teacher may say something like, "why don't you and your partner create three sentences where you clean, cut and eat your favorite fruit."

The tablet with the software loaded on it will be available on the language work shelf. Initial setup of the main activity for that week could be done by the teacher or a third- or sixth-year child. This is a decision that the lead guide can make.

During work cycle a child can take the tablet off the language arts shelf, set up a work rug on the floor, grab their writing journal and invite a friend to join. At this point they can start sentence creation. For example, the first child may make the sentence, "Rosa washes the red apple", by selecting the corresponding images. The second child would then check the grammar. In order to do so, the child would first check to make sure the arrows and dots match for the first two cards (subject and verb) and then she would check to make sure that the dots and faces match on the second two cards (noun and adjective). Once both students are confident that the sentence is correct, they would click the "check work" button. If there is an error, graduated corrective feedback would be given. This starts with a simple, "please check your work again", and slowly move towards more explicit corrective feedback the more mistakes the child makes during the formation of that sentence. Notice the initial check and correction is handled by the child and not the tool. The tool is only used for correction only as a last resort.

After the grammar has been checked, they will each write the sentence in their writing journal and then read it out loud. This fits together with the Montessori paradigm of "teaching writing before reading and reading through writing". (Khachatryan, 2015, p. 306) The "check work" button allows the children to hear the sentence read by a fluent speaker in case they are uncertain of pronunciation. This process could be repeated using different sentences in the same activity or the board and cards could be switched out to create a more complex narrative.

3 RESULTS

The MontessoriSpanish Grammar App's single activity prototype creates a solid foundational framework to create a fully featured tool that could support dozens of sentence structures and hundreds of vocabulary terms. By adding a few more features, such as article and verb tense support, this tool could continue to provide grammar instruction past the elementary levels. Support for Italian, French and Portuguese could be added using the same exact grammar framework.

Because of government mandated school closures, it was not possible to test the tool in the two Montessori lower and upper elementary classrooms that originally

agreed to be part of this research project. However, through PC emulation and Zoom meetings, students from these classes did receive exposure to the tool. While it was well received by the students in that setting, a real test would require installing the tool onto a classroom tablet to see how the children utilize it during self-directed learning throughout the year.

Katy Allen (Director of Harbour Oaks Montessori School, Head of Lower Elementary Teacher Training at The Montessori Teacher Education Institute of Atlanta, and Lower Elementary Lead Guide with 25 years of Montessori teaching experience) was given a copy of the tool and asked to share her opinion and initial impressions. She stated that, from what she experienced, she would not hesitate to integrate the tool in her classrooms. The reason she gave for this was that she felt the tool strictly adhered to the Montessori language pedagogy and philosophy of child development. She also stated that the tool would save a lot of shelf space and help avoid the rearranging of Spanish materials throughout the year. Next, she observed that the tool was designed in such a way where she felt that she could facilitate its use in her classroom, despite not knowing Spanish nor being familiar with mobile technology. Finally, she expressed that, in her opinion, most Montessori elementary lead guides would welcome a tool like this into their classroom after a brief explanation of its intended usage.

4 CONCLUSION

It is the hope that this paper has demonstrated that by integrating the Montessori pedagogy and philosophy of child education into an EdTech tool, one can increases the chances of a Montessori educator adopting educational technology in their classrooms. This is partly because the educator is not required to sacrifice dearly held pedagogical ideals. By extending and applying the language pedagogy to L2 instruction, we help solve the problem of how to effectively implement an L2 curriculum in smaller Montessori schools with limited budgets. These factors all form the groundwork for making a MALL tool that can successfully coexist on the shelf with traditional Montessori materials and manipulatives.

The development of this tool, plus the research and principles outlined in this paper, can hopefully serve as a model for other developers to follow when creating educational technology tools for use in the Montessori domain.

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[i] Work cycle for children is mostly self-guided. They can set-up work wherever they want. Many times, work is not done at a desk, but rather on a 'work rug' on the floor. Therefore, we will focus on the practicality of MALL solutions over CALL solutions. (Yang, 2013)

[ii] There are a handful of mobile apps that focus of simple Montessori inspired preschool skills, most of which are from a company called EDOKI ACADEMY. Yet none of these are geared towards L2 learning.

[iii] Definition of "Dynamic Emersion" taken from: https://lifehacker.com/language-learning-showdown-rosetta-stone-vs-duolingo-1790938306

[iv] These are symbols and techniques are not part of the Montessori domain, but rather developed and owned by Marco Costa.