Speculative Plausible Future Design of an AI eLearning Application for a Vocational Institution in Tokyo

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Abstract: *This study applied a speculative design concept to define a cone of plausible futures for Artificial intelligence (AI) eLearning application of English conversational skills installed by 1,229 students at a vocational institution in Tokyo, Japan. The AI eLearning application was designed to give students an immersive learning experience in an augmented learning space that would have been difficult to realize in physical space since the COVID-19 pandemic. The input for the assessment of the plausible future was in-depth interview results from 25 students and teachers, with the subsequent analysis conducted using framework foresight. The key was to determine a definition for a cone of plausible futures and define the plausibility limits for the baseline, alternative and preferred futures. This paper describes how the speculative design concept was applied to the AI eLearning application to transform the created cone of plausible future findings into practical implementation goals. Education potential in the post COVID-19 pandemic needs to adopt augmented learning space by applying the power of multiple technologies based on computer artificial intelligence.*

Keywords: Artificial Intelligent eLearning Application, Augmenting Space, English Conversation Skill, Plausible Futures, Speculative Design, Vocational Institution, Tokyo

1. Introduction

Speculative design is essential for the designing process of eLearning applications since it differs from traditional and affirmative design (Dunne & Raby, 2013; Johannessen et al., 2019; Malpass, 2017). Speculative design can be considered an exploratory design genre that does not aim to focus on a commercial while a general term of design covers a great mechanism of socio-technical intervention which connects a future-oriented discipline and traditional realms of production and communication (Sedaghat-Baghbani, 2021). Speculative design for education is not only to minimize an uncertain and ambiguous future when applying technology to the contexts but also to maximize new solutions in the most exciting ways to create educational media for those scenarios (Tran, 2019). This current study focuses on a cone of plausibility for language learning to tailor future learning environments in augmented learning spaces. Digital technology has evolved rapidly and is being adopted for various services, such as digitally augmented spaces (Parker, 2018), the concept which was first introduced by Lev Manovich, who described how technologies could create layers over physical spaces (Manovich, 2006). By adopting digital technology, this research validated a concept of speculative plausible future design to illustrate a new augmented learning space that would be difficult to realize in a physical space.

The internet now serves over 4.5 billion people, and social media users have surpassed 3.8 billion. Nearly three-fifths of the world's population is already online, and recent trends indicate that more than half of the world's total population used social media presently (Jespersen, 2022). Every day, the average internet user spends six hours and 54 minutes online (Jespersen, 2022). That equates to more than 100 days of connected time per internet user per year, implying that people spend roughly two-fifths of their waking lives online (Jespersen, 2022). Many of the other Sustainable Development Goals (SDGs) solutions rely on the use of technology and corporations leveraging Artificial Intelligence (AI), Big Data, and Machine Learning (Goh & Vinuesa, 2021; Sustainability in the Digital Age, 2019; United Nations,

2021). AI on eLearning is a recommended major component for an 18th SDG on Digital Technologies Serving People and the Planet to ensure that the digital age supports people, the planet, prosperity, peace, and partnerships and another 18th SDG on "Life with Artificials" (Sustainability in the Digital Age, 2019; The Mind Future Foundation, 2020). To turn insights into large opportunities, the solutions to coexist and define common rules are speculative design as well as design thinking. The concept of speculative design needs practice since the investment in application development involves a high budget and redesigning is even more expensive.

In countries where English is a foreign language, especially Japan, to increase the target language engagement and improve language proficiency, learners should ideally be put into immersive environments in which the target language is being used in daily life (Hato, 2006). However, this is not easy to physically achieve, especially in situations such as the current COVID-19 pandemic (Asare et al., 2021; Gordon & Burgess, 2020). Virtual reality (VR) technology, for example, can be used to create immersive environments in which all the characters speak the target language, as well as incorporate VR into language training communication technologies such as artificial intelligence (AI) technology.

This article describes the situation at a vocational institution in Tokyo, Japan, in which an AI eLearning application (AIeLapp) was developed to provide better opportunities to engage with a foreign language, in this case, English conversational skills. As the key to developing foreign language proficiency and as English is not used in everyday life in Tokyo, students generally have better results if they study in a country in which the target language is spoken (Takahashi, 2020). However, this is not possible for everyone and is impossible when the world is locked down due to emergencies such as the COVID-19 pandemic. Therefore, to overcome these problems, the vocational institution where this research was conducted introduced an AIeLapp to give students the opportunity to fully engage with English.

The development of the AIeLapp had two primary purposes: 1) to provide learning tailored to the student's individual needs, and 2) to provide a conversation practice partner for the students anytime and anywhere. Due to a malfunction in the AIeLapp, the students had been reluctant to use it and these original purposes had not yet been achieved. The aim of the major research, therefore, was to determine a method to enhance the quality of the AIeLapp to meet the primary plausible future installation purposes. However, rather than applying design thinking to increase the popularity of the AIeLapp, this research sought to understand the students' dissatisfactions and then design a plausible future to guide the AIeLapp modifications, which required the elucidation of the future environment through the design of future scenarios on the ways the students could adapt the AIeLapp to their lives. A speculative design concept of a plausible future was employed, the details for which are given in the following literature review and research methodology sections.

1.1 Problem Statement

An institutional report from the vocational institution in Tokyo, Japan, found that the AIeLapp which was called as Version-1 from now on, needed to be improved (Takahashi & Vate-U-Lan, 2019). This AIeLapp Version-1 was one of many educational applications that the institution co-operated with the outsource companies to tailor the digital learning material to serve the curriculum. At the end of every semester, the institute conducted an online survey to elicit students' satisfaction towards all facilities and learning material. It was found that students' satisfaction toward the AIeLapp Version-1 was too low for two semesters continuously, thus the research to study which part of this AIeLapp needs to be redesigned was started. The AIeLapp Version-1 was designed and used for two semesters, thus, this research is a part of redesign processes. To determine the problems, 25 students and five lecturers were interviewed, the findings were analyzed to create the cone of plausible futures to inform a cooperative AIeLapp redesign by the researchers and the engineering teams.

1.2 Research Objective

To determine a speculative plausible futures design for the AIeLapp with a team of engineers to augment the learning space at the vocational institution in Tokyo, Japan.

1.3 Research Question

What speculative plausible futures design could be employed to augment the AIeLapp learning space?

2. Literature Review

This section introduces research on speculative design, plausible futures, and framework foresight.

2.1 Speculative Design

Design is associated with many fields of interest, such as the graphic design in posters and magazines, architectural design, and interface and user experience design; therefore, design is inherent in our daily lives. Proper design methods

are meant to resolve problems, such as increasing product sales or improving and enhancing user experiences (Coulton et al., 2016). As the rapid development of new technologies and global environmental changes have made futures more unpredictable, to respond to such changes, ideas must change.

Speculative design, which was first advocated by Dunne and Raby from the Department of Design and Interactive Studies at the Royal College of Art in the United Kingdom, involves the development of new questions, it provides a new possibility for innovation (Dunne & Raby, 2013; Mitrović, 2015). The process of addressing major societal issues through design processes and systems is a definition of 'Speculative design' (Lombardo, 2022; Tran, 2019). Generally, people consider their preferences based on a set of possible futures; however, current designs or services hinder people's attempts to build those futures (Peace, 2019). Therefore, the primary objective of speculative design, which is focused on possibilities, not probabilities, is to force a future aspect into the present to assess the reactions (Tonkinwise, 2014).

Importantly, speculative design is not akin to the problem-solving found in design thinking, as it involves imagining what the future society may be like and then designing future scenarios based on these imaginings to present a different perspective (Mitrović, 2015). Therefore, as the speculative design expands the design boundaries (Hines & Bishop, 2013) it can be employed to explore people's views and concerns, generate debate on relevant issues, and reimagine relationships (Tsekleves et al., 2019). Dunne and Raby in their book 'Speculative Everything' (2013) arranged their expanded taxonomy of alternative futures into four classes: possible, plausible, probable, and preferable: considered the probable or preferable futures from a present perspective, and the plausible futures as a range to open up future possibilities more enthusiastically.

2.2 Plausible Future

Plausibility is a notion between probability, likeliness, credibility, and reasonableness, and compared to possibility, only exists as a result of human reasoning (Van der Helm, 2006). Therefore, a plausible future is the range of subjective alternative futures based on an understanding of the status of social processes and the ways their forms may possibly change over time (Dunne & Raby, 2013; van Duijne & Bishop, 2018).

2.3 Framework Foresight

Framework foresight is a structured approach for forecasting and planning strategic foresight, which involves methods to reveal assumptions by identifying the volatilities, complexities, uncertainties and ambiguities in trends (Hines & Bishop, 2013; van Duijne & Bishop, 2018). Framework foresight was developed by Hines and Bishop (2013) at Houston University as a systematic analysis to identify the driving forces of change before developing concrete plans. The aim of framework foresight is to find solutions that are likely to have positive outcomes and generate an explicit, contestable sense of the future (van Duijne & Bishop, 2018).

The framework requires the organic filling of gaps to determine the answers. By looking at current issues and stakeholders, the first step is to develop a clear definition of the domain to determine the in-scope and out-of-scope issues, the duration, and the possible critical issues. Then, the trends that could possibly impact the research are analyzed and a baseline future outlined to assess the impacts of possible unrealized problems (Voros, 2017). Therefore, this framework also provides opportunities to consider alternative futures.

Based on the current research problem and the literature review, a speculative design concept and framework foresight were applied to develop a plausible future for the AIeLapp.

3. Research Methodology

This qualitative research aims to explore and elucidate the plausible futures for the AIeLapp, with in-depth-interviews being employed as the primary research instrument.

The research was conducted at an institution that had 1,229 freshman students aged between 18 and 20 with a 30 per cent to 70 per cent male to female gender ratio. A purposive sampling method was employed for the interviews, which were conducted in five participant groups: four student groups and one teacher group. The sample of 20 students were fully voluntary. Each group had five participants and were formed based on the participants' education and similar English proficiency levels to avoid confounding effects. The teacher group participants had similar backgrounds and the same relative seniority.

The interviews were conducted in May 2019, at which time there were no COVID-19 fears; therefore, the participants were seated in the same room around a round table. The interviews were recorded both video, and audio with the participants' permission, after which the interview data were analyzed with a focus on modifying the current AIeLapp version based on the identified plausible futures. All interviews lasted approximately one hour and used a round-table

discussion format to identify the issues causing participants' frustrations while using the AIeLapp. The interview was conducted in Japanese, the participants' mother tongue (Takahashi & Vate-U-Lan, 2019).

4. Research Findings

The findings of this current research were described based on the framework foresight. First, the domain was defined, which involved an exploration of the current conditions to determine the baseline and the possible alternative futures. Then, the cone of plausibility was employed to elucidate the plausible futures and identify the AIeLapp functions to be redesigned and modified.

4.1 Domain Definition

The research domain was related to the problems that had been encountered in the use of the AIeLapp Version-1. To align with the original goal of the institution, the AIeLapp was supposed to help students prepare for class by providing training based on the class contents and corrective AI feedback. The AIeLapp opportunity for entirely free conversation practice was not considered in this study. The geographic focus was Tokyo, Japan, in which the institution is located, and the time horizon was the start of the new academic year in April 2021.

Providing language learners as many opportunities as possible to engage with the target language is the key to improving language proficiency. This has become especially important in the COVID-19 pandemic, which has highlighted the importance of providing augmented learning spaces for practice both in and outside class.

4.2 Assessment of Current Condition

The stakeholder interviews revealed the current AIeLapp conditions. The stakeholders who could influence the domain were the teachers, the students at the institution, and the engineers responsible for modifying any technical issues with the AIeLapp.

The focus group interviews sought to elucidate the AIeLapp Version-1 problems. However, to ensure that frank opinions were given, close attention was paid to the participant selection as previously described. All interviews were one hour each and employed a round-table discussion format to identify the issues associated with the participants' frustrations when using the AIeLapp.

4.3 Baseline Future

The growth in mobile device and internet technologies over the last 20 years has allowed for a commensurate growth in learning anytime, anywhere concepts, and with the developments in AI, programs can now be adapted to individual needs (Stansberry et al., 2019). By changing the nature of work and establishing a new relationship between man and machine, AI could double annual economic growth rates by 2035 (Purdy & Daugherty, 2022). The impact of AI technologies on business is expected to boost labor productivity by up to 40% and allow people to make better use of their time (Purdy & Daugherty, 2022). However, what has not changed is the English as a Foreign Language (EFL) environment in Japan, as English is not used in daily life, a situation that is not expected to change in the scoped time.

The goal in this stage was to determine how the AIeLapp could be modified to reduce user frustrations and improve their English proficiency.

4.4 Alternative Forecast

Infrastructure damage and the lack of Internet connections due to a disaster could significantly affect the aims of this research, which would mean that the AIeLapp would not be effectively modified, and the cause of the user frustration would remain. Currently, the potential event situation is COVID-19, which has forced the school to shut down and made it impossible for the students to learn in an authentic school environment (Duggan, 2020). As this event was unexpected, people remain unsure how this will affect their lives.

Learning in an augmented space using the AIeLapp is different from learning in a classroom setting. The AIeLapp was initially developed to support students learning alone and even at home but was not intended to be a replacement for the teacher or their classmates. As there are limits to the operations of AI technology on consumer platforms, the provision of classroom setting learning using the AIeLapp is still unresolved. However, conversation practice focused on user interests could change the future of the application.

4.5 The Plausible Future of AIeLapp and the Functions to Be Modified

It is essential to increase target language engagement to improve foreign language proficiency; notably, in situations such as the COVID-19 pandemic, studying abroad and even going outside the home has become difficult. This study was important because it increased target language engagement anytime and anywhere by providing an augmenting

space using the AIeLapp. Therefore, because of the ongoing AIeLapp issues, it was unlikely to be used unless it was appropriately modified.

The plausible future supports student study by augmenting their learning space with the AIeLapp, which also provides informative content in line with the curriculum and tailor-made exercises and feedback based on the user's current level and needs.

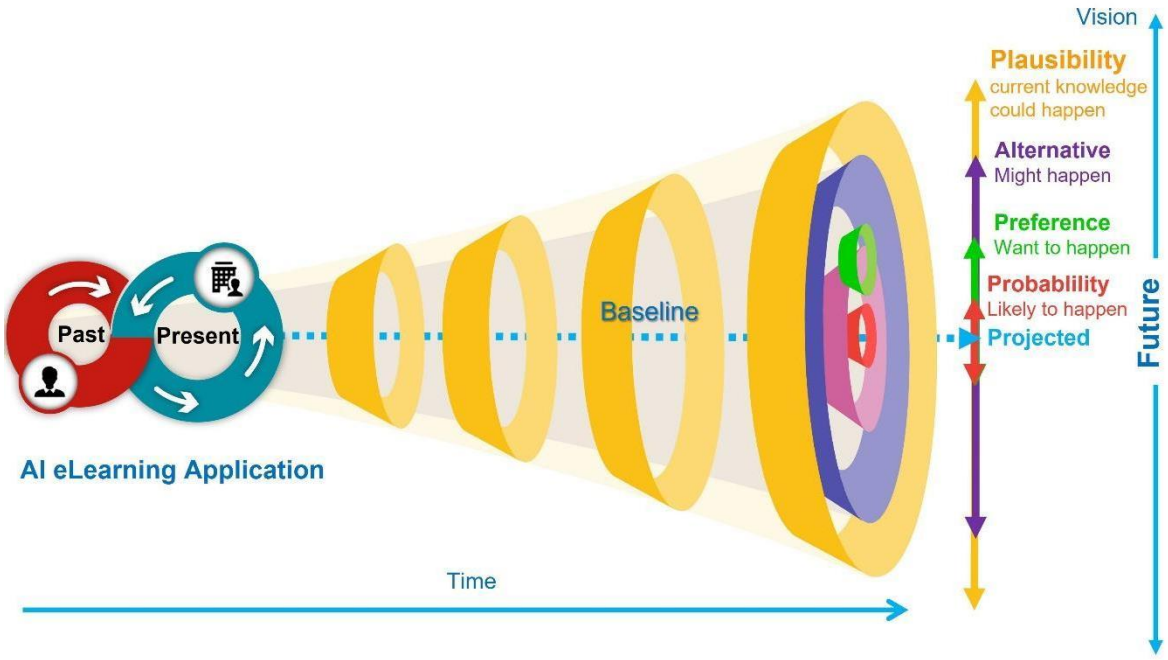

Figure 1. Cone of Plausible Futures for AIeLapp.

Figure 1 shows the cone of plausibility for the AIeLapp, with the past explaining why it was introduced in the AIeLapp and the present indicating the current state of the AIeLapp.

The AIeLapp was installed at this institution to increase student engagement with English without them having to study abroad. Initially, the AIeLapp had basic English conversation exercises such as greetings and self-introductions, after which original content from the institution was embedded based on the freshmen curriculum, which included self-learning materials for in-class lesson preparation and after-class reviews. While the structure was considered ideal, there were issues with some of the functions, which meant that the primary student users were dissatisfied. This is the present state of the AIeLapp.

The horizontal line across the bottom of Figure 1 shows the time axis for the functional review of the AIeLapp, which is one academic year cycle for the modification, trial, confirmation, and start of the new version services. In Japan, as the new fiscal year starts in April, the goal was one month before that time in March.

The limits of plausibility indicate the current technology, the information structure, and the peripheral limits. Specifically, as the technology can be only operated using tablets, smartphones and peripherals that the students are able to use at home, ignoring these specifications would not be a feasible future.

The middle straight line depicts the baseline future. In this research, the baseline future was to appropriately modify the AIeLapp, and especially the AI function that was currently providing incorrect feedback. The preferred future is a chosen future not based on current conditions; therefore, in this case, the preferred future was an AI function that communicated like the teacher or like the classmates. The alternative futures are the multiple lines, which indicate the broader possible range of futures generated by the impacts of various things, such as equipment, platform, and peripheral developments.

A vision requires a shift in perspectives to reveal the blind potential in the future rather than only seeing the future as an extension of the present. The debates on this vision reveal the value of the potential futures and the discovery of the most plausible future, the most possible future, and the most preferable future; that is, the debates shift the perspective from possibility to value and empower the realization of other futures that are not limited to probable futures.

The vision for the future of the AIeLapp was to be able to support the students in a perfectly augmented learning space. Therefore, the future changes needed were not the result of one technology or one trend but were the result of overlapping efforts and concurrent changes from the intervention of many people and things, that is, the imagined future was not a simple extension of the present but was the culmination of many possibilities. Based on the cone of plausibility, the interview results detailing the functions that needed to be modified were summarized and are shown in Table 1.

Table 1. Interview summary and the functions to be modified (n=25)

Summary of user comments	Frequency	Percentage	Type of Future	Function to be modified
1. Poor English pronunciation peculiar to Japanese recognized as the correct answer.	20	80%	Plausible	AI (Voice recognition)
2. Voice recognition malfunction, particularly for pronunciation.	20	80%	Alternative	Not a functional problem Requires peripherals to work properly.
3. Malfunction in pronunciation scoring	19	76%	Plausible	AI (Voice recognition)
4. Malfunctioning voice recognition.	16	64%	Plausible	AI (Voice recognition)
5. Politeness not considered in scoring.	15	60%	Preferred	AI
6. Need to have training challenges and surprises.	15	60%	Preferred	AI
7. No way to look back at mistakes	14	56%	Plausible	AI (giving a correct feedback)
8. Assigning a high score to poor pronunciation.	13	52%	Alternative	Not a functional problem Requires peripherals to work properly.
9. Malfunction in voice recognition, particularly in dictation practice.	12	48%	Alternative	Not a functional problem Requires peripherals to work properly.
10. The criteria for the scores need to be displayed.	11	44%	Plausible	UI needs to be redesigned

11. The speed of the speech should be considered in the scoring.	8	32%	Plausible	AI (giving correct feedback)
12. Number scores need to be displayed along with the badges.	7	28%	Plausible	UI need to be redesigned
13. Estimated lesson time should be displayed.	6	24%	Plausible	UI need to be redesigned
14. Response speed should be considered in scoring.	5	20%	Plausible	AI (giving correct feedback)

The above table is a summary of the results from the analysis of interview videos and audio. The left-most column summarizes the most common opinions, followed by the frequency, and the number of people who had the same opinion. Specifically, dissatisfaction was expressed with the behavior of the AIeLapp, with eight out of the 14 (57%) highlighted problems being related to problems with the AI, the most noticeable of which were problems related to the voice recognition capabilities. These problems were identified as being related to peripheral devices and accuracy, and it was recommended that users use an external microphone. Even though many users were unaware that the use of peripherals was necessary to ensure accurate app performances, given possible future technological advances, it would be better if the app could perform accurately without the need to employ peripherals.

The future types are specified in the second item from the right in Table 1. There were nine plausible future items in the 14 items. The mapping of the interview results to the types of futures highlighted the nine problems that could be solved and should be solved, which were then discussed with the engineering team.

The problems associated with incorrect feedback first required that the correctness of the input be checked. While it was already clear that most students had not been using peripherals, it also turned out that there were problems with these peripherals. Therefore, the discussions with the engineering team were focused on the ambiguity of correctness judgments and the English pronunciation selections being used as the sample judgment criteria. As a result of a trial with a small number of users, it was found that the ambiguity for general users was not enough for those students majoring in language studies. However, some users claimed that they would be discouraged if the criteria were too strict; therefore, the trial needed to further confirm the appropriate tuning.

Item number seven was based on user comments that they were unable to review their own mistakes, which was more specifically related to the pronunciation practice function. When the AIeLapp pronunciation practice function displays one-word at the time on the screen, the learner pronounces the word and AIeLapp then analyzes it for correctness. If the learner makes two pronunciation mistakes on this word, the AIeLapp was forcibly advancing to the next word, which was making it difficult for the students to understand what was wrong. Some students wanted the opportunity to pronounce the word over and over until they achieved the correct pronunciation. The engineers explained that this specification had been included to avoid the app getting stuck on one word; therefore, it was decided that while the basic training flow would stay the same, a new function would be developed to list all mispronounced words in the feedback at the end of each lesson.

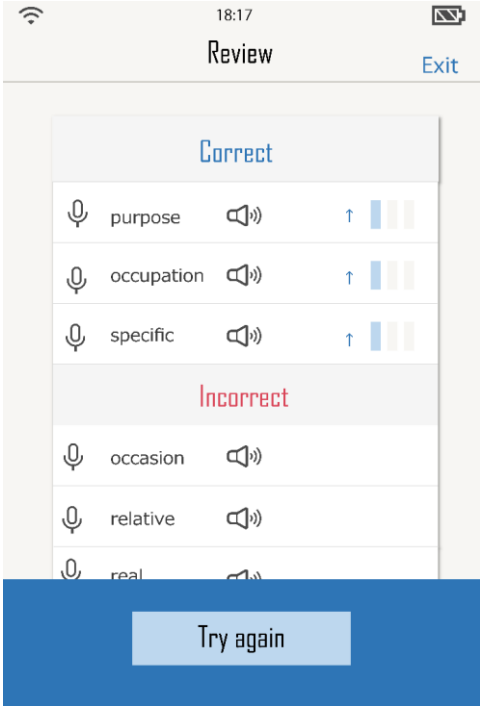

Figure. 2 List the mispronounced words

Figure 2 shows an example list for mispronounced words. The microphone icon provides the training again and the speaker icon allows the students to listen to and objectively review their own pronunciation. Therefore, during the practice, the AI technology allows the learner to focus on the words that are incorrectly pronounced. If correctly pronounced, the three squares on the right will be colored, with the number of colored squares indicating the correctly pronounced frequency. This list will be maintained for future reference.

Item number six indicated that the users wanted some challenges and surprises during the training, which suggested that when practicing the role-playing conversations with the AI, they wanted to be able to practice until they had memorized the dialogues; however, some wanted the conversations to surprisingly diverge in ways that were similar to real conversations. As current technical limitations at this time make it impossible to fully reproduce diverse conversation modes, this requirement was judged to be a preferred future. The engineers said that as it would be possible to change the dialogue order so that the communication context would not be disrupted, the future of this item could be changed from a preferred future to a plausible future.

5. Discussion

These findings answered the research questions focused on applying speculative design based upon the plausible future for the ALeLapp to augment the learning space at a selected vocational institution in Tokyo, Japan. The functions that needed to be modified by the engineers were specified within a strategic foresight framework in in-depth stakeholder interviews based on the AIeLapp Version-1, which provided an extensive overview of the plausible futures for an augmented learning space that incorporated the AI technology. The speculative design concept proved effective in organizing the issues to be modified in the AIeLapp to enhance its quality and motivate the users to take advantage of the augmented learning space. The developed cone of plausible future of AIeLapp can be employed as an effective tool to foresight the next stage of the application among all stakeholders (Voros, 2017). It influences the institute in terms of applying technology in particular AI to the curriculum. These results have significant implications for education, especially in times when there are physical distancing restrictions as in the current COVID-19 pandemic.

Speculative design, which has been employed to solve social problems and many other issues, was applied to solve the issues found in AIeLapp Version-1, with the framework foresight employed to reveal and draw the futures and organize the needed modification to the AIeLapp. Initially, the framework foresight recommended a shorter time span as the content was dependent on technical progress and a shorter goal was deemed more suitable. Therefore, there is

room for further research on appropriate time periods, especially for technology-related speculative designs. Then, with an emphasis on a design concept that focused on the user demands, a cone of plausibility was employed to assess the problem, reveal important ideas and criteria and test them on small groups of students and teachers.

6. Recommendation and Conclusion

This paper described the speculative design concept which aimed to enhance the quality of English language practice, the AIeLapp, in a vocational institution in Tokyo, Japan. In-depth interviews revealed that the AIeLapp had several user issues which could be categorized as AI function, vice recognition, giving correct feedback and UI needs to be redesigned. The framework foresight is then employed to organize those issues into a plausible future for the engineering team before the redesign process of the application. This paper adds to the growing body of research on speculative design. The results and impact of this current study for the vocational institution in Tokyo could be clearly significant, while its generalization was complicated, since this part of practice the application including the test must parallel with the curriculum of institute not equally with the public. However, the concept of the speculative design could be generalized and integrated into other institutions.

As not all students learning a foreign language have the ability to study abroad, augmented learning spaces can provide alternative productive learning environments. Because AIs have the capabilities to provide immersive language learning, this research could inform AI developments in other schools, other languages or other cultures. 2020-2021 has seen the effects of a global pandemic and the changes needed in society to contain it. UNICEF's Policy Brief: The Impact of COVID-19 on children reported that there had been pandemic closures in around 190 countries, which had disrupted the education of around 1.5 billion children (Gordon & Burgess, 2020). Therefore, using technology to provide engaging educational experiences without the need to go to school is becoming more crucial now. The utilization of technology is indispensable for engaging experiences; however, the development of technology requires people to first imagine and look into the future (Dunne & Raby, 2013; Lombardo, 2022; Tonkinwise, 2014). Then based on this future vision, it is essential to understand the value that the technology can create and to be aware of how the technology works before proceeding with any development or installation. It is also necessary to provide a sustainable service that optimizes the entire application to ensure that it is able to learn and continuously improve itself.

7. Ethics approval

Ethical approval to report this case was obtained from a selected vocational institution in Tokyo, Japan.

8. Informed consent

Written informed consent was obtained for anonymized patient information to be published in this article.

9. Conflict of interest

The authors declare that there are no conflicts of interest.

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