Foreign Languages for a Modern World of Automated Translation

Recommendations for K-12

September 9, 2022
Table of Contents

I. Introduction: Why teach world languages to students in an age of automated translation? .......................................................................................................................... 1
II. CCR Recommendations for K-12 ....................................................................................... 6
III. Linguistics for All Learners ......................................................................................... 9
IV. Comparative Cultures for All Learners ........................................................................ 10
V. Flow Chart for Foreign Language Acquisition .......................................................... 11
VI. Language Learning in the U.S. .................................................................................. 14
VII. Conclusion ............................................................................................................. 16
Appendices ......................................................................................................................... 17
    Appendix 1: Studies in (Post) High School Foreign Language Proficiency .......... 17
    Appendix 2: ACTFL Five Goal Areas for Language Learning ............................... 18
    Appendix 3: Difficulty parameters to learning a foreign language ...................... 19
    Appendix 4: Writing systems ...................................................................................... 21
    Appendix 5: Examples of Digital Language Learning Resources ......................... 24
I. Introduction: Why teach world languages to students in an age of automated translation?

Historically, the benefits of language learning have been categorized by three arguments: Communication, Culture, and Cognition. Before the advent of AI, language learning was necessary to facilitate communication between language communities (e.g., for business, diplomacy, research) and was considered culturally and cognitively beneficial.¹

These arguments about the usefulness of second language acquisition persist (and are often warranted, particularly in the case of cognitive development - see further down in this document). However, advances in automated language translation² force the question of the usefulness of continuing to instruct foreign languages, and particularly in the present formats.

Technology: As a related example of technological progress, Automated Speech Recognition (ASR) is now better than humans at speech recognition. Microsoft achieved parity in error rate at 5.9% in October, 2016³, and has improved since:

"By 2030, speech recognition will feature truly multilingual models, rich standardized output objects, and be available to all and at scale. Humans and machines will collaborate seamlessly, allowing machines to learn new words and speech styles.

organically. Lastly, speech recognition will engender the principles of responsible AI, and operate without bias.”

Similarly, researchers predict AI will outperform humans in diverse domains over the next ten years, notably, translating languages (by 2024). Consumers have access to a number of translation tools and apps used for daily activities. Machine translation demonstrates rapid expansion and adoption, across domains of expertise, and state-of-the-art machine translation now reaches a 60% non-differentiable level between machines and humans:

![Graph showing accuracy of distinguishing machine from human translations](image)

**Communication:** Many scholars still argue that foreign language skills are one of the “ultimate skills for the 21st century.” In a globalized world, where communication is crucial, foreign language and intercultural skills empower students to appreciate and understand other societies and to critically examine global issues from multiple perspectives. Foreign language skills, particularly of economically important or critical languages, provide a distinct advantage in cultural capital and social power for multilingual speakers, and this even in a world of rapidly improving AI translation

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4 Hannun, Awni, “Speech Recognition is not Solved.”
7 [https://doi.org/10.1038/s41467-018-01873-9](https://doi.org/10.1038/s41467-018-01873-9) Nature Communications: *Transforming machine translation: a deep learning system reaches news translation quality comparable to human professionals*
10 Critical Languages Program, U.S. Department of State.
technologies. Languages, by virtue of being human, are rife with subtleties, nuance and complexities and are constantly evolving. Technology, at that level, may fail catastrophically in high-stakes situations, or impede the human-to-human contact.

Language learning is therefore useful from a practical perspective to have high-performance fluency for business, negotiation, debate, and a host of deep interactions. The following chart describes the quality required:

Culture: Foreign language classes are cultural classes in which students not only encounter new ways of speaking, thinking, and doing, but compare the cultural and sociopolitical worlds of other language groups with their own. Language understanding and learning is at the heart of developing global awareness in students and through language acquisition students become aware of the civic, economic, health and environmental situations in the target language group. A highly interdisciplinary activity, language acquisition develops these forms of literacy, as well as information, media, and technology literacy. Language classrooms are a rich arena for teaching an

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array of cross-cultural skills that are not addressed in other subjects, and a site for
connections between other disciplines such as economics and technology.

However, there are more efficacious ways to learn about cultures, and about many more
of them, via introductory courses in Comparative Cultures, participating in online
communities that focus on international exchange, visiting museums, watching
documentaries, and participating in intercultural events locally. A single language will,
by definition, focus only on that language’s culture(s) at the exclusion of others.
Introducing concepts that reinforce cultural competence14 is possible within other
domains of study (e.g., world literature, world history) and technology permits learners
to access authentic cultural materials from around the globe.

**Cognition:** Scientific research touting the cognitive benefits of foreign language
learning consistently confirms the cognitive benefits of learning another language.
These benefits are not limited to language and communication, but to problem solving,
focus, neuroplasticity, and long-term mental health.

Learning other languages, especially at higher levels of mastery, strengthens the brain’s
executive function, because multiple language use requires multilingual individuals to
manage interference from the automatisms of different languages. The same brain areas
used to distinguish which word to use are used when trying to complete a task and focus
without distractions. The muscle memory developed from learning other languages
applies to different skills.15 Additionally, fluency, originality, and creative flexibility are
improved in one’s first language when learning a second language.16

Cognitively, this is similar to musical learning. Psychological and neuroscientific
research demonstrates that musical training in children is associated with heightening
of sound sensitivity as well as enhancement in verbal abilities and general reasoning
skills.17 The cognitive and sensorimotor benefits of musical training are similar to those
of bilingualism and prevent cognitive decline.18 Furthermore, because of the significant
overlap of neuroanatomical and physiological mechanisms of foreign language learning
and music perception, music learning positively reinforces language acquisition and vice
versa.19

From a practical perspective, foreign language learning has shown to have a positive
impact on academic performance in general. Around 90% of studies looking at the effect

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18 “How Are Learning Languages and Learning Music Linked?” Tsoulas (2014); “Playing Music in Childhood Linked
to a Sharper Mind in Old Age,” The Guardian (2022).
learning a language has on achievement in other subjects of the school curriculum report a positive impact, across native language learning, literacy, math, and science. This seems to be the case for language learners from a variety of countries, with different language combinations, and from varied socio-economic backgrounds.

**Competencies in support of Cognition:** The practice of second language acquisition is an excellent school subject through which to instill certain Competencies/Subcompetencies into K-12 education, namely **Communication, Resilience** and **Metacognition.**

![Competencies Table]

Foreign language learning is an exemplary subject for the development of **Communication**, in both native and target languages. Listening and being capable of clearly articulating information are the traditional cornerstones of second language acquisition and are accompanied (sometimes to a level of caricature to facilitate comprehension) by non-verbal and para-lingual communication. Foreign language learning requires communication via multiple modes of communication - oral, written, digital - and interaction with native speakers develops new ways of interacting within physical space, as different cultures interpret and perform space in different ways, improving the development of empathy. The process of being exposed to other languages engages students with new audiences, new communities, and new ways of adapting their communication within and beyond the classroom.

Daily practice, commitment, and immersion in new situations are key mechanisms for developing proficiency in a foreign language. Accordingly, learners can develop **Resilience** through their learning foreign language studies. To be successful, they must resiliently manage the stress that comes with conveying ideas in a language that isn’t their own and persevere through the challenges of languages functioning in unexpected ways, getting over shyness, not good-enough thoughts, and other discomforts. By having a clear purpose, and the support of other speakers at different experience levels, a learner will be most likely to develop resilience.

Learning a new language is not only a cognitive, but deeply metacognitive process. Key aspects of **Metacognition**, such as reflecting upon processes, patterns and monitoring one’s comprehension of every utterance are constant activities in foreign language learning, particularly at the lower levels. Foreign language learning forces the brain to

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observe differences and parallels between native and target languages, particularly encouraging metacognitive reflection of the native language. The learning of a second language creates an opportunity to gain capabilities in social perspective taking (“stereoscopic vision” analogy), these capabilities only increase when a learner approaches the acquisition of a third language (triangulation). When speaking, writing, and listening become conscious activities (rather than automatisms), students are obligated to closely manage the information around them and to think and react adaptively. Since language is a tool - a literacy that permits learners to perform in all other disciplines - it may be a very effective yet neutral mechanism for developing metacognitive (“observer”) abilities.

II. CCR Recommendations for K-12

What should be learned for Foreign Languages?

In spite of, and due to, automatic language translation, the goal of foreign language education in CCR’s model is to render students fluent in one to two more languages than their own native one, by starting during early childhood and deep learning. CCR advocates for second language acquisition due to the following benefits:

- Communicative: The general socioeconomic importance to a second language locally and globally (for instance, English worldwide, French in Canada, etc.)
- Cultural: The crucial nature of (inter)cultural competence (including of one’s own culture) in order to understand and interact ethically and effectively with people possessing different cultural backgrounds.
- Cognitive: Immediate and long-term benefits of second language exposure and acquisition to an array of cognitive skills (e.g., math, music), improving learners’ outcomes in K-12, preventing cognitive decline with age, and preparing them to make sense of the world through a broader perspective.

Second language learning is typically divided into two types: implicit learning (that which occurs predominantly from ages 4-10) and explicit learning (that which occurs predominantly from ages 10-18). These forms of learning are not mutually exclusive and for both forms the consensus is that the key elements to success in acquisition are

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exposure and usage. But due to the high level of plasticity involved in learning languages, it is CCR’s recommendation that one learns via implicit learning, and thus while young. **CCR recommends beginning second language acquisition around the age of three, and a second one by age seven of high linguistic distance (section V)** as most research\(^{22}\) concludes that there are “critical periods” for language acquisition.

![Synapse Formation in the Developing Brain](image)

**But what if we miss early childhood? Recommendations for ages 10-20:**

From age ten onward, students are equipped with greater maturity, better problem-solving strategies and learning skills than at younger ages. Older learners know more about themselves, the world and their native tongue; they can therefore benefit from explicit learning and from engaging with younger students in language activities. More fine-grain aspects of the language can be learned at this stage (e.g., grammar, nuance in meaning, and expression). At this level, social proficiency in a language can be sought after, roughly equivalent to the definition of a B2 level according to the CEFR,\(^ {23}\)


\(^{23}\) Common European Framework of Reference for languages.
students “can interact with a degree of fluency and spontaneity that makes regular interaction with native speakers quite possible without strain for either party.”

However, reaching fluency is a LOT harder by then, and a lot more time-consuming, which would take away from time spent on less automatable disciplines, subjects, topics, and Competencies. CCR recommends that older students first learn to appreciate foreign languages and cultures via linguistics and cultural studies; then, if still motivated, learn to understand them, and finally, only in select cases, learn to produce (speaking and writing) them. 24

How should Foreign Languages be learned?

Implicit learning occurs best in contexts of immersion; this is acquisition of language skills, rather than explicit language learning.

1. Play and other multi-sensorial activities are key to this process and allow children to better store memories about language than when formally presented information. Songs, rhymes, storytelling, movies, role play, and a host of games and online language resources are ludic ways for children to be exposed to the target language and encouraged to use it. Because learning implicitly requires that students imitate native speakers, this kind of learning requires a lot of time with native speakers (or authentic target language materials. It is a shame that many countries dub TV programming!).

2. Customized language learning paths based on the speaker’s native language(s). These paths have been mapped onto a flowchart (see section V) to clearly illustrate acquisition progressions based on mother tongue and crucial world languages.

3. Wise use of linguistic science25 (using word frequencies or hierarchies, etc.).

4. Use technology26 (Appendix 5) to enable and accelerate language acquisition. For instance, the use of language apps, coupled with VR, can help a student achieve immersion-level performance far faster than even immersed in the country itself, and at a much-reduced cost and logistical difficulty (particularly for a 4–7-year-old!).

24 This is a similar approach to many music programs and even conservatories: students spend several months to a year being introduced to different instruments and styles of music before, if they so choose, specializing in one particular style or instrument. Even without specialization, this varied exposure instills both the curiosity and the basic capacities to pursue their musical interests, whatever they may be. This approach could also be applied to students ages 2-10, if the possibility to deploy full foreign language learning as recommended is not available.

25 https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0163623

III. Linguistics for All Learners

Because humans are socialized in and through their languages, most students do not have a clear conception of how their language works, how it has changed, and how it continues to evolve. Understanding these aspects of language provide students with a solid foundation for learning any language, as well as for appreciating their native language(s) (and ideally initiate a lifelong appreciation of language in general). Research suggests that, in addition to exposure and usage, motivation is key in language learning. If we want to encourage students to learn different languages, they must be exposed to many different languages, and these languages need to seem enjoyable, even “cool.”

An exposure to broad linguistic diversity assists in the comprehension of a broad world of cultural differences (for instance, the word *Schadenfreude* in German and other idiosyncrasies). CCR recommends the integration of a trimester of basic comparative linguistics and language discovery, as a source of cultural exposure and a potential gateway towards interest in foreign language learning. This course will introduce students to the fun part of languages - their differences, similarities, and functions - and will permit students to understand what languages are, and are about.

Polemic debates in linguistics, such as metaphor theory or the Sapir-Whorf hypothesis, are excellent entry points for students to dive into linguistics as it applies to everyday life. Is cognition shaped by language? If so, how? Do the analogies we use every day inform our behavior and perception? (The answer is yes!). Research demonstrates “whorfian” tendencies in language that prime speakers for particular perceptions and (re)actions, as well as the fundamentally analogical or metaphorical nature of language and cognition. But of course, this view cannot be taken to a naive extreme, such as “Semitic languages do not have a future tense, therefore its users cannot think about the future.”

Because language and cognition are profoundly interwoven in human minds, bodies, and cultures, these kinds of linguistic inquiries immediately connect language, and

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language use, to learners’ own lives and ways of thinking, and being and provides an opportunity to create curiosity in language, cognition, and cultures.

**Writing systems/Scripts:**

Writing systems are another example of a fun and striking way to demonstrate diversity in human language and the fundamental role of language in human life and thought. Writing developed independently in the Near East, China, and Mesoamerica (the first being Mesopotamian cuneiform script, created in present-day Iraq, ca. 3200 BC). The antecedent of the cuneiform script was a prehistoric system of counting and recording goods with clay tokens. The evolution of writing from tokens to pictography, syllabary, and alphabet, via partial rebus systems, illustrates the development of information processing to deal with larger amounts of data in ever greater abstraction. Exposing learners to the visual evolution of these symbolic systems - that began with the symbolization of direct, embodied experience - directly links linguistic form to the evolution of humanity and cognition. In Appendix 4, we have collected a few important visualizations of scripts evolution, and family trees.

### IV. Comparative Cultures for All Learners

Foreign language courses are often justified as important because they serve as an opportunity for a student to learn more about other cultures. As the world’s economy becomes increasingly interconnected and technologies enable global teams to efficiently work together, gaining an understanding of cultures different from one’s own has a clear practical value. Cognitively, learners with the knowledge of other perspectives can flexibly consider a problem from a wider number of vantage points. However, these skills do not need to be tied to the effortful and time-intensive acquisition of language.

For that reason, CCR advocates for the *explicit* teaching of cultural understanding unattached to the development of a foreign language for a *variety* of cultures, through a Comparative Cultures course. A traditional approach to gaining cultural understanding is to learn about the culture of the language being studied—Spanish learners study the cultures of Spain and Latin America, for example. By instead participating in a broader Comparative Cultures course unattached to the learning of a foreign language (and aided by an increased understanding of linguistics), a learner can deepen understanding

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of a variety of cultures, in a less resource-intensive way than when coupled with the study of vocabulary and grammar.

The student who historically studied Spanish and thus only the cultures of Spanish speakers (spoken by some 500 million people globally) still is missing out on better understanding over 95% of the world’s population. In introducing students to cultures beyond just those studied for language acquisition, many more cultures and customs become accessible to students. Courses in Comparative Cultures then can expose learners to a greater variety of belief systems, cultural rituals, ways of being, and governing or social structures. Units can focus on the dominant ways of thinking, acting, and behaving across a variety of contexts, such as social or business situations. Through this study, learners then can develop a deepened understanding and contextualization of their own culture, and better take the perspectives of the diverse peoples they will inevitably collaborate with throughout their lifetime.

Schools also can welcome the technology that is increasingly connecting the world into their classrooms and repurpose the skill sets gained by necessity through distance learning during the COVID-19 pandemic. Teachers can facilitate collaborative work with classrooms from other cultures, conduct video-conference interviews with citizens from other places, and utilize a diverse landscape of rich multimedia to go on “virtual field trips” to demystify other cultures.

V. Flow Chart for Foreign Language Acquisition

Importance: To create a framework with which to tailor target language choice for each learner, CCR conducted a review of resources concerning “crucial” or “important” world languages for the 21st century, the most comprehensive of these being the Power Language Index (PLI). The PLI identifies the number of total speakers, economic importance, and projected importance of major world languages. Using this data, a flow chart can be mapped demonstrating a hierarchy of “power” for key languages in the 21st century. Excluding English, the most widely spoken and economically important languages are currently34:

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## Language Economic Importance (of World GDP) Power Language Index Score (2016) Total Speakers (L1 + L2, MM, 2022) Difficulty for Native Anglophones

<table>
<thead>
<tr>
<th>Language</th>
<th>Economic Importance (% of World GDP)</th>
<th>Power Language Index Score (2016)</th>
<th>Total Speakers (L1 + L2, MM, 2022)</th>
<th>Difficulty for Native Anglophones</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mandarin Chinese</td>
<td>19.64%</td>
<td>.411</td>
<td>1.118 b.</td>
<td>Category IV</td>
</tr>
<tr>
<td>French</td>
<td>3.3%</td>
<td>.337</td>
<td>274.1</td>
<td>Category I</td>
</tr>
<tr>
<td>Spanish</td>
<td>6.04%</td>
<td>.329</td>
<td>548.3</td>
<td>Category I</td>
</tr>
<tr>
<td>Modern Standard Arabic* (MSA; excluding dialects)</td>
<td>5.25%</td>
<td>.273</td>
<td>274.0*</td>
<td>Category IV</td>
</tr>
<tr>
<td>Russian</td>
<td>3.1%</td>
<td>.244</td>
<td>258.2</td>
<td>Category III</td>
</tr>
<tr>
<td>German</td>
<td>3.2%</td>
<td>.191</td>
<td>134.6</td>
<td>Category II</td>
</tr>
<tr>
<td>Japanese</td>
<td>4.1%</td>
<td>.133</td>
<td>125.4</td>
<td>Category IV</td>
</tr>
<tr>
<td>Hindustani (Hindi, excluding Urdu)</td>
<td>4.07%</td>
<td>.117</td>
<td>602.2</td>
<td>Category III</td>
</tr>
</tbody>
</table>

The **Power Language Index Score** projects that the following ten languages will become increasingly important over the next several decades:

### Table 3: Power Language Index ranking (2050)

<table>
<thead>
<tr>
<th>RANK</th>
<th>SCORE</th>
<th>LANGUAGE</th>
<th>NATIVE (MM)</th>
<th>GEOGRAPHY</th>
<th>ECONOMY</th>
<th>COMMUNICATION</th>
<th>KNOWLEDGE &amp; MEDIA</th>
<th>DIPLOMACY</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.877</td>
<td>English</td>
<td>541.6</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>0.515</td>
<td>Mandarin</td>
<td>940.5</td>
<td>6</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>3</td>
<td>0.345</td>
<td>Spanish</td>
<td>589.0</td>
<td>3</td>
<td>5</td>
<td>3</td>
<td>6</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>0.325</td>
<td>French</td>
<td>88.4</td>
<td>2</td>
<td>8</td>
<td>6</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>5</td>
<td>0.295</td>
<td>Arabic</td>
<td>494.1</td>
<td>4</td>
<td>7</td>
<td>4</td>
<td>18</td>
<td>4</td>
</tr>
<tr>
<td>6</td>
<td>0.242</td>
<td>Russian</td>
<td>134.1</td>
<td>5</td>
<td>10</td>
<td>10</td>
<td>8</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>0.155</td>
<td>German</td>
<td>88.6</td>
<td>10</td>
<td>3</td>
<td>9</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>0.149</td>
<td>Portuguese</td>
<td>273.4</td>
<td>7</td>
<td>9</td>
<td>8</td>
<td>12</td>
<td>9</td>
</tr>
<tr>
<td>9</td>
<td>0.138</td>
<td>Hindi</td>
<td>489.1</td>
<td>11</td>
<td>4</td>
<td>7</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>10</td>
<td>0.110</td>
<td>Japanese</td>
<td>106.1</td>
<td>30</td>
<td>6</td>
<td>17</td>
<td>7</td>
<td>8</td>
</tr>
</tbody>
</table>

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35 L1 = First (native) language, L2 = Second language *MSA is not an L1
36 As determined by the U.S Department of State Foreign Language Training program.
Complexity: In addition to its current and project importance, the flow chart for target language is also informed by the difficulty of the target language for the learner. The hierarchy of difficulty of a target language is determined by three factors (Appendix 3):

- Cognitive flexibility
- Syntax (primarily Subject-Verb-Object order)
- Phonetic consistency

The flowchart demonstrates a mapping of suggested target languages for a monolingual L1 English speaker according to PLI ranking and level of difficulty. This flowchart changes according to the linguistic competencies of the student in terms of L2 acquisition difficulty (not in terms of global importance). For example, for an L1 Arabic speaker, Hindustani is a relatively easy language to learn compared to an L1 English speaker, whereas for an L1 Japanese speaker, English poses considerable challenges.

Color Legend: Blue = Anglophone; Green = Category I; Yellow = Category II; Orange = Category III; Red = Category IV

It is also important to consider local versus global utility when choosing a target language (e.g., in the U.S. Spanish is a more locally useful language than German, even if they are similar in level of difficulty for a native anglophone). This framework allows educators and individuals to create a custom-fit for target language choice based on individual linguistic backgrounds, personal interests and objectives for foreign language study, and the global importance of the language.

The situation gets more complicated for those whose native language is not English, given its global predominance. In this case, the reverse would be recommended (i.e., French, then English, then Chinese later). It gets further complicated if there is a local language as native language (Basque, Khoisan, etc.) that needs to be learned as well. In that case, the recommendation becomes the local language, then the dominant country language, then English (or Chinese, if the dominant country language is already English). The following flowchart helps the decision-making process:
VI. Language Learning in the U.S.

In the United States, two entities have historically defined the best practices for language learning: ACTFL\textsuperscript{37} and NASDFL\textsuperscript{38}. However, research and resources are limited, and many of these practices are debated. Moreover, little legislation concerning foreign language learning exists in the U.S.\textsuperscript{39} These factors, among others, have led to ill-funded, research-poor, fragmented language learning classrooms with deplorable success rates\textsuperscript{40} (Appendix 1).

\textsuperscript{37} American Council on the Teaching of Foreign Languages
\textsuperscript{38} National Association of District Supervisors of Foreign Languages
\textsuperscript{39} “Best Practices in Foreign Language Learning,” Kuhlman (2017).
\textsuperscript{40} “Learning Foreign Language a Must in Europe, Not So in America,” Devlin (2015); “The Numbers Speak: Foreign Language Requirements are a Waste of Time and Money,” Caplan (2012); “The True Failure of Foreign Language Instruction,” Snow (2017); “The attrition of school-learned foreign languages,” Jessner et al. (2020).
The Commission on Language Learning argued in their 2017 report that, “there is an emerging consensus among leaders in business and politics, teachers, scientists, and community members that proficiency in English is not sufficient to meet the nation’s needs in a shrinking world, nor the needs of individual citizens who interact with other peoples and cultures more than at any other time in human history.”

In the 21st century classroom, it is necessary to prepare students not only with content knowledge, but with skills to play a meaningful role in society. Communication - professional, interpersonal, local, international - is a crucial skill for all career and life paths and language learning geared towards communicative competencies and cultural appreciation are fertile sites for developing this skill. It is for this reason that ACTFL’s “World Languages 21st c. Skills Map” places communication at the core of its standards (Appendix 2) and the CEFR lists communication and mutual understanding as its primary objective.

For the US, CCR’s recommendation considers the preponderance of Spanish as a de facto second national language (akin to French in Canada), and Mandarin as the language of the superpower competition for this century:

- For native English speakers, learn Spanish by age three and Mandarin starting at age seven.
- For Spanish native speakers, learn English immediately and concurrently, and Mandarin starting at age seven.
- For non-English nor Spanish native speakers, learn English immediately and concurrently, and Mandarin starting at age seven.

Could we consider programming languages as “foreign languages”?

In the US, as a way to get around the lack of time and inflexibility of schedules, some have advocated that “programming languages are foreign languages too.” While CCR recommends computer science for all students, this justification is very specious. Though natural languages and programming languages share the same purpose - communication - programming languages are not natural languages. Programming languages distinguish between syntax and semantics, and because of this, like natural

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42 To avoid the creation of language gaps (“Leaping the Language Gap: Strategies for Preschoolers and Head Start Teachers,” Abel et al. (2015).) (e.g., receptive-expressive vocabulary, (“The Receptive-Expressive Gap of Young Second-Language Learners,” Gibson et al. (2012))).
43 To avoid the creation of language gaps (“Leaping the Language Gap: Strategies for Preschoolers and Head Start Teachers,” Abel et al. (2015).) (e.g., receptive-expressive vocabulary, (“The Receptive-Expressive Gap of Young Second-Language Learners,” Gibson et al. (2012))).
languages, form language families with similar syntax and/or semantics. However, because programming languages are artificial creations\textsuperscript{44}, constructed languages\textsuperscript{45} with rules defined beforehand, their grammar is self-defining and does not change according to context. Programming languages do not have anything similar to the morphology found in human languages, which accounts for the ability of the latter to create synonyms, analogies, make historical, cultural or personal references, and allegories.\textsuperscript{46}

\section*{VII. Conclusion}

The recommendations outlined in this paper aimed towards:

\begin{itemize}
  \item Modernizing goals in language learning, to achieve fluency
    \begin{itemize}
      \item Advocating for relevance and usefulness in target languages offered in curricula
      \item Starting in early childhood to benefit from early developmental stages
      \item Modifying instruction to use technology and linguistic science
    \end{itemize}
  \item Integrating a module of general linguistics for exposure to language diversity
  \item Explicitly teaching cultural studies for exposure to a wide range of cultures.
\end{itemize}

CCR believes that this combination of approaches will properly prepare a Citizen of the Modern World.

\textsuperscript{44} \url{https://en.wikipedia.org/wiki/Timeline_of_programming_languages}
\textsuperscript{46} “Human Languages vs. Programming Languages,” Harris (2018).
## Appendices

### Appendix 1: Studies in (Post) High School Foreign Language Proficiency

<table>
<thead>
<tr>
<th>Source</th>
<th>Dates of Study</th>
<th>Sample Size</th>
<th>Fluency Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Social Survey</td>
<td>2000 &amp; 2006</td>
<td>4000+ post-high school adults</td>
<td>25.7%: Speak a language other than English.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>41.5% claim to speak the other language “very well.”</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>7.0% say they learned to speak this foreign language in school.</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>(If you multiply out these three percentages, you get 0.7%; less than one</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>student in a hundred acquires fluency. And that’s self-assessed fluency,</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>which people exaggerate).</td>
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<td></td>
<td>If you lower the bar from “very well” to “well” 2.5% of GSS respondents</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>claimed to reach this level of foreign language competence in school.</td>
</tr>
<tr>
<td>CASLS, U. of Oregon</td>
<td>2007-2009</td>
<td>16,556 high school students</td>
<td>Reading: 12.5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Writing: 13.2%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Speaking: 3.7%</td>
</tr>
<tr>
<td>(See detailed graphs for</td>
<td></td>
<td></td>
<td>(% of students who achieved 5+ proficiency in 4 years of study)</td>
</tr>
<tr>
<td>five world languages)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### The Atlantic

<table>
<thead>
<tr>
<th>Year</th>
<th>Claims less than 1% of U.S. adults speak a language they learned in high school.</th>
</tr>
</thead>
</table>

### AP Exam Statistics

<table>
<thead>
<tr>
<th>Language</th>
<th>2021</th>
<th>Pass Rate (3-5)</th>
<th>Perfect Score (5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>French</td>
<td>18,312 students</td>
<td>71.3%</td>
<td>12.6%</td>
</tr>
<tr>
<td>German</td>
<td>4,275</td>
<td>65.1%</td>
<td>18%</td>
</tr>
<tr>
<td>Italian</td>
<td>2,098</td>
<td>72.4%</td>
<td>20.6%</td>
</tr>
<tr>
<td>Japanese</td>
<td>2,208</td>
<td>74.3%</td>
<td>47.5%</td>
</tr>
</tbody>
</table>

### NCES

<table>
<thead>
<tr>
<th>Year</th>
<th>Number and percentage of high school graduates who took foreign language courses in high school and average number of credits earned, by language and number of credits</th>
</tr>
</thead>
</table>

### Appendix 2: ACTFL Five Goal Areas for Language Learning

The language teaching community has reached strong consensus regarding the goals of a language program: to develop students’ communicative competence* around modes of communicative competence reflecting real life communication. This is reflected in the Standards for Foreign Language Learning in the 21st Century in the opening statement of philosophy, “Language and communication are at the heart of the human experience.” The national standards are undergirded by five goal areas (the 5 Cs) that focus language learning on:

**Communication:** The ability to convey and receive messages based on the three modes of communication; interpersonal or two-way interaction with someone else, interpretive, the ability to understand and interpret a one-way aural or written text, and presentational, the ability to present information in either a written or oral format.
These modes reflect how people communicate in real life. The examples included in the World Language Skills map reflect these modes of communication.

**Cultures:** As the teaching of language and culture are inextricably intertwined, students learn to understand the culture of the people who speak the target language through learning about the products and practices of the culture and how those relate to the perspectives of the people of that culture.

**Connections:** The content of a language course becomes inherently engaging to students as they learn concepts from other disciplines and how their knowledge of the language opens up new frontiers for their learning.

**Comparisons:** As students learn the new language and culture, they develop insight into their own language and culture thus providing them with a deeper understanding of how language works and how cultures reflect the perspectives, practices, and products of the people who speak that language.

**Communities:** Language learning becomes even more purposeful for students when they see the application beyond the classroom. Language classrooms today bring the world to the students as teachers provide opportunities for students to use the language beyond the confines of their classroom walls.

**Appendix 3: Difficulty parameters to learning a foreign language**

*Cognitive flexibility* refers specifically to the alphabet structure of a language and the level of adaptation a student will have to make from the alphabet of the native language to learn that of the target language. There are three tiers of cognitive flexibility in CCR’s framework:

1. Target language shares an alphabet with native language (e.g., English and French)
2. Target language possesses an alphabet, but it differs significantly from that of the native language (e.g., English and Arabic)
3. Target language is logographic, whereas native language possesses an alphabet (e.g., English and Mandarin)

*Syntax*, primarily subject-verb-object order, is the second deciding factor of difficulty as target languages possessing a closer syntax to the native language will be easier for students to master quickly. There are three tiers of syntactic complexity:
1. Target language shares the same SVO order as native language (e.g., English and Mandarin)\(^{47}\)
2. Target language possesses either SVO or SOV order, different from the native language. (e.g., Japanese and English)
3. Target language possesses VSO or relatively free word order (e.g., Greek), different from the syntactic ordering of native language (e.g., English and Arabic)

_Pronunciation_ refers to a language’s phonology, or the sound system of a language that must be physiologically produced by a speaker. Double consonants, tonal vowels, and inflection are all examples of challenges that can be posed by a target language depending on how significant the differences are between the target and native languages panel of phonemes.

_Phonetic consistency_ identifies languages whose pronunciation does not change between spoken and written speech. Russian, Korean, and Arabic are strongly phonetically consistent, whereas languages such as English and French are not phonetically consistent. Finally, languages with character systems, such as Japanese and Mandarin Chinese are non-phonetic.

1. Target language shares same phonetic consistently with native language (e.g., German and Russian)
2. Target languages have slightly different levels of phonetic consistency (e.g., German and Spanish)
3. Target languages have highly different levels of phonetic consistency (e.g., Japanese and Arabic).

The framework also permits the orientation of language learning towards specific goals. If promoting cognitive flexibility is the primary goal for a native monolingual anglophone, choosing a logographic language will be preferable. If choosing an easy target language for basic language exposure is the goal for a native monolingual anglophone, it is preferable to choose a language that ranks low on all three factors, e.g., a language such as German that shares an alphabet and Subject-Verb-Object order with English and is phonetically consistent.

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\(^{47}\) 85% of world languages utilize SVO or SOV.
Appendix 4: Writing systems

The richness of writing systems is a major addition to the understanding of different cultures and should be learned with an eye towards their multilinear progression from pictograms representing concrete objects, to rebuses\(^\text{48}\) representing a first jump into abstraction, to a final jump in non-alphabetic systems that assign an abstract idea to a concrete representation, to be understood as abstract due to its context.\(^\text{49}\)

\(^{48}\) For instance: The pictograms “eye” and “deer” represent “I-deer” and form the rebus “idea”

\(^{49}\) For instance: The symbol for “one” also representing “unity,” and for Taoism, “the source of life”
The ABCD Family Tree

This infographic shows how 57 different scripts are descended from ancient Egyptian hieroglyphs. The colors show the type of script, and the red arrows show how the scripts are related. For scripts which are not read from left to right, the black arrows show the direction of writing. Where possible, letters corresponding to the A, B, C, and D symbols in the Latin alphabet are shown. In nearly every script, these letters correspond to sounds similar to the /a/, /b/, /g/ or /k/, and /d/ sounds.

By Starkey Comics
Appendix 5: Examples of Digital Language Learning Resources

**Carnegie Mellon Open Learning Initiative:** The OLI at Carnegie Mellon is not target specifically for language learning, but they offer several excellent courses. From elementary Spanish and French to Chinese, you’ll find frequent courses available in the world’s biggest and most commonly learned languages.

**Duolingo:** A fun, free app with activities to boost language skills in 40 languages. Duolinguo offers a skill tree of lessons that use listening exercises, flashcards, and multiple-choice questions to drill on vocabulary, grammar, and expressions.

**FluentU:** FluentU is a website offering foreign language immersion online in 14 languages and a large collection of curated web content of authentic language materials. The immersive approach, using real-world content and context, allows learners of all levels to develop their language skills and be exposed to the target culture.

**Headstart2 Defense Language Institute:** The Defense Language Institute (DLI), like the Foreign Service Institute, is a government service that makes high-quality language learning programs available for free. Headstart2 is one of the best and most easily navigable services hosting complete DLI courses. After quickly registering for an account, you’ll be launched straight into interactive lessons with maps, images, sound, cultural notes and more.

**Houghton Mifflin Harcourt World Languages:** With programs for both 6-12 French and Spanish, HMH’s language learning programs integrate technology for an augmented reality/virtual reality (AR/VR) approach to learning that can scale 1-1 tutoring. VR field trips and other virtual immersive experiences provide a unique language acquisition experience for learners in the 21st century.

**Internet Polyglot:** Internet Polyglot offers many of the same kinds of resources as the sites listed above, with the awesome added advantage of its “quick start menu,” which allows you to choose not only what language you’re learning but also what language you’re learning it in. Do you already speak Spanish and want to get started on Portuguese? Just select “Spanish” for the language you speak, and get started with a composite mental exercise to strengthen one language while building another.

**Learn a Language:** Learnalanguage.com is a website with links to extensive resources on and in 19 different languages. You can learn over 1400 words in your target language for free with their vocabulary lists and verb conjugation charts.

**The Mega List of Massively Open Online Courses (MOOC):** The blog *Web Technos and Translation* smartly and helpfully recommends taking an MOOC given in the foreign
language you’re studying and gives you a decent list to get started on doing so. For learners who have attained an intermediate level, and are ready to start doing more with their language skills, why not try taking a course conducted in that language?

**Open Culture:** Open Culture is an e-learning website that hosts “the best free cultural and educational media on the web,” and when it comes to languages, they’re not bluffing. Open Culture maintains a list of free courses in 48 languages across the Web, from Amharic to Yiddish.

**Rosetta Stone:** Rosetta Stone uses cloud-based solutions to help all types of learners read, write, and speak more than 30 languages, including several endangered languages. Using an immersive-based approach, Rosetta Stone is an excellent tool for developing a strong base in grammar and vocabulary.

**Streema:** Though not necessarily as a language learning tool, Streema offers free TV streaming from over 100 countries around the world in nearly as many languages. This is an especially exciting resource if you’re learning a less commonly studied language with less widely available video material. Tuning into your favorite Albanian or Nepali TV station can easily make up for the lack of other learning materials in your language.