

# Project Abstract

We are interested in doing a project related to AI for education, in the context of language learning. There has been a lot of research on this topic for decades, and much of this has focused on developing intelligent tutoring software (most of which focused on grammar correction). Many of the existing language learning apps and software focus on memorizing vocabulary and/or grammar. However, motivation for learning language, especially people learning English in other countries like China, is often extrinsic and learners are not intrinsically motivated to learn. We would like to explore different ideas for the integration of AI and language learning, and try to come up with some new approaches that may be more motivating for learners. Here are some preliminary ideas:

1. Use AI as a scaffolding/support system for conversations between human learners. For example, in a language exchange situation where there is a native English speaker learning Chinese and a native Chinese speaker learning English, the AI can analyze the conversation and suggest phrases to help move the conversation forward. During the conversation, as well as after, the AI could provide feedback on the learner's language use in order to push the learner toward becoming more fluent.
2. Have the language learners teach an AI agent the necessary knowledge to do well on a given language task. This could be a good way of forcing the users to switch roles into the teacher, going with what people often say that one way of mastering something is through teaching it. This would also lead to standardized evaluations since the knowledge that the user gives the model can be thought of as supervised data that the model trains on and is then evaluated on a standardized set for all users.
3. Build AR/VR/virtual world tasks/quests for learners to complete. In order to complete these quests, they need to communicate with their partners. In this case, we would bring together partners who do not share the same native language but are learning the same target language (e.g., two people who both want to learn English; one is from Korea and one is from Argentina). The AI can predict the types of language that are needed to complete the task and provide suggestions and feedback.

## Academic research for AI in language learning

- Dodigovic, M. (2007). Artificial intelligence and second language learning: An efficient approach to error remediation. *Language Awareness, 16*(2), 99–113. <http://doi.org/10.2167/la416.0>
  - Describes an AI-powered system that corrects learners' grammatical errors. Human study of learners' error rates before and after using the system.
- Heift, T., & Schulze, M. (2007). *Errors and intelligence in computer-assisted language learning*. New York: Routledge.

- Book describing the state of the art (in 2007) for intelligent CALL (computer-assisted language learning). Focuses on error detection and feedback.
- Nagata, N. (1993). Intelligent computer feedback for second language instruction. *The Modern Language Journal*, 77(3), 330–339.
- Nagata, N. (1995). An effective application of natural language processing in second language instruction. *CALICO Journal*, 13(1), 47–67.
- Nagata, N. (2009). Robo-Sensei’s NLP-based error detection and feedback generation. *CALICO Journal*, 26(3), 562–579.
  - These three papers by Nagata describe a series of projects to build intelligent and adaptive systems to teach Japanese as a foreign language. Descriptions of NLP implementations and experimental results from human studies.
- Virvou, M., Maras, D., & Tsiriga, V. (2000). Student modelling in an intelligent tutoring system for the passive voice of English language. *Educational Technology & Society*, 3(4), 139–150.
  - Describes error parsing and detection for an English language teaching system.
- Weston, J. E. (2016). Dialog-based language learning. In *Advances in Neural Information Processing Systems* (pp. 829-837).
  - Focuses on using the back and forth of conversations to train a model to learn how to answer questions in a domain

## Comparative Review

- Duolingo
  - PROS: Gamified, attractive visuals, easy to use, can be done in short bursts
  - CONS: Mostly just translating sentences from one language to another, no real interaction
- Memrise
  - PROS: Can adjust it to whatever you want to learn, good for independent and motivated learners, makes flashcard learning easier
  - CONS: Just flashcards, no other forms of learning, takes a lot of time to build custom decks
- LinguaLift
  - PROS: Claims to be built by Oxford University language specialists
  - CONS: Looks to be just an online textbook?

- Kwiziq
  - PROS: Adjusts the material that is being taught
  - CONS: Just provides support for a teacher
- E-dictionary & online dictionary
  - PROS: works well for just-in-time vocabulary support
  - PROS: very accurate and reliable
  - CONS: does not afford prolonged and engaging learning experience
  - CONS: limited support for learning how to speak English
  - CONS: limited support for appropriate use of the vocabulary (e.g. context)
- Google
  - PROS: just-in-time vocabulary support
  - PROS: appropriate use cases (through direct google in google and google book)
  - PROS: relatively accurate and reliable
  - CONS may be less accurate if people are using words incorrectly
- Interesting apps in app store:
  - English with Andy - chat & learn <https://andychatbot.com/>
  - Speak - practice your English  
<https://itunes.apple.com/us/app/speak-practice-your-english/id1181737552?mt=8>
  - Cambly - English Teacher (tutoring?) <https://www.cambly.com/en/tutors?lang=en>
  - English Speaking for beginners  
<https://itunes.apple.com/us/app/english-speaking-for-beginners/id1069709715?mt=8>
  - ELSA Speak - Accent Reduction <https://elsaspeak.com/home>
  - Hello English <https://itunes.apple.com/us/app/hello-english/id1148009516?mt=8>
  - Orai - AI Communication
  - Learn English by Conversation
- <https://www.liulishuo.com/en/>
  - The company claimed that its software to be “A Leading Intelligent Adaptive Learning System Like AlphaGo Our personalized English learning system shifts the traditional language acquisition paradigm with a brand new, self-evolving teaching model. It can continuously learn and self-evolve like AlphaGo.”
- Other interesting products
  - AI Product review in Chinese from <http://jyuny1.github.io/liulishuo/>

## Expert Interviews

**Interview 1:** Conversation with a middle-school English teacher, 6 yrs of teaching experience, in Chengdu Foreign Languages School (CFLS) located in the capital of Sichuan province. For context, Chengdu's educational level is upper medium in the country, less developed than coastal areas or megacities, but amongst the better in south-west regions of China. The school CFLS takes students

from around the province, based on meritocratic selection. English is not necessarily a criterion when they recruit for middle school.

## 1. Challenges

1. Contextual changes: China, due to the administration's focus on cultivating a more unified country, observes changes in how English is being taught. Specifically, 1) a decrease in focus on English education on the institutional level especially in comparison with Chinese related education; 2) Skill-focused textbooks/curriculums are gradually shifting towards standardized curriculums created by Chinese teachers/education bureaus to standardize English education across the board; 3) Textbook has less compared to before contents about "foreign countries" in general in comparison to domestic contexts
2. Why this matter to the project: this seems to suggest that test-taking becomes more of a focus of the English educational system. It has two important implication: 1) Test-taking being an important focus area will have a tremendous multiplier effect and may affect the most number of students, especially the less privileged ones in the system; 2) Assistive tools in developing skills in more effective scale to substitute what the system offers could be potentially highly motivating for educators and students
3. Middle school students: they start 7<sup>th</sup> grade generally with low levels of English. English education in China typically starts around 3<sup>rd</sup> grade. Students from Chengdu local primary schools can probably form short sentences about self-intros, interests, and hobbies but not much more than that. Students not from Chengdu are reputed to have zero bases (or just some words like color, pencils, bananas) in English.

## 2. Opportunities

1. Use AI to diagnose ability levels and make personalized recommendations for learning materials and exercises:
  1. Context: a huge part of learning a language is seeing it in real-world contexts. Teachers generally assign tasks like news, magazine articles, short-simple-story-book, etc. to encourage students to learn outside textbook contexts. However, it is relatively hard to find the right level of material for students. 1) the teacher's skill and experience can change their recommendations a lot; 2) they usually make a general recommendation for the class or at most 2-3 tiers of materials, hard to personalize; 3) students selecting materials for themselves are hard due to information gap, and inaccurate goal-ability match.
  2. Outcome: AI can make recommendations for teachers to better assign materials. They (teachers) can even reduce their own information barrier by seeing the recommendations of AI for materials they may or may not have known. This helps the exercises and contents students consume be challenging but not too challenging, and it can also help with students acquire the materials with propped up dictionaries, quizzes, and illustrations, etc.

2. Use AI to diagnose and analyze for tests: This is just an idea that the teacher brought up as of interest to teachers and school administrators in China. This does not represent my opinions. Essentially, if somehow a digital platform can be constructed such that students can take some "take-home" homework or exams through digital platforms, the results and analytics can be visible to teachers on the back end (seeing where the errors congregate, making adjustment in curriculum accordingly) but also students to see their own errors and practice accordingly.
3. Digitalizing and thus democratizing educational resources seems to be a trend with rural schools: **Chengdu No.7 High School recorded classes (and sometimes had live classes) with rural high schools. Results are tremendous where previously rural schools have minority university entry results transform to majority 3-tier university acceptance, moderate 2-tier and even top school acceptance for rural Sichuan. Made national headlines. However, this is mostly MOOC style but only institutionalized by schools rather than relying on individuals' willingness and ability to learn.**

### 3. Stakeholders

#### 1. Students:

1. In middle school level, the teacher observes a division of topics girls and boys are interested. Girls: Fashion, clothing, etc. Boys: Sports stars, games, etc. **This divergences blurs once they know more what is out there (i.e. read more news, encountered diverse topics, etc. that are outside of their preferences/comfort zone as a result of assignment)**
2. Middle school students have an elementary level of English (words not phrases, or zero bases)
3. English education in 7th grade starts with the alphabet and their pronunciation
4. Confidence is more important than skills. They need lots of encouragement and positive feedback.
5. Topics they care about gauge more willingness to try.
6. They are very curious about countries outside of China. E.g. life in UK, US vs. China. That prompts them to learn the language.
7. They engage better when they can relate. Complete strangeness results in silence.
8. They can't follow through apps/tasks if not required. Teachers need to facilitate. Interests alone don't carry through for these kids of their age especially when they have so many subjects to learn and high academic pressure.

#### 2. Teachers

1. **Interested in assistive AI product to assist their job in teaching, less so in students "do it themselves"**
2. Interested in helping students gain abilities but their economic incentives aligned with deliverable performances (aka. Exam performances)

3. Have observed that focusing too much on ability does not get as many buy-ins from students or parents sometimes because the latter are more performance driven
  4. Some have used ed-tech startups product like Liulishuo, although this is not common. User feedback varies - generally does not seem to be very desired by teachers.
3. Parents
    1. Interested in having kids improve their scores and abilities, but will prioritize the former if there is a trade-off.
    2. Wields a lot of power in terms of dictating what students do and prefer to do
  4. Schools and administrators
    1. **Straying away from "looking outside" to "looking within", increasing Chinese education, standardizing curriculums, discourages studying abroad in general**

**Interview 2:** Interviewed a stanford graduate student from Russia about experience learning English as a second language

- Motivation:
  - when at school, there is no motivation; was a good student and do all the homework; inspired by a teacher who would find new books every week and tell students how great they are.
  - At university, E read articles for research. She thinks the motivations for her friends are to learn English for songs, movies, and TV
- Difficulty & her own learning experience
  - When at university, E still had difficulties talking in English. She can read but rarely speak in English. Her writing is much better than her speaking
  - When with teachers, she is not afraid but conscious about her mistakes; not comfortable using English at the beginning but not afraid
  - E does not want to make the same mistakes; always avoid learning the wrong things and double check using different sources to prevent mistakes
- Tools & Solutions she tried
  - Books
    - + for professional English; very job-related
    - - didn't use them much and used them only for relevant tasks
  - Dictionaries
    - E.g. Oxford dictionaries
    - + accurate
  - Internet
    - To check and double-check English to prevent new mistakes
  - Google search phrase and over time learned to use the number of search results from Google and Google book to tell accurate uses from misleading uses.

- Google book to check Grammar
- Ideal learning experience:
  - Less time consuming, save time - very task-relevant
    - 'If I can immediately ask someone, then AI might be better (24/7)'
  - Things important to her (ranked in order):
    - Accuracy
    - just-in-time help
    - Task-driven; task-relevant
    - Less time consuming
  - Conversations
    - Real speaking
  - Screen
    - Multiple modalities;
    - Has to be able to see how a word is written
- Her own learning strategies:
  - Search in Google and google book
  - Shape content to things relevant to her own life
- Comment on current solutions
  - Not very individualized; what you learn is not very specific
  - Teachers are expensive and you have to find a match
  - Chatbots are not authentic enough;
    - E doesn't trust chatbot results!
    - E wants to have an instant opportunity to check where the result came from. If it is accurate; if native speakers use that way;
    - E wants to see the backend

**Interview 3:** Principal of language school in China, who's been in the industry for 5+ years.

- Principal Wang runs an English learning/training (after school) organization. His students are mostly high schoolers with some from middle schools. Most of his students came to him with English ability around 5.5 IELTS, which he thinks is not enough if they plan to study A-level.
- He has been teaching and in the industry for six years. He witnessed a decline in the afterschool English courses and a decline in the popularity of international curriculums. The size of students enrolled in the international curriculum is shrinking in almost all cities.
- The top learning challenges he witnessed through his teaching and experience:
  - Many Chinese ESL students can't understand the difference between "detrimental" and "harmful"
  - Many can't understand words such as "irreversible" because they think "reversible" as a permanent attribute but are confused in thinking "irreversible" as negating a permanent attribute.
  - Many have problems understanding different types of verbs, such as momentary ones and process verbs. This, in turn, affects their understanding of English.

- Many students have narrow subject knowledge and have trouble expressing their ideas.
- Many have limited opportunity using their English and simply do not read enough; they do not read and write enough
- When constructing sentences, many use verbs too soon (might have been affected by Chinese sentence structure). Their English use is heavily affected by their knowledge of Chinese
- As for English listening, some students who speak dialect heavily, their English learning might be affected. He observed that if the students learned English, in dialect or Chinglish, when they're younger, their English ability might be negatively affected.
- If they did not do well in their High School Entrance Exam, do not have good grammar and intuition for English, it is almost impossible to improve their English listening.
- Another well-observed program is students' mindset - they study learning for tests and are not very cognitive about their English ability and where they lack.
  - 3 types of motives
    - For tests
    - To study abroad
    - Have been abroad
- Q: Potential of AI
  - See the potential of AI in improving English reading and listening
  - Traditional teaching methods do not help learners prevent making the same mistakes. Learners need more powerful methods to help them from making the same mistakes.
  - The prerequisite for a lot of English learning is memorizing vocabulary. It is hard to engage and motivate students to do that. Without vocabulary, it is hard to learn English.