

# The Effects of Native Language on Block-Based Programming Introduction: A Work in Progress with Hispanic Population

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**Abstract**— Computer Science (CS) is an English-centric discipline which still needs to explore how cultural factors such as learners' native language may impact the understanding of CS concepts. We evaluated adult participants with no prior coding experience performing tasks in a conventional block-based programming platform: Scratch. We collected data from these interactions and compared between Native-English speakers, and Hispanic speakers who knew English as a Second Language (ESL). Our findings suggest that learners' native language may not impact their ability to come to a proper solution, but it does affect how they interact with block-based environments, when their native language is inconsistent with the language featured in the tool. This pilot study invites the Computer Science Education (CS ED) community to explore how to effectively reach Hispanic and non-English speaking communities, impacting the community outreach in other regions.

**Keywords**— CS Education, Computing Education, CS for All, Language-consistency, CS Inclusion, Block-based technologies

## I. INTRODUCTION

Block-based instructional technologies have been designed for a decade with the premise that they enhance learning outcomes when removing syntax from the environment [1]. Nevertheless, multiple-language support is only available in less than half of the major block-based educational tools (e.g. Scratch, Alice) [2]. This forces non-native English speakers to learn how to program using a different language. The CS ED community has been trying to make Computer Science (CS) more accessible to the public by helping to overcome identified barriers such as cost, age, race and gender gaps, as well as cognitive and physical disabilities. However, the fact that CS literature is typically English-centric, limits it to be a discipline unable to reach non-English-speaking individuals and communities.

Considering that language barriers might cause communication to breakdown, we conducted this pilot study to explore how language-consistency, and the relation between a user's native language and an interface language, between learners and a conventionally used block-based educational tool such as Scratch, can impact learners' performance when responding to a set of programming activities. In order to know

whether it is important for these block-based educational tools to support more languages, we must first establish if language-consistency is negatively impacting learners' abilities to grasp coding concepts when using these platforms. We manipulated language-consistency, as our independent variable, with two levels: English-Speaker & English-Interface (EE) and Spanish-Speaker & English-Interface (SE). We hypothesized that the lack of language-consistency between a novice's native language and the interface they use will negatively impact their effectiveness, confidence, and exploration capacity when introduced to block-based programming environments.

## II. RELEVANT LITERATURE

In recent years, there have been studies in the CS ED community that suggest language is a factor that should be considered when designing tools for education. Raj et al. [3] conducted a study to understand if language consistency between the student and the instructor impacted how students learned programming concepts, and Guo [4] found that non-English-speaking students perceived language barriers when learning how to code, and that they wanted instructional materials to use simplified English without culturally-specific slang.

Referring to language-consistency with block-based tools, Dasgupta & Mako [5] pioneered a study with Scratch, finding that novice users who used the tool in their countries' native languages demonstrated a faster learning rate of programming concepts than those users who worked primarily in English. The authors results are based on users from five non-Hispanic countries. Regardless of the high quality of their results, the authors describe limitations due to the method they followed to validate their hypothesis. The lack of control of their sample population in regards to age, gender, native language (which can be different from the country's language), lead to further research initiatives, as our study, to understand how learners' languages impact learning processes in CS.

From our review, language-consistency has been mainly addressed considering classroom environments (i.e. vernacular medium learning), with limited literature referring it in the context of educational tools intended to teach CS concepts.

Moreover, Hispanic communities have not been reached for this topic. *How do Hispanic individual experience commonly used block-based programming environments? Is language-consistency between the individual and the tool a factor to be considered and scaffolded in block-based learning environments? How should language-consistency be scaffolded in block-based learning environments?* Questions like these are still open, and with this pilot study we contribute to the discussion and to bring language as a factor to consider when addressing CS for All.

### III. STUDY DESCRIPTION

#### A. Participants

Sixteen individuals participated in the study. We had two groups of participants: a control group of native English speakers ( $n=7$ ), and an experimental group consisting of Hispanic individuals ( $n=9$ ) who know English as a Second Language (ESL). All participants reported no prior experience using block-based programming tools or text-based programming languages. We designed the study to be gender-balanced: 43.8% of our participants were female, and 56.3% male.

#### B. Method and Variables

The study began with an introduction to expectations of participation followed by a 30-minute tutorial, a break period, a 15-minute assessment, and then a survey. We ended the study by providing a final survey, asking them to rate their experience using a Likert scale (1-7) for multiple questions, provide demographic information regarding their gender, age, race, and native language, and to give feedback with open ended questions. To verify question completion, we analyzed the video of the screen captured for each participant's test to determine whether the task was completed properly.

Both, the tutorial and the assessment, requested the participants to complete the functionality of two video game setups. The mechanics of both video games were the same, varying exclusively in the video games' contexts.

Language-consistency, our independent variable, has two levels: English-Speaker & English-Interface (EE) and Spanish-Speaker & English-Interface (SE). Our dependent variables are Effectiveness - measured by the number of tasks completed by the participant in the test, Confidence - measured by Likert scale (1-7) responses regarding the participant's self-perceptions, and Exploration - measured by the time (minutes) the participant took to place the first block onto Scratch's canvas.

The tutorial and assessment were provided in English for the native-English-speakers, and in Spanish for the Hispanic participants. This, looking to reduce any confound regarding the instructions given. Guidelines were revised by native speakers in both languages. Both groups interacted with Scratch featured in English.

### IV. PRELIMINARY FINDINGS AND DISCUSSION

Hispanic participants answered 7.63 test questions [Mean = 7.63, SD = 3.46], compared to English speakers, who answered 6.83 questions [Mean = 6.83, SD = 2.48]. However, most of the Hispanic participants agreed that their performance would have

improved if Scratch was provided to them in their native language. Also, Hispanic participants took longer to make the first interaction with the Scratch canvas, with an average initial block dragged time of 5.65 minutes [Mean = 5.65, SD = 5.81], as compared to English speakers' average 3.52 minutes [Mean = 3.52, SD = 3.37]. We consider that Hispanic participants took longer to make the first interaction due to possible constraints on understanding or exploring the tool. These, referring to qualitative feedback provided by some of them:

- **Quote 1:** "Having Scratch in my native language would have allowed me to understand better the functions of the blocks and save time."
- **Quote 2:** "I think [typo: it] would be better to explain the meaning of some english [typo: English] words and that's it".
- **Quote 3:** "I needed to understand the interface, and the assignment better, as well as start memorizing where to search for the correct units."

### V. DISCUSSION AND CONCLUSIONS

Based on our findings and results, even though the two groups did not score significantly different, the majority of ESL Learners (i.e. Hispanic participants) thought that they would perform better in their native language. This feeling of inadequacy can impact confidence in learning and overtime grow in those who are trying to learn to code when they are non-native speakers of English. We believe the Hispanic participants may have taken more time on average to make their initial interaction due to compounding effects based on a language barrier to understand how to interact. However, this is only a theory, and further research is required to verify it.

This pilot study contributes showing that even ESL speakers struggle when introduced to blocks programming. If they have a difficult time completing relatively simple exercises, then it stands to reason that individuals who do not speak English at all, may struggle more. Next steps of our research will involve non-US Hispanic population, to evaluate if the total lack of English as a second language may be notorious when introducing learners to block-based environments.

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