

Conceptual Artificial Intelligence framework to Improving English as Second Language

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Abstract—English has become a global language in modern day world. It is widely spoken among the non-native English communities as well. However, due to the lack of resources, such as, teaching literature and skilled English teachers, the teaching of English language becomes inefficient. Educational institutions and non-native English students are equally affected by these problems. In order to efficiently cope with the aforementioned issues, we propose an AI-based English learning framework. The proposed AI-based framework combines the previously proposed algorithms and other newly developed techniques to enhance the language learning. The proposed framework enables the individual learners to interact with the framework for improving and enhancing the process of learning English language. In addition, the proposed system has the capability to effectively cope with the lack of resources available to the educational institutes providing English learning courses. In addition, we also perform data collection and develop new modules that are integrated in the proposed framework. We assess the proposed framework by allowing a group of participants to learn English language. These participants are non-native speakers from a foreign land. The results make it evident, that the proposed framework assists the students in learning English as a foreign language.

Keywords- language-learning; Education; Intelligent Tutoring Systems; styling; Artificial Intelligence.

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1 Introduction

In modern world, English has become a global language. Therefore, the use of English language in non-native communities has also increased significantly [1]. It has been observed that learning the syntax and semantics of English language is a major hindrance faced by non-native speakers. This hindrance becomes more daunting when educational sectors of non-native English communities have limited resources for effectively teaching the language. In addition, the lack of appropriate interactions with expert and profound English language speakers is also a major impediment for the amateur English language students. It is logical to understand that the unrestricted and unlimited availability of conversational practice greatly improves and speeds up the students' understanding of the language for performing effective communications. The students learning English language in a foreign land learn English language majorly in academic environments, such as schools, institutes, and relevant establishments [2]. In addition, these students have a greater chance of interacting with native speakers, thus, leading to efficient learning. Contrary, educational institutions that facilitate the learning of English language in non-native communities are usually equipped with limited resources. In addition, these

institutions also face other issues, such as, few trained staff members that have the ability to properly teach English language, limited teaching materials, etc. [3]. These problems have a direct impact on the efficiency with which the students learn English language. It is quite possible that the non-native students that are attending an institute in an English native country may not have the opportunity to freely practice with native speakers. This may be usually due to the fact that new learners of any language are conscious and afraid of using poor grammar and sentence structure, when given a chance to converse with native speakers. This not only hinders the process of learning, but also effects the students' confidence. Therefore, a system needs to be developed that provides an unconstrained opportunity to learn the English language effectively and efficiently. The major purpose of this work is to develop a system that has the ability to properly address the scaled educational problem, specifically for non-native students learning English language. We focus on conceptualizing and implementing a computational (artificial) intelligence framework for improving the process of learning English language. The proposed system provides an unlimited and unrestricted access for conversation practices. Thus, providing a chance to effectively mitigate the aforementioned hindrances in learning English language.

The use of artificial intelligence (AI) for solving problems has been a focus of research community [4]. There are many areas where AI has proven its capability to perform tasks independently and efficiently, without human supervision [4]. Thus, in this work, we propose a framework that imitates the human-level ability for teaching English language with no detection of imitation. Thereby, assisting in improving non-native speakers' level of confidence, and relieving stress that is usually faced in the event of a discussion with a native speaker. Moreover, the proposed AI-based framework effectively reduces the cost of teaching English language correctly and can be used by educational institutes that provide education in non-native communities. The conceptualized solution is grounded in the AI implementation. Thus, leading to following research questions.

- 1) Can an AI-based system be developed for providing conversational systems and how effective will such systems be?
- 2) How do we evaluate a conversation AI-based system in order to measure its effectiveness?
- 3) What tools, techniques or methods are available and most suitable for developing a bespoke conversation AI-based system?
- 4) How will these tools, techniques or methods interact among themselves in order to fulfill the aforementioned research goals?

It is noticeable that the authors of this work are non-native English speakers living in a community, whose native language is not English. Moreover, the researchers of this work are educationists who profoundly understand the difficulties faced by educational institutions and problems faced by students who learn English as a foreign language. These factors shape the authors' perspective toward this work.

As presented in [5], the artificial neural networks (ANNs) are used in various industrial applications to achieve breakthroughs and massive advancements. We are keen to highlight the impediments faced by educators when a classroom comprises over 30 students. As established in [5], the AI and chalkboard move hand-in-hand to cause disruption in the conventional damaging model of current education system. The standard of learning among students will improve drastically, as the current "one-size-fits-all" education model will enable the implementation of a more robust and customized learning model. This model is assisted and facilitated by various AI applications for creating a more interactive, and interesting learning environment for students whose interest lies in increasing knowledge and debasing their fear of learning.

The rest of the manuscript is organized as follows.

In Section II, we present the review of research literature. In Section III, we present the research approach of this work. In Section IV, we discuss the expected outcome of the proposed AI-based framework. Finally, in Section V, we conclude our work.

2 Related Work

Intelligence is defined as the ability to acquire knowledge and skills, and the very ability to apply the acquired knowledge and skills for solving a well-defined problem [6]. Intelligence in any form is integrated into different cognitive functions, such as memory, perception, attention, planning, and language (which is the basis of this research). We observe that the integration of intelligence in learning language is pivotal. The resource of human intelligence in teaching English to non-native speakers is scarce. Our perspective is influenced by the emergence and applicability of AI for improving the quality of learning English language among non-native speakers. Moreover, the proposed technique is an effort to harness AI prowess in providing breakthrough technology for the education sector in modern society. The usage of technology is not uncommon for facilitating the educators for improving the quality of education. However, AI has never been efficiently applied for developing advanced technology for educational purposes. This is established by reviewing research literature that vividly discusses the existing methods for facilitating quality education as well as educational conversational systems for language learning.

The successor of AI, i.e., computational intelligence (CI), is pivotal in this work. CI relies on algorithms that are heuristic in nature [7]. CI is immensely used in cognitive functions, such as perceptual experience, signal analysis, and object identification, etc. In addition, other cognitive functions, such as, projecting, complex delegacy of knowledge, logical thinking, episodic memory, and realization of symbolic knowledge, which requires solving non-algorithmizable problems are also explored using computational intelligence. As presented in [7], CI is a heterogeneous combination of rough set, fuzzy systems, probabilistic reasoning, multi-agent systems, evolutionary computation, and neural networks etc.

The authors in [4] discuss that the direct influence of AI in the field of education is imminent as new possibilities of AI are recorded and challenges for teaching and learning emerge. The authors also discuss that education as a field of study will feel the current wave of advancements in AI, and the future thereof will be shaped by emerging technologies and computing prowess of intelligent machines – one of which this research work is conceptualized on.

Though, the conceptualized idea of this research is novel, there are methods discussed in literature that showcase the interplay of AI and the field of education. The authors in [8] emphasize the practical and theoretical successes recorded by using the AI applications in education. The results are evident in the promotion of self-learning or self-development, virtual teaching, virtual classrooms or laboratories, and creative schools which provide the alternatives to every student against the provision of standard curriculum [9]. The authors in [10] present the impact of AI on learning, teaching and education in a report presented to the European Union Joint Research Centre. In the 80's, AI-based educational applications were built on knowledge-based approach. Broadly, this research work presents a framework categorized under existing methods, referred to as intelligent tutoring systems (ITSs). The ITSs are used to facilitate learning among students. However, ITSs models encounter difficulties while trying to broaden the learning domains. Thus, coping with ITS problems and the application of AI/CI algorithms for creating teaching interfaces and learning diagnostics for students are recommended. The usage of AI/CI based systems for developing learning and monitoring systems is emphatically stressed. The introduction of active and personalized learning among students, leads to the development of ITSs on the basis of AI algorithms [11]. Thus, the key to this research work includes the concept, application and interplay of CI and the field of education for the development of an ITS that facilitates active and specialized learning with respect to student's level.

Authors in [12] present English dialogue companion (EDC). The proposed EDC system considers English language and assists elementary students in learning English language as their second language of choice. EDC system encourages the students by splitting learning of English language into two modules, i.e., the teaching phase and conversation phase. For evaluating the EDC, authors conduct a pilot study and observe the impact of using EDC system. The results show positive impact on the participants of the study. The authors also observe that most of the participants preferred the teaching phase as compared to the conversation phase. The EDC systems developed in [12] allow the learners to choose his/her companion, either for learning or conversation. The authors report that most of the participants prefer the same gender for learning.

Authors in [13] present a method that focuses on oral language proficiency. The authors also discuss the use of AI for language teaching and learning.

The authors in [14] discuss the language techniques, such as data-based machine translation, translation memories, and collaborative translations. These

techniques assist in the areas of cognitive activity and professional translation where technical specialization of human translators is not required. The research presented in [14] is limited to language translation via AI, however, it further buttresses the achievements and applicability of AI-based models in improving language learning. A more congruent research is presented in [15]. The authors use Rasch model to assess the learning of English as a foreign language among 250 participants. The examination of latent differential items, which functions in English during listening test was carried out among the sample population. The listening test contains questions in problem solving, planning and evaluation, mental translation, person knowledge, and directed attention. The listening test analysis leads to the best-fit two latent class model. Please note that the authors use neural network and chi-squared test to examine the nature of latent classes.

Similarly, authors in [16] perform a study to examine the relationship between lexical and grammar knowledge to that of reading comprehension among non-native English-speaking students, who are learning English language. The study includes 825 students, who take English as a foreign Language (EFL) test. The authors use a multi-layered neural network (NN) to categorize participants into either high ability or low ability readers on the basis of grammar and vocabulary. Artificial language learning (ALL) is the hallmark of the research presented in [17]. ALL explore language principles and language learning, as it deals with linguistic systems and studies the ecological validation of assessments of natural language abilities. Thus, it is evident from the review of existing methods that a novel way of improving language learning is possible. Our goal is to develop a novel language learning framework by combining various AI/CI algorithms and techniques into a single framework. The resultant framework is capable of improving English language learning as a second language.

3 Research Approach

We approach this work by means of qualitative research methodology. A quantitative research approach will help to evaluate the research work with facts and figures [18].

Please note that the proposed research is interdisciplinary, i.e., it explores the fields of education and AI/CI. The novelty of the proposed work lies in the core aim of developing a framework that assists in improving the ESL by integrating various AI methods, techniques, and tools. In addition, the datasets, tools, techniques,

methods, and algorithms that are used in this work are applied in a bespoke manner. Please note that we have originally developed some of these methods. As evident by the literature review of existing methods, there are singular methods for specific purposes. However, in this work, we approach the problem by combining relevant methods to achieve our goals.

Figure 1 presents the proposed research methodology presented in this work. As depicted, a thorough and elaborate review of literature is conducted on language learning and how AI is harnessed to improve language learning – in this case English language.

We perform formulation of modules, identification of corresponding algorithms in each module, and mode of interactions or integration among modules. In addition, we perform data collection, data cleaning and data preparation for the proposed method.

Tentatively, the development of the framework is carried, which involves a lot of programming. Finally, we evaluate the proposed and developed framework in terms of efficiency and effectiveness. We also consider evaluating the proposed framework by allowing individuals to interact with it. These participants are learning English language as a second language.

The participant's group is divided into two subgroups. First group includes those participants who use the proposed application, and the participants of second group do not use the proposed AI-based framework. We also keep the academic tracks for each participant, as the performance level of each participant is measured in order to ascertain the significance of the AI-based language learning.

Finally, we present the recommendations and identify the potential future works. The report writing is equally paramount for the purpose of documentation and for contributing towards the academic knowledge.

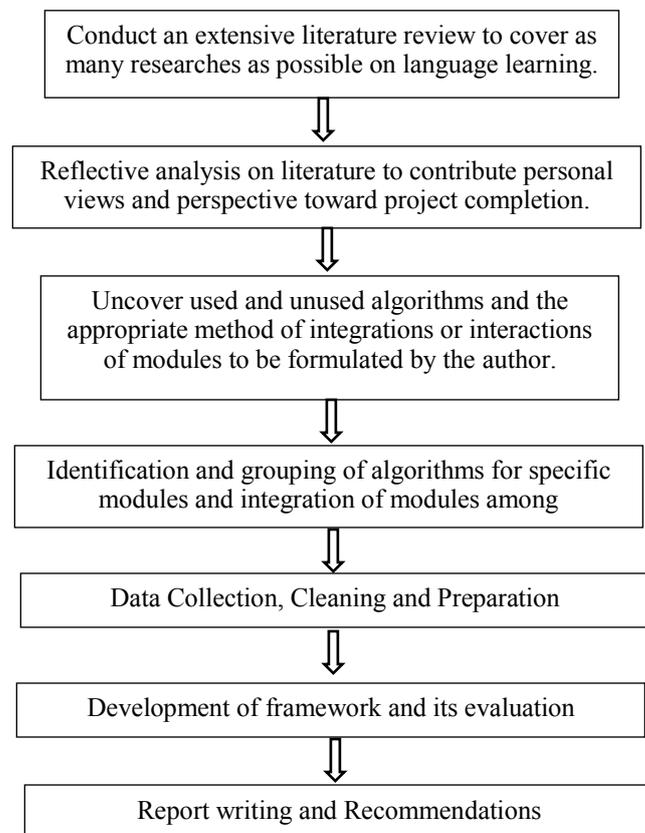


Figure 1. The proposed methodology presented in this work.

II. Expected Outcome

The motivation of this research is to develop a framework that greatly enhances the learning of English language among non-native speakers in foreign nations. The expected outcome of this research includes:

- 1) novel design of modules responsible for developing an AI based experimental framework for (English) language learning.
- 2) novel method of AI/CI algorithms usage or combinations to facilitate (English) language learning.
- 3) novel integration definitions of AI/CI algorithms, tools, and techniques while developing (English) language learning framework.
- 4) Creation of a novel custom dataset for language learning purpose.
- 5) novel AI-based framework for learning English language for non-native speakers.

Overall, we expect that at the end of this research, we will be able to develop an experimental framework that is practically implemented and is made available for the students. Thereby, resulting into another record of advancement for AI applicability to proffering solutions for resolving societal problems.

4 Conclusion

In this work, we present an AI-based framework that assists the non-native English speakers to learn English language. Due to the lack of resources, i.e., teaching material and skilled individuals, there are various problems faced by the individuals learning English language. These prevailing problems are faced by millions of non-native English-speaking students, ranging from age 7 to 11, who are unable to properly learn English language as their second language. Moreover, we desire to significantly modify the damaging old educational model by providing a customized learning experience for each student user and not just the “one-size fits all” learning experience. The proposed AI/CI framework assists the educational institutions in foreign countries with limited staff members. Thus, the proposed innovative research work provides an educative and scalable product that renders learning English language correctly as a service to students even outside the usual academic settings.

References

- [1] D. Crystal, *English as a Global Language - Second Edition*. 2003.
- [2] B. Turnbull, “The use of English as a lingua franca in the Japanese second language classroom,” *J. English as a Ling. Fr.*, vol. 7, no. 1, pp. 131–151, 2018.
- [3] E. Protassova, “Teaching Second Languages at Pre-School Age,” in *The History of Language Learning and Teaching Vol. II. 19th-20th Century Europe*, 2018.
- [4] S. A. D. Popenici and S. Kerr, “Exploring the impact of artificial intelligence on teaching and learning in higher education,” *Res. Pract. Technol. Enhanc. Learn.*, vol. 12, no. 22, pp. 1–13, 2017.
- [5] J. Schmidhuber, “Deep Learning in neural networks: An overview,” *Neural Networks*, vol. 61, pp. 85–117, 2015.
- [6] J. Shabbir and T. Anwer, “Artificial Intelligence and its Role in Near Future,” *Journal Latex Cl. Files*, vol. 14, no. 8, pp. 1–11, 2015.
- [7] S. Sumathi and P. Surekha, *Computational Intelligence Paradigms Theory and Applications*. 2010.
- [8] M. Wollowski, T. Neller, and J. Boerkoel, “Artificial Intelligence Education,” *Association for the Advancement of Artificial Intelligence*, no. 5. pp. 1–3, 2017.
- [9] E. Gomed, F. H. Gaffo, G. U. Brigano, R. M. De Barros, and L. D. S. Mendes, “Application of Computational Intelligence to Improve Education in Smart Cities,” *Sensors*, vol. 18, no. 267, pp. 1–26, 2018.
- [10] I. Tuomi, “The Impact of Artificial Intelligence on Learning, Teaching, and Education,” *European Union JRC Science for Policy Report*. pp. 1–47, 2018.
- [11] F. S. Gharehchopogh and Z. A. Khalifelu, “Using Intelligent Tutoring Systems in Instruction and Education,” in *International Conference on Education and Management Technology*, 2011, vol. 13, pp. 250–254.
- [12] Y. T. Huang, J. C. Yang, and Y. C. Wu, “The development and evaluation of English Dialogue Companion system,” *Proc. - 8th IEEE Int. Conf. Adv. Learn. Technol. ICALT 2008*, no. July 2008, pp. 864–868, 2008.
- [13] S. Yang, “Artificial Intelligence for Integrating English Oral Practice and Writing Skills,” *Sino-US English Teach.*, vol. 4, no. 4, pp. 1–7, 2007.
- [14] R. K. Al-Tuwayrish, “An evaluative study of machine translation in the EFL scenario of Saudi Arabia. *Advances in Language and Literary Studies*, 7(1), 5-10.” *Adv. Lang. Lit. Stud.*, vol. 7, no. 1, pp. 5–10, 2016.
- [15] V. Aryadoust, “Fitting a Mixture Rasch Model to English as a Foreign Language Listening Tests: The Role of Cognitive and Background Variables in Explaining Latent Differential Item Functioning,” *Int. J. Test.*, vol. 15, no. 3, pp. 216–238, 2015.
- [16] V. Aryadoust and P. Baghaei, “Does EFL Readers’ Lexical and Grammatical Knowledge Predict Their Reading Ability? Insights From a Perceptron Artificial Neural Network Study,” *Educ. Assess.*, vol. 21, no. 2, pp. 135–156, 2016.
- [17] M. Ettliger, K. Morgan-Short, M. Faretta-Stutenberg, and P. C. M. Wong, “The Relationship Between Artificial and Second Language Learning,” *Cogn. Sci.*, vol. 40, no. 4, pp. 822–847, 2016.
- [18] J. W. Creswell, *Research design: Qualitative, quantitative, and mixed methods approaches*. 2nd Edition. 2017.

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