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Aviate, Navigate, *Communicate!*: DX-inspired pilot - ATC exchange training.

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Abstract

The purpose of this research is to gauge the effectiveness of recently developed online applications, utilising DX approaches to pilot training. The Aircraft Radio Simulator (ARSim) application makes use of disruptive technologies such as Artificial Intelligence (AI) and Natural Language Processing (NLP) to train student pilots in simulated Air Traffic Control conversations and then exercise their knowledge in realistic exchanges with the range of simulated ATC services in airports around the world.

本研究の目的は、最近開発されたオンラインアプリケーションの有効性を評価することであり、パイロットトレーニングに DX アプローチを利用することである。航空機無線シミュレータ（ARSim）アプリケーションは、人工知能（AI）や自然言語処理（NLP）などの破壊的技術を利用して、航空管制の模擬会話で学生パイロットを訓練し、世界中の空港で模擬管制サービスの範囲との現実的な交流でその知識を行使する。

Keywords: Natural Language Processing (NLP), communications, Air Traffic Control (ATC), DX, Artificial Intelligence (AI)

1. Communicate!

"Digital Transformation (DX) is about adopting disruptive technologies to increase productivity, value creation, and social welfare." (Ebert and Duarte, 2021, pg 16). It "is driven by a flood of software technologies... data analytics, cloud storage and services, convergent interactivity and cognition, augmented reality with visualization and simulation, pattern recognition, machine learning and AI." (ibid, pg 16).

A large proportion of pre-service and in-service pilot education takes place in flight simulators (aka. Flight Training Devices, or FTD), which have become increasingly complex and realistic with recent advances in hardware and software. FTDs give pilots the chance to make mistakes and recover from them in an augmented reality environment. The FTD educates and exercises pilots in the first two verbs of this paper's title: to aviate and to navigate.

The third verb is also an essential part of pilot education: the ability to communicate by radio with Air Traffic Control (ATC) before, during and after flights. In Japanese domestic aviation, these communications are typically in Japanese, but for international flights passing over Japanese airspace and, indeed for Japanese aircrew flying internationally, communications are in English as has been mandated by the International Civil Aviation Organisation (ICAO) since 2011. Moreover, pilots flying internationally pilots are obliged to pass proficiency tests in Aviation English which cover

- Standard phraseology, ie. the "jargon" governing routine communications between pilots and ATC such as requests to

taxi to and from a specified runway, requests to change altitude or heading, permission to land and so on.

- Plain English, ie. communications required by non-routine situations, such as technical or mechanical faults with the aircraft, or a sick passenger.

Japan enjoys the expertise of professional and experienced pilots, in many cases former airline captains, who are routinely employed in Japanese air training institutions. Less available are experienced resources for teaching Aviation English.

The cost of flight training in the United States, New Zealand and Australia being far less than the equivalent training in Japan, many Japanese universities, Dai-Ichi included, send their students overseas usually for a period of six months to gain their initial flying license, known as the Private Pilot's License (PPL). The focus of English language instruction hitherto has been to prepare students for their lives overseas, to make them functional in the language of the host country and able to perform tasks such as ordering food in a restaurant, purchasing goods in a supermarket and enjoying everyday conversations with people around them.

The approach at Dai-Ichi has been a little different; the emphasis is equally on preparing students for their ATC communications, such as they are required to use when they pilot actual aircraft. Classes are typically small; on average 7 to 8 students per lesson but even so, offering students sufficient production practice is a challenge. Students need the opportunity to make mistakes and recover from them, learn how to deal with uncertainty and develop good memories, as the instructions from air traffic control are often delivered quickly and not uncommonly with five or six instructions in the one communication, which the pilot must remember and read back accurately. AI powered software can potentially fill an instructional gap, allowing students to work at their own pace and in their own time using their mobile device to access language production practice, whilst getting feedback in real time.

As pilots flying real aircraft in controlled airspace, students are required to communicate with various sections of ATC such as Tower, Ground and Approach, for routine events such as requesting permission and directions to taxi to a designated runway. ATC responses are often terse and rapidly delivered: "Hold short of runway 34. Taxi via Charlie 1, Charlie 2, Charlie 3" which the pilot is obliged to understand completely and repeat accurately in a process called "read back".

Trainee pilots appear to have the most difficulty mastering ATC communications; cockpits are noisy places and the radio airwaves are often filled with the conversations of other pilots in the area. Pilots who are first learning to fly have to remember and cope with a large number of simultaneous prompts and actions; it is not uncommon for the cognitive load to become very heavy indeed.

Moreover, there is anecdotal evidence that non-native English speaker pilots can be reluctant to communicate over the radio knowing that native speaker pilots share the same airwaves and have been heard to make insulting comments about their English.

Nevertheless, the ability to think in, and be understood in English is required, especially in emergency situations such as in the case of a technical malfunction in the aircraft, where pilots

on the flight deck may literally be being bombarded with a variety of diagnostic messages.

Preparing for an all-English living and training environment within 12 months is a large undertaking, but it is one our students approach with dedication and commitment.

The genesis of this project was a Morning Conversation involving three pilot students. The topic for the week was “online resources you use to supplement your pilot training.” Students shared multiple YouTube channels hosted by popular Japanese pilots, FlightRadar24.com, on which it is possible to view the movements, altitudes and designations of aircraft worldwide in real time, various ATIS (Automatic Terminal Information Service) broadcast websites. Like most English learning websites, they simply reported information and required little or no interaction from the user. However, one student volunteered ARSim, and quickly added that because it was all in English he had found it difficult to use. I noted all suggestions, and downloaded a free version of the software a short time later.

This paper outlines a research project with students from the 21TA and 22TA (third year and second year aviation students, respectively) who volunteered their time to test the software and agreed to report and discuss their findings with me over a period of 3 months.

2. Research Questions

1. How easy is ARSim to use for Japanese L2 English pilot trainees? Is it suitable for self-directed learning (SDL)?
2. How does the software benefit the students?

3. Background

English is mandated by the International Civil Aviation Organization (ICAO) as the international lingua franca of aviation. This has come about not least because of multiple and avoidable airline disasters whose cause was at least partially attributed to faulty communication between pilots and ATC. According to Cookson (2009), causes of the mid-air collision above Zagreb in 1976 and the runway collision at Tenerife in 1977, significantly though not exclusively were attributable to linguistic factors.

The stakes are high. Similar errors could happen in Japan. Esteval and Molesworth (2009) have studied the potential impact on aviation safety of language proficiency of pilots whose first language is not English and their ability to effectively communicate with ATC and found reason for concern, especially in the face of increasingly busy airports, increasingly busy and stressed aircrew and support staff.

It is therefore appropriate to review the status of English in Japan, before exploring cultural influences on learning.

3.1 English as a Lingua Franca

English is now the world’s dominant second language.

British linguist David Graddol (2000, pg 7) asserts that English generally and American English in particular ‘is dominant as an international language because of its global economic power’. However, he contends that in the post-colonial age, the ownership of English is changing. There are now more speakers using English as an additional or second language, than those using it as their native language. Not only are non-native speakers greater in number but English is also used increasingly in multilingual contexts both inside and outside the traditional English-speaking countries (eg. United

Kingdom, United States, Canada, Australia). According to Graddol (2000, pg 58) native speakers lost their majority in the 1970s, and he projects that by the year 2050 native speakers of English would number 433 million compared to those who have nativised the language at 668 million. Linguists from non-native English speaking cultural backgrounds (Canagarajah, 2012; Gao, 2007; Kumaravadivelu, 2003) argue that in future, English will be predominantly used in multilingual contexts as a second language and for communication between non-native speakers.

David Crystal (1997) adds that the English language has some form of official status in 17 countries while the results of a British Council survey administered to 1,398 respondents in 1995 (in Bamgboe, 2001) showed that 96.3% of respondents agreed that English would remain the world's dominant language (pg 357); in short there is overwhelming acceptance of the global dominance of English. Additionally, Crystal (1997, pg 106) reports that in the academic, scientific and technological sectors ‘over 80% of all information is stored in electronic retrieval systems in English’.

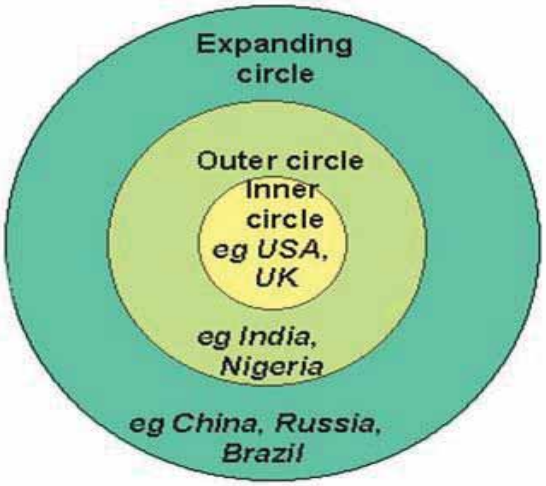
This is an especially pertinent point for Japanese pilots flying international routes. leaving Japanese airspace and heading west towards Europe, pilots will overfly countries such as Vietnam, Korea, India, Pakistan, Myanmar, Thailand and China before they even get out of Asia. Flying South to Australia or New Zealand, they may need to overfly Taiwan, the Philippines, Malaysia, Indonesia; The common factor in all of these being that Air Traffic Control in each of these countries will be staffed by controllers for whom English is a second, and not their native language.

So where does Japan sit internationally in terms of its English competency?

The most influential and oft-quoted paradigm for understanding World Englishes remains Kachru’s (1992) Onion-ring model.

Figure 1: Kachru’s Onion Ring model

The three onion rings consist of the Inner, Outer and Expanding Circles where the Inner Circle refers to traditional cultural and linguistic bases of English such as Britain, the United States, Canada and Australia, countries where English is spoken as a



Native Language (ENL). The Outer Circle represents the institutionalised non-native varieties (English as a Second Language - ESL) in countries which have experienced extended periods of colonisation by either Britain or the United States such as India, Malaysia and the Philippines. The Expanding Circle includes regions where performance varieties of the language are used essentially in English as a Foreign Language (EFL) contexts. Countries such as China, Japan and Korea are part of the expanding circle (Kachru, 1985 pp 366-7).

Pennycook (2017, pg 518) contends that while the onion ring model is informative, it entrenches the central role of Native Speaker (NS) English, in the process de-legitimising Non-Native Speaker (NNS)

models in portraying the *norm-providing* Inner Circle, the *norm-developing* Outer Circle and the *norm-dependent* Expanding Circle.

According to Matsuda (2003, pg 723) 'learners may internalise a colonialistic view of the world and devalue their own status in international communication. They may also feel that that their peripheral position in international communication in English is irreversible.'

Torikai (2011) and Yano (2001) seem to agree that no such nativised version of English will develop in Japan, where it will remain a foreign language functioning 'only as a means of communication with the non-Japanese in international settings'. Within the broader Japanese community, English is not expected to form part of a speaker's identity repertoire. 'There will not be a distinctly local model of English, established and recognisable as Japanese English, reflecting the Japanese culture and language'. Yano (2001) suggests as inevitable that Japanese linguistic and sociocultural characteristics seep into the English of Japanese speakers, wryly adding that for example as the Japanese phonetic system does not distinguish between /l/ and /r/ sounds, it would uniquely be possible to consult *Wrongman's Dictionary* (pg 127). Contrasting Japan with the countries of Europe, where Crystal (1997, pg 80) calculates that 99% of organisations use English as an official language, Yano suggests the 'Japanese will not use English intensively and extensively enough to establish what might be called Japanese English in the same way as Indian English or Singapore English'. He suggests it will be a kind of formal and normative form of English, showing little regional variation and meant for only occasional public and formal communication. He concludes that the Japanese form of English would be 'socioculturally and geographically neutral'.

3.2 Cultural influences on learning

Benson and Voller (1997) question whether or not concepts of autonomous and self-directed learning are culturally bound, and if there are any ethnic or social groups whose cultural background predisposes them either for or against such approaches. According to Pierson (1996, cited in Quoc, 2005, pg 52) the popular trope is that non-western learners are 'conditioned by a pattern of cultural forces that are not harmonious to learner autonomy, independence or self-direction'.

Hall (1976) identified Asian learners as operating within what he termed *high context culture*, in which societal groups are closely-knit and can be relied upon to support each other. High context cultures 'tend to have a long shared history. Usually they are relationship-oriented societies where networks of connections are passed on from generation to generation' (Meyer, 2016, pg 40). Japan is an island nation with a largely homogenous population (ibid, pg 40) and while China has extensive land borders and has been subject to invasion throughout its history, the most recent four hundred years has seen significant periods when both nations were closed to the rest of the world. Meyer argues that this has brought about a shared consciousness, especially in Japan, where the unsaid but implied part of communication can be as important as, or more important than the words physically spoken. Contrasted with this are the sources of English language, young and immigrant nations such as America in particular, with its "melting-pot" diversity of ethnicities, is the archetypal low-context culture where oral communications have a strong tendency to be taken at face value.

Littlewood (2001, pp 4-6) outlined three perspectives: Collectivism and Individualism, Attitudes to Authority and Motivational Orientation as the basis for his cross-cultural study of East Asian and European students' attitudes to classroom English learning, but even now the most quoted and authoritative taxonomy of cultural influences comes from Geert Hofstede (1991) who, using data from management surveys of 116,000 IBM employees in sixty six countries (McCoy, 2003, pg 1004) proposed four dimensions of culture which he claimed could be used to explain why people from different countries do things differently. These indices he titled Power Distance, Individualism – Collectivism, Masculinity - Femininity and Uncertainty Avoidance.

The first index, Power distance refers to the 'the extent to which the less powerful members of organisations accept and expect that power is distributed unequally' (Meyer, 2016, pg 121). Hofstede also extended the concept to families and other social structures, such as communities or tribes. Learners in Asian countries are generally considered to tolerate unequal power distance, and to accept that the teacher is more likely to be an authority figure than a facilitator or partner in learning.

The second; Individualism – Collectivism, indicates the degree to which people are willing to subsume their own needs and wants for the good of the group. Asian learners, who show a strong proclivity to group orientation, tend to score highly on this index.

Thirdly, the Masculinity - Femininity index refers to the degree to which *masculine* values such as performance, success and assertiveness dominate over *feminine* values like quality of life, warm personal relationships, caring and solidarity. Hofstede found learners in Asian countries showed a greater respect and favour for masculine values over feminine ones.

The fourth index, Uncertainty avoidance, specifies the degree to which people prefer structured and predictable situations over unstructured and unpredictable ones. Hofstede found that learners in Asian countries are not highly tolerant of risk and strongly tend to avoid uncertainty.

Uncertainty avoidance is a pertinent point for university students, and especially freshmen who have in the main graduated from high schools where they were not encouraged to experiment or to question the teacher and where the fear of making a mistake - drummed into them for many years - inhibited the kind of risk taking attitude required for learning a foreign language for fear of losing face.

Ho and Crookall (1995, pg 237) state that the concept of face applies to communication, in that 'one must protect the other's self-image and feelings, [in order that] he or she is not confronted directly'.

Kumaravadivelu (2003, pg 710) finds the reference to Asian cultures altogether too broad. 'It is apparent that there exists a harmful homogenisation of nearly three billion people belonging to cultures as contrasting and conflicting as Chinese, Indian, Japanese, Korean, Vietnamese, and many others – all thrown into a single cultural basket labelled Asian.' He further contends that Asians do not have passivity all to themselves: 'the classroom behavioural profile attributed to Asian students is not confined to them alone; it can be seen among mainstream North American students as well'.

Perhaps it is best to view cultural influences on learning as tendencies rather than certainties, as

helpful rather than indicative. The truth for specific learners in specific communities is likely to be more nuanced and less deterministic; influenced by physical (climatic, geographic, genetic) factors as much as cultural ones.

Even so, Hofstede's analysis probably carries some weight in that his surveys were conducted with IBM employees throughout the world. Pilots and IBM systems analysts share some important characteristics, including that they are typically:

- Tertiary educated,
- Practical and problem oriented,
- Accustomed to working under pressure,
- Accustomed to responsibility.

4. Method of research

4.1 Participants

Selection of participants was based on convenience or opportunity sampling which as Dörnyei (2007, pp 98-99) explains is 'the most common sample type in L2 research'. The most important criterion is the convenience of the researcher; participants are chosen 'if they meet certain practical criteria, such as geographical proximity, availability at a certain time, easy accessibility or the willingness to volunteer'.

With software so freshly developed, there are always going to be "teething problems", and I deduced that participants needed to be risk-takers who would not be put off or discouraged by occasional vagaries or faults in the software. I explained that it was AI-based, lacking human discernment. As such its voice recognition could not be expected to be 100% accurate, and there were times when even I couldn't get it to recognise a particular word and I'm a native speaker! In the software demonstrations, I believe it was reassuring for the students to see that I wasn't always 100% correct.

Four groups of students (total eight, later expanded to nine) were selected by convenience sampling. The first group consisted of two male second year students (21TA) from the first cohort imminently leaving for studies in the US.

The second group consisted of two male second year students (21TA) from the second cohort leaving for the US in the autumn semester, 2022. This was later expanded to three when another student asked to join the program.

The third group consisted of two male third year students (20TA) who had recently returned from the US and were about to commence Commercial Pilot Licence (CPL) training at Saga airport in Japan.

The fourth group comprised two female third year students (20TA) who also had recently returned from the US and were about to commence CPL training in Kagoshima airport in Japan.

4.2 Materials

4.2.1 Software

Fully functioning copies of ARSim were provided to the school by the software publisher and technical support provided by Mr. Muharram Mane, who also suppported me with online training and

guidance in how to use the Dashboard.

For the purpose of localising the training, the software publisher added a number of Kyushu airports to the database with which our pilot students are familiar, in that they often fly to them either in real aircraft or, more frequently, on a Flight Training Device (FTD).

- Kagoshima (RJFK)
- Nagasaki (RJFU)
- Fukuoka (RJFF)
- Miyazaki (RJFM)
- Saga (RJFS)
- Kumamoto (RJFT)

ARSim is designed to be a resource to help trainee pilots learn to use Aviation English (also known as “standard phraseology”), especially in communications with ATC for purposes such as getting clearance to taxi, take-off, enter and leave airspaces, approach and landing, an area of difficulty for trainee pilots, regardless of whether they are English NS (Native Speakers) or ESL (English as a Second Language) speakers.

4.2.2 Interactivity

A brief overview of how the software interacts with the user is appropriate.

The software is structured into modules for

- TRAINER,
- BASICS,
- VFR,
- IFR and
- FLY.

Fig 2: Trainer mode main screen

TRAINER in turn is divided into twenty levels with four stage checks, which rehearses the student in identification and production of a wide range of standard phraseology and usage. Levels 1 and 2 are relatively simple: instructing the student in numeric information; altitudes, distances, headings, runway orientation.

There are four lessons at each level. Level 1 tests the student’s ability to identify and pronounce numerical information, from two digits (distances) to five digit (frequencies).

Fig 3: Say the number

Selecting Level 1 Distances, the first lesson requires the student to identify the number using aviation terminology, in this case “one zero” (and not “ten”).

4.2.3 Feedback

The student uses the microphone to record their response, which is analysed by the NLP system, and feedback presented on a continuum from 0 to 100.

Where the student identifies the correct prompt and pronounces it within accepted boundaries, the software responds with 100% feedback.

Fig 4: Partial success

In this instance, the student pronounced "one" correctly, but failed to produce a recognizable "zero", as is revealed in feedback on the following screen.

Fig 5: Keyword feedback

ARSim identifies the correct and incorrect digits and prompts the student to tap a (red) word for the option to hear it spoken by the software (speaker icon).

In that ARSim is an AI system based on a learning heuristic, it is constantly constructing a model of the student's voice and its accuracy improves over time. Students may *Mark As Correct* a word or words, which helps the software learn their voice. In the training, I suggested this as a last resort – to be used if a specific numeral or piece of vocabulary had been marked correctly previously, but now perhaps due to subtle changes in the student's voice (eg. due to sore throat), or the learning environment (incipient noise etc.) was now being flagged as inaccurate.

Fig 6: Students may Mark As Correct

The lessons in Level 3 are significantly more complex, and this level is the first opportunity for the student to produce rateable well-formed requests to ATC, for permission to taxi out and permission to take off at origin, for permission to land (enter) and permission to taxi in at destination.

Fig 7: Student's aircraft "at ramp" at Isla Grande airport.

The student is given a scenario: they are "at ramp" and are required to produce a clearance request to ATC for VFR flight. All required information, such as the aircraft identification, ATC location and ATIS update version are displayed on screen. The student is required to use the information to make a valid request to ATC.

The student's response is assessed for appropriacy against a correct response.

Fig 8: ARSim can suggest an appropriate response

By pressing the RES button, the student can view an appropriate answer, which they can then read verbatim. I suggested to students to use this function sparingly and to make every effort to produce well-formed ATC requests.

Fig 9: Structured feedback on ATC communications

Given the difficulty for students in making well-formed ATC communications, the Keywords Feedback screen is very helpful to the student in differentiating and identifying the items of information they need to produce, and the order in which they need to produce them.

The structured Keywords Feedback prompts the students to formulate responses to:

- Who you are talking to (which branch of ATC and in which location)
- Who you are (your aircraft identification)
- Where you are (if airborne, what is your altitude, heading, direction and distance from ATC), and
- What you want (the nature of your request).

These four separate items of information make up the bulk of routine ATC communications and learning their structure and order gives the trainee pilot real assistance in developing fluency in ATC communications.

For the purposes of the research project, the participants were asked to invest time in the TRAINER mode. The software itself also includes BASICS and VFR (Visual Flight Rule) sections, which reinforce and add complexity to what is introduced in the TRAINER section. IFR

(Instrument Flight Rules) is beyond the scope of the trainees and not used at this level, though the opportunity certainly exists to test it with senior students who have completed their Commercial Pilots Licence (CPL). FLY mode offers the student to choose an origin and destination airport, and to perform the entire range of ATC communications from taxiing out at origin, takeoff, cruising, approach, landing and taxiing at destination.

4.2.3 Hardware

Pilot trainees at Dai-Ichi Institute of Technology use iPads or laptops for their studies and most of the common flight manuals and instruction books are in PDF or e-book format. All research participants used an iPad, though the software also runs on Android and a web version is available for Microsoft Windows.

5. Procedure

Having sought and accepted volunteers for the project, I invited them in groups of two and three to my office for initial demonstrations which lasted between 45 minutes to one hour. I asked students to bring their iPads with them and ensured that installations and logins were completed successfully and that there were no problems with the microphones.

I demonstrated the TRAINING section, testing the voice recognition on their equipment and showing how its sensitivity could be adjusted to suit a non-native voice.

If the student still appeared interested in the software at this point, I allocated an Institutional licence which gave them access to the complete ARSim software suite. All students chose to continue.

Initially there were teething problems on some iPads where, due to a recent iOS upgrade, the navigation menu failed to scroll and was concealing the TRAINER, BASICS, VFR, IFR and FLY buttons at the bottom of screen, rendering the software almost unusable. However, the publisher quickly rolled out an update which appeared to resolve the issue.

We also checked Settings and saw how to set English Proficiency to Limited (instead of Intermediate or Advanced), and to set the phraseology standard to ICAO instead of FAA.

The participants' task initially was to work through TRAINER, before progressing to BASICS and VFR; to note any difficulties (and successes) and to keep me informed of their progress.

6. Results

I gathered results through three methods,

- Observation,
- Face to face and online (SNS) discussions, and
- An online Google Forms survey.

The survey was anonymous and gathered no email addresses, so that I could not know who had responded or what they had stated. This is an important consideration for ensuring students feel free to be honest, and not constrained by concerns about their teacher's "saving face" or the threat of reprisals. I received responses from eight of nine participants. The first question asked the participants to rate ARSim with respect to vocabulary learning, from 1 (not helpful) to 5 (very helpful).

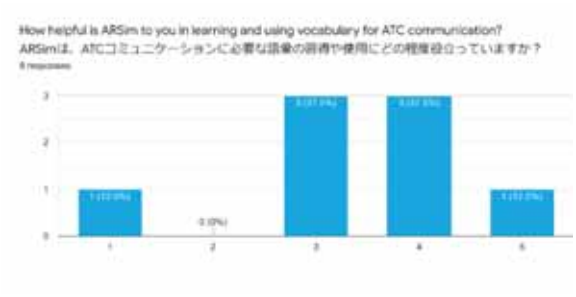


Fig 10: Learning and using aviation vocabulary

Seven of eight respondents rated ARSim at least moderately helpful. The software assesses pronunciation but not definitions or understanding of the terminology, though of course many of the terms will form part of subsequent ATC communications.

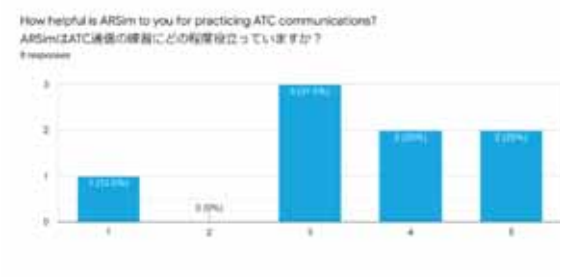


Fig 11: Practicing ATC communications

Again seven of eight respondents (87.5%) rated ARSim at least moderately helpful in practicing ATC communications, and two (25%) rated it very highly. Its ability to assist with ATC communications is an important part of the software's "raison d'etre" and forms the bulk of its marketing message.

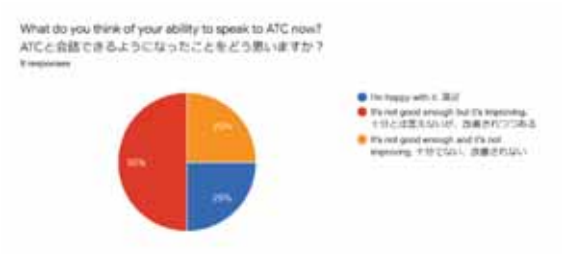


Fig 12: Your ability to communicate with ATC

Six of eight participants (75%) found ARSim helpful in developing their ability to communicate with ATC. However, two (25%) were disappointed at their progress.

The following question asked participants to rate ARSim with respect to its recognition of their voice, on a scale from 1 (never) to 5 (all the time).

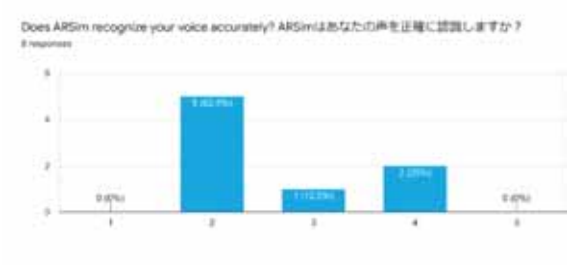


Fig 13: Voice recognized accurately?

Five of eight respondents (62.5%) rated ARSim below average in its voice recognition, and this was supported by many of the written comments. This is a concern, which highlights more work possibly needing to be done in the NLP.

The following question asked respondents to specify the areas in which ARSim was beneficial to their learning. It was possible to choose more than one answer, and twelve options were recorded by the eight respondents.

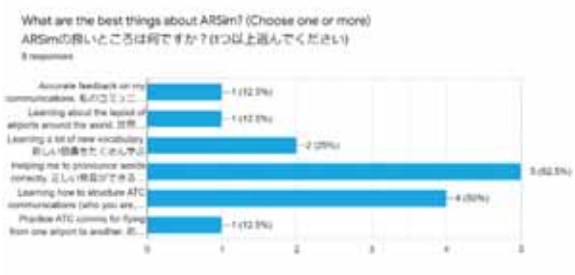


Fig 14: Advantages of ARSim

Assistance toward more accurate pronunciation was cited by five of eight (62.5%) respondents, while assistance in learning how to structure ATC communications was cited by four (50).

The following question asked what problems the

participants had with the ARSim software. It was possible to choose more than one answer, and eleven options were recorded by the eight respondents.

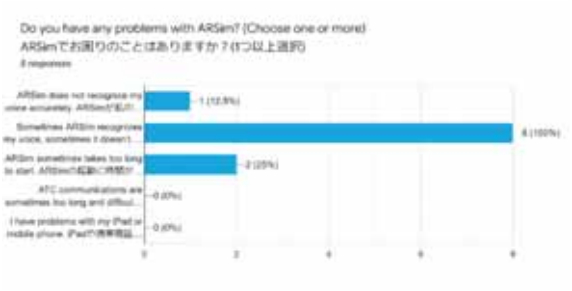


Fig 15: Problems with ARSim

Consistent with the concerns over voice recognition, all eight respondents (100%) stated that the software was at least inconsistent with respect to recognising their voice. Two respondents (25%) stated that the software at times took too long to start.

Fig 16: Is ARSim useful to trainee pilots?

The final question asked respondents if they felt ARSim was a useful addition to the pilot training course. Five of eight respondents (62.5%) replied that they believed it very useful and deserving of being included in the curriculum. Two respondents (25%) believed it should be an optional resource. One (12.5%) was unsupportive of its use in the curriculum.

7. Achievement

Despite issues of pronunciation and the voice recognition difficulties reported by the students, the nine participants nevertheless averaged over 80% accuracy over the extent of their exposure to ARSim.

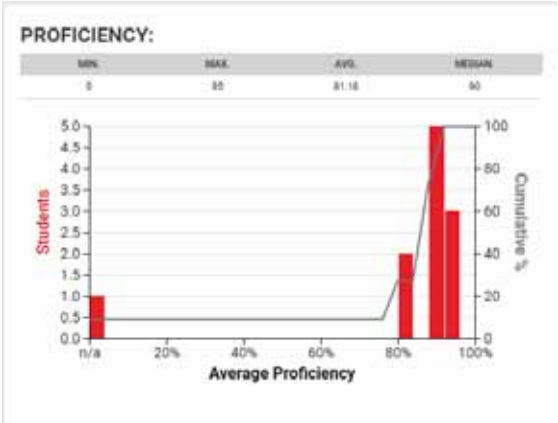


Fig 17: Average Proficiency of the participants.

Mean proficiency was actually higher, at 90%, which translates to Radio Proficiency Level 6 (RPL 6) on a scale of 1 to 6, where RPL 4 (70%) is the performance threshold required to advance to higher levels.

Students are given multiple attempts at each level and the ARSim software records their best effort.

8. Discussion

All but one of the participants reported some level of satisfaction with the software, though for six of the nine participants, the amount of time they were able to invest in it was impacted by the requirements of actual flight training in the US and in Japan. One commented that “I’m worried that I didn’t work on it much because I was busy with my training in the US.”

One of the participants in the 21TA group used the software frequently and reported great success and satisfaction with it. He was quoted as saying “I think it is perfect for first year students, before they go to the United States. The information is quite general though; every airport has its own patterns and procedures.”

Though the sample was small and the research

period for many of the participants was impacted by their studies in the US, I believe RQ1 was answered in the affirmative, notwithstanding concerns about the software's voice recognition. Participants were able to navigate the software and to use it at their own speed and in their own time, with minimal direction from me. It proved to be an appropriate resource for Informal and Self-Directed Learning (SDL).

Participants noted ARSim's contribution to their understanding of the "grammar" of ATC communications and, despite difficulties with voice recognition, participants frequently mentioned improvements in their pronunciation. The voice recognition is quite nuanced and particular about /l/ and /r/ sounds, an area of genuine difficulty for Japanese L2 speakers according to Ueno and Yamane (2020, pg 172). For instance the word "ramp" was recognised provided the participant took care to pronounce the /r/, whereas a response sounding like "lamp" was flagged as incorrect.

The same was true of English words with consonant endings, to which Japanese L2 English speakers frequently add an extra syllable, such that the two syllable word "down`wind" is pronounced in three syllables as "down`win`do". The latter was not recognised (appropriately) by ARSim and participants were required to reflect on their pronunciation.

For these reasons, it can be concluded that participants benefited from exposure to ARSim and RQ2 can also be said to be answered in the affirmative, though research over a longer period and with larger cohorts is certainly warranted, as is more careful reflection on the part of the researcher as to how to introduce the software and support it over a longer period.

The current research was heavily time and resource-limited. It primarily took place between January and April of 2022, (though some participants are still using the software.) which was probably poor timing for those in 21TA who needed to turn their attention to PPL training in the United States, and those in 20TA CPL training in Saga and Miyagi in Japan. The participants who were able to devote most time to it were the 21TA students in the second cohort of US trainees, and it is these students who have recorded the highest training times and the farthest progress into the software.

It will be encouraging if their persistence pays off and they achieve greater fluency in their ATC communications as they undergo FTD training prior to departure to the United States. If that is the case, then the research will have proved its worth.

9. Further research

More aspects of the software are deserving of research than what was possible in the limited time frame.

BASICS, VFR and FLY could be implemented over a year's course, with sections such as Vocabulary and Phonetic Alphabet of direct relevance to first year aviation students.

IFR could be implemented with third and fourth year students who have passed the PPL and CPL qualifications. IFR rating is a requirement for entry into the domestic passenger aviation sector.

10.Notes

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