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TraduCode: Bridging the Language Barrier in Computer Science Education

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In 2021, one out of four students in public schools were from immigrant-headed households, that is more than 11 million public school students, showing a rapid growth of diverse and multilingual student populations across the country. Among those students, English learners represent one of the fastest growing demographics in American education, with Hispanic students making up the majority of this group. Despite their increasing numbers, state and federal educational policies and funding fall short of meeting the language and academic support these students urgently need–particularly for older immigrant students who have less time to fulfill graduation requirements and become fluent in English.

In 2018, a study found that non-native English speakers faced significant barriers when learning programming, particularly because programming is primarily based in English. These barriers included difficulties with reading instructional materials, reading and writing code, communicating technical ideas all while learning English and programming. Barriers such as these ranged from cognitive to emotive to social. Having to cognitively translate information into one's native language, especially in real time while listening to a lecture, adds additional cognitive strain and reduces understanding. Non-native English speakers are less likely to ask or answer questions as they can find it difficult to formulate verbal questions along with anxiety about lack of English fluency. This was very evident in my time translating for Alex.

Alex had recently migrated from Ecuador to the US, leaving his family behind and he was ready to begin a new life. Alex was prepared to face the significant language barrier, knowing that learning English would be key to pursuing his education in the US. But he was not prepared for his first computer science(CS) class, where he found himself navigating not one, but two new languages simultaneously: English and programming. Inspired by

Alex's story, TraduCode emerged to address the gap between availability and true accessibility in CS education.

While there are many browser extensions and tools that translate website text, few focus on translating code snippets or programming content–largely because programming languages are inherently designed with English-based syntax and terminology. TraduCode is a browser extension designed to address the linguistic challenges of native Spanish-speaking students. Currently, TraduCode operates as a tool that translates Python programming keywords into Spanish on an educational platform called GeeksForGeeks, making it easier for users to understand and engage with coding concepts. This project was developed in response to the significant barriers native Spanish-speakers face when learning programming. By translating in real time, TraduCode simplifies the learning process, reduces cognitive strain and fosters confidence among native Spanish-speaking students. While currently limited to a single platform, TraduCode envisions expanding its functionality to support additional programming languages and platforms in the future.