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PHONETIC AND PHONOLOGY STUDY: AVIATION SAFETY IS ON THE TIP OF THE TONGUE

Didik Agus Suryono[1], Hamzah *A.* Machmoed[2], *Burhanuddin Arafah*[3], *Seli Marlina Raja Leba*[4], *Rezky Uspayanti*[5]

[1.2.3]English Language Studies, Postgraduate Program,

Faculty of Cultural Sciences, Hasanuddin University, Makassar of Indonesia

[4.5]Faculty of Teacher Training and Education

University of Musamus, Merauke, Papua, Indonesia

[1]didik.atc@gmail.com, [2]hmzmachmoed@yahoo.com, [3]burhan-arafah@unhas.ac.id,

[4]selly@unmus.ac.id, [5]rezky05@unmus.ac.id

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ABSTRACT

A large number of researches had been conducted in the subject of phonetic and phonology, yet none of them had given a special concern on waypoint pronunciation. This research was aimed to understand the consideration of phonetic and phonology in aviation industry especially in air-ground communication. This research was also aimed to provide any possible solutions to solve air-ground communication problem in terms of sound and spelling. Air-ground communication is so important that miscommunication should be anticipated. Miscommunication in air-ground communication may result a serious incident or accident. A smooth air-ground communication will automatically promote the safe and efficient conduct of flight. The research had found that there was a lack of awareness in English sound and spelling within air traffic controllers in Makassar Air Traffic Service Center. There are some factors which have resulted the condition such as the absence of sound and spelling subject in the syllabus of the initial ATC training. Another factor is the absence of labio-dental fricative sounds in Indonesian local language.

INTRODUCTION

Air traffic controller (henceforth ATC) in Makassar Air Traffic Service Center (henceforth MATSC), just like the other air traffic controller in the world, is

responsible for the safe and efficient conduct of flight within its jurisdiction airspace [1]. MATSC handle flights in almost two third of Indonesian airspace which is known as Ujung Pandang Flight Information Region (hereafter FIR). The FIR is divided into nine sectors to distribute a fair workload the ATC. Voice-over radio communication and Controller Pilot Data Link Communication (CPDLC), a text based communication, have been employed to meet the responsibility. Both media are used interchangeably depend on the situation.

In most cases voice-over radio has become primary means of communication because of its simplicity. The reason is that voice communication has more flexibility for a rapid exchange of communication compared to the text based communication. CPDLC will only take over the primary means when the flight is beyond the radio coverage. Indeed, a study has shown that the usage of CPDLC has put ATC communication in risky situation. Without being detected by authorized ATC, there is a possibility for unauthorized person to send an ATC like instruction to the flying pilot using CPDLC [2].

ATC services cover almost all flight activities started from departure phase at the airport of origin, en-route phase and arrival phase at the destination airport. A smooth information exchange between ATC and pilot is a must within all flight phases, without which incident or accident can occur unpredictably which may endanger flight crews and all flight occupants. Miscommunication between ATC and pilot shall be avoided, thus communication between ATC and pilot is highly structured.

Besides its simplicity, unfortunately, voice-over radio has its own typical weaknesses which will lead to miscommunication. Most of the miscommunications are contributed by human factor. As a matter of fact that interaction between ATC and pilot involve a vast possibility of communication participants, Native English speaker or Non Native English Speaker with various L1 background. This is a great challenge to conduct a successful air-ground communication where linguistic feature such as pronunciation, especially phonology, do take effect [3].

In linguistic, vocabulary is considered as one of micro skills. It is called micro skill as its role is very important to link the four skills of language they are reading, listening, writing and speaking. In order to be able to communicate effectively, it is required that someone have to be able to acquire and develop his/her vocabulary knowledge, this includes vocabulary size and vocabulary depth. Vocabulary size is about the number of words are being memorized, and vocabulary depth is about someone's ability to utilize the words e.g. the word's pronunciation (phonology) [4]. The knowledge of phonology is inevitably important to aviation English to ensure the effective communication is conducted in air ground communication.

A preliminary research, as a reaction to some miscommunications involving waypoint pronunciation in MATSC, has revealed that at average 29% of turns taking between ATC and pilot conversation contain waypoint information. For safety reason, the pronunciation of waypoint is worth attention as it is quite

often to cause some miscommunications. An organization has to be able to identify and anticipate any kind hazards so that they will not impact the safe operation of the organization.

LITERATURE REVIEW

Air ground communication is unique. ATC and pilot do not know each other personally but they are bonded with a strong relationship and trust [5]. Air ground communication is conducted without the presence of visual clues for example gestures and mimic. In communication, sometime the presence of gestures and mimic may help communication better. Visual clue so important that, in text communication, inability to catch the gestures, emoji is often being utilized to express communication participant's feeling [6] [7].

Indonesia has decided to use English language to provide air traffic services. It is seems that this option were taken based on the capability of Indonesian citizen. English has become a compulsory subject at Indonesian schools [8]. Unfortunately, English sounds and spelling are not well taught from the early age of school. A study on the need analysis to conduct an English training has shown that without a good analysis a learning process will not gain its goal [9][10]. This is probably because only limited number of people which has a combined knowledge of linguistic with aviation skill who teach aviation English. When the teacher has a limited knowledge on aviation then only general English will be taught to student, in other word, student will cannot learn when a teacher does not understand the material [11].

International Civil Aviation Organization (henceforth ICAO) has provide a recommended level of English proficiency within ATCs. ATCs have to show their capability in vocabulary, pronunciation, structure, comprehension, speaking and interaction, at least, a certain level called level four. ATCs have to be trained to meet the criteria. There are a lot of training conducted to train ATCs in English language including English for specific purposes, yet some ATCs are still anxious when they are faced to an unexpected situation that make them use plain English language. A study on anxiety has shown that a good speaker without feeling anxiety needs an appropriate learning process [12]. Another study on English for Specific Purpose has revealed that the subject of English for Specific Purpose cannot develop students speaking ability [13].

RESEARCH APPROACH

This research has found the presence of problematic waypoint pronunciations in MATSC which have resulted miscommunication. Fortunately, there still no serious consequence so far but the increasing ATC workload. Researcher has immersed himself to the operational activities in MATSC to understand the phenomenon and to provide suitable recommendation. This is seen by researcher to be the best approach and that the recommendation of this research will be well accepted by operational of MATSC. To understand more about the background, some literature reading regarding waypoint pronunciation and assignment have been conducted. The reading includes ICAO documents and some later works of researcher in the field of linguistics.

METHOD

This research applied a mixed quantitative and qualitative research. Data were taken from two resources such as voice recording facility in MATSC, interviews with two informants and twenty active ATC. Recorded voice data were analyzed to understand the frequency of waypoint pronunciation in ATC-pilot communication. Interviews with twenty active ATC have provided an understanding to researcher on the ATC awareness and understanding to English sound and spelling system. Interviews with experienced ATC and pilot have provided an understanding to researcher on the expert perspectives to the ongoing problems. After analyzing all of the data, researcher has made an interpretation and conclusion, and from here, provide suggestions to all stake holders.

FINDINGS

A step further to the analysis, interviews had been conducted by involving two informants which were seen as experts in their own profession. Those two informants are holding experience of more than twenty years in their field. One of the informant is an active air traffic controller who also has a role as supervisor, OJT instructor and ATC check controller in MATSC (hereafter called ATC informant). The other informant is a retired pilot with more than 25.800 hours of flying experience with multiple aircraft ratings in multi-national airlines. He is also an active instrument pilot instructor in a flight training institution (hereafter called pilot informant). To have a deeper understanding on the situation of MATSC operational room, twenty experienced controllers with valid license and rating were also involved in the interview.

Both ATC informant and pilot informant had listened to the tapes of ATC and pilot communication before the interview. They were interviewed separately to avoid the opportunity of influencing each other's opinion. ATC informant was interviewed face to face and the pilot informant was interviewed by phone conference.

According to ATC informant, waypoint has become one of the most frequent topic being exchanged in air ground communication. Although all of ATC in MATSC hold a valid standard level of English proficiency, yet most of them do not seem to understand a complete knowledge of English phonetic and phonology. This condition may lead ATC to mispronounce waypoint or misunderstands pilot's waypoint pronunciation.

According to pilot informant, like a pilot, an ATC has to have their own strategy to anticipate the miscommunication caused by waypoint pronunciation. Unfortunately, he continued, the strategy of anticipating miscommunication in waypoint pronunciation is very much dependent on his/her experience. An experienced controller, who has been exposed to many conversations involving pilots with many different background may have a better strategy or pattern to handle such miscommunication caused by waypoint pronunciation. An example of his experience was when he flew to Europe, crossing two FIRs, France and Spain with their mutual waypoint "NANTES". A France ATC will normally pronounce /nɔŋt/ for the NANTES and it is contrary to how Spain controller pronounce it as /nʌntes/. There was a

moment of confusion on the conversation and pilot needed to do some strategy to clarify the waypoint uttered by the France ATC. Fortunately it was not a peak hour so that communication was possible for clarification and found the correct waypoint meant by ATC.

Both ATC informant and pilot informant agreed that a failure to exchange waypoint to another may cause fatal incident or accident. Especially when one of the communication participant hesitates to make a confirmation and just execute maneuver to a specific waypoint which he thinks the right one and in fact it is a wrong waypoint. This may lead to break down the standard separation minima of the aircraft.

Interview with twenty licensed air traffic controllers had revealed that almost all of them were aware of the difference between Indonesian spelling system and English spelling system. Yet they only have limited knowledge on English spelling rule. Air traffic controllers usually pronounce waypoint based on what is seen on their radar display and using Indonesian spelling system. Because the customers are coming from various background around the world, hence this condition leads to cause miscommunication. According to their experience, there are some waypoints that they have marked as problematic waypoints. The issues is in the variation of possible pronunciation of the waypoint. Some problematic waypoints and their possible pronunciation can be seen in **Table 1**.

Table 1. Waypoints and its varying pronunciation

Waypoints	**Variation 1**	**Pronunciation Variation 2**	**Variation 3**
BUTPA	/bʊtpʌ/	/ bʊptʌ/	/bʌtpə/
CAHYO	/ʧʌhjɔ/	/kæhjɔ/	-
CUCUT	/ʧʊtʃʊt/	/kjʊkʌt/	/k^hʊk^hʊt/
ELANG	/əlʌŋ/	/ɪlæŋ/	-
EMIRE	/emɪre/	/ɪmaɪə/	-
KECOA	/kətʃoʌ/	/k^hekoʌ/	-
KEONE	/keɔne/	/kɪɔnɪ:/	/kɪwʌn/
KEVOK	/kefɔk/	/kɪvɔk/	-
NYOMA	/ɲomʌ/	/njomʌ/	/naiomʌ/
SAMGE	/sʌmge/	/sæmdʒɪ/	/sæmɪdʒ/
SINGA	/sɪŋʌ/	/sɪŋgʌ/	/sɪndʒʌ/
TAVIP	/tafɪp/	/tævɪp/	-

In the interview, it was also asked ATC's English performance level and cultural background. It was found that all interview participant were at a standard level of English proficiency and above. The questions also found out that air traffic controllers were coming from various provinces of Indonesia so they have different mother tongue.

DISCUSSION

According to the research finding, there are some topics that can be discussed to satisfy the research goals. Those topics include the current condition of air-

ground communication in MATSC, the contribution of waypoint pronunciation to the safe and efficient conduct of flight, and items which will be promoted as the solutions of the problem.

Based on the first finding that waypoint pronunciation is very much becoming a topic of air-ground communication, it cannot be treated as trivial matters. In some normal occasions, a failure to exchange waypoint will only result an inconvenient to both communication participants, yet in a busy period the result will be more unpredictable. This condition is well illustrated in figure 1. By looking at the result of interviews involving twenty ATCs, it can be seen that some waypoints are problematic by their pronunciation. The absence of standardized pronunciation system is seen as the main cause of this problem. Procedure designers in Indonesia tend to assign a name to waypoint based on Indonesian reading convention and disregarding the costumers which will utilize waypoints may come from various countries.

A further literature review by researcher has shown that Indonesian people are not accustomed to differ voiced labio-dental fricative [v] sound and voiceless [f] labio-dental fricative sound by nature. It is well understood that all Indonesian local language, as most ATC L1, do not have labio-dental fricative sound. It can be seen on figure 2 and figure 3. The absence of both voiced and non-voiced labio-dental fricative voices in Indonesian local languages is seems to be the cause of most all ATC in MATSC for not correctly pronouncing waypoints with voiced labio-dental fricative sound. The lack of this particular can be viewed through the examples of local alphabet transcriptions below.

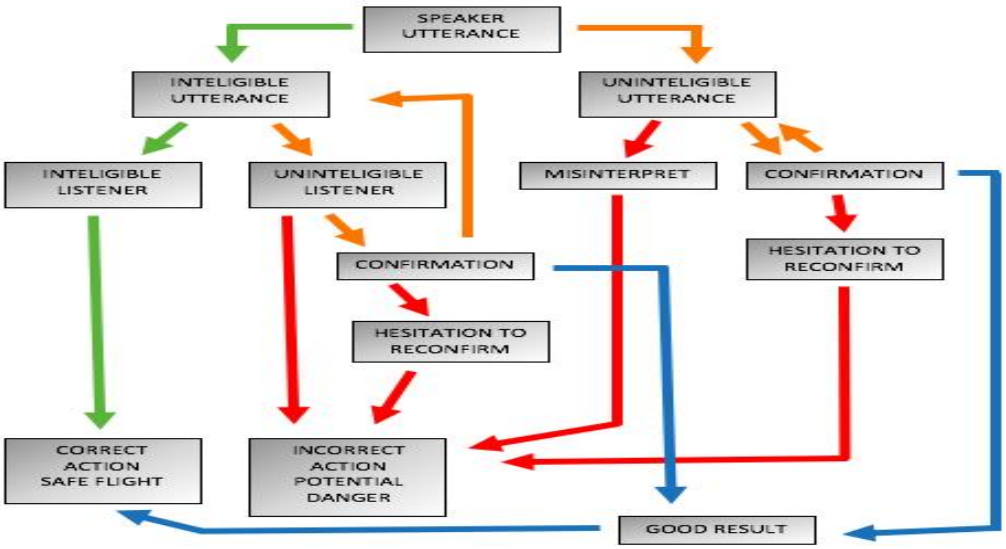

Figure 1. Conceptual Frame Work

Figure 2. Javanese Local Transcription

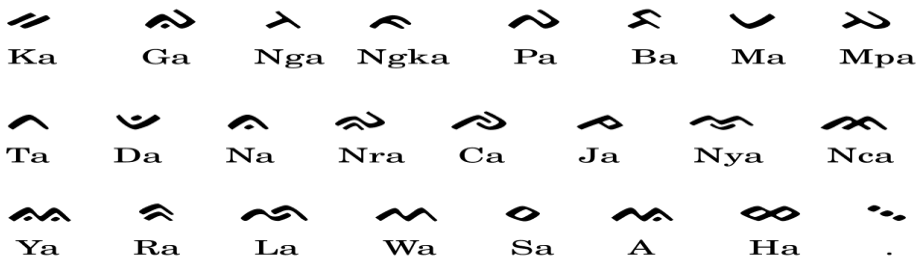

Figure 3. Makassarese Local Transcription

In English language, voiced labio-dental fricative sound and voiceless labio-dental fricative sound belong to different phonemes, so that these two sounds create different meaning. There are some pairs of words in English language which clearly differ these two sounds such as fan and van, fault and vault, fast and vast, safe and save etc. A failure to pronounce voiced labio-dental fricative sound by ATC in MATSC in a waypoint pronunciation, of course, will lead an English speaking pilot to expect the presence of the letter "f" in the waypoint name in communication.

Beside a problematic labio-dental fricative sound mentioned above, another set of problem in communicating waypoint in MATSC is the absence of knowledge within air traffic controller on English spelling rules. This is the reason why miscommunications occur in the field regarding the spelling of waypoints. There are some variant of pronunciations for a single waypoint. According to communication theories, such as Ferdinand de Saussure theory, that to conduct a successful communication, all of the communication participants have to share the same knowledge of language. This means that they have to share the same code and spelling convention. A different code utilized by a speaker may not be understood by listener. For example, in Indonesian language spelling the letter "c" has a constant sound of voiceless retroflex affricate /t͡ʂ/, while in English the letter "c" has three sounds depend on what letter is following the letter. In English the letter "c" will have /s/ sound when followed by letter "i", "e", or "y" and it will have /k/ sound when followed by letters other than that mentioned, and it will have /tʃ/ sound when followed by letter "h". Likewise, the letter "g" also has two sounds of /g/ and /dʒ/ depend on what letter following the letter "g", while in Indonesian spelling the letter "g" has a constant sound of /g/. Furthermore, Indonesian

language does not have long vowels, so diphthongization is never been constructed by a single vowel.

Based on the interview result, all of ATC in MATSC have not received the knowledge of English spelling subject from their formal school, including in their aviation academy. This condition is contrary to the fact that aviation language used in Indonesia is Aviation English. The absence of English sound and spelling knowledge raise the opportunity of waypoints to be pronounced differently and lead to misunderstanding and miscommunication.

There are three other principles are dedicated to phonetic features in Aviation English, as follows: avoiding words and phrases which are prone to be influenced by differences of pronunciation; using phrases proven by experience to be phonetically suitable; and avoiding words containing sounds or syllabic constructions that are difficult for non-native English speakers to pronounce [14]. By looking at the finding of the research, the mispronunciation of waypoint has a high opportunity to occur in MATSC.

There are some strategy which are offered by this research to overcome the problems. One of the solution is to follow pilot informant suggestion regarding ATC strategy to avoid a lengthy conversation on waypoints confirmation and clarification. Instead of having a modification to the pronunciation of waypoint, which has no guarantee that this will be directly understood by pilot, an ATC should spell the waypoint by utilizing aviation phonetic alphabet as soon as the first attempt of pilot to confirm the waypoint. Unfortunately, this strategy contradicts with ICAO (2016) policy which is said that the use of phonetic spelling should be dispensed with in order to expedite the process of communication. But for the sake of flight safety, this strategy is worth trying.

So far, aviation authorities have provided a pronunciation guidance to their waypoints, as seen on table 2 and table 3. Yet, the guidance is still prone to be misunderstood and, again, depend on reader's spelling convention. Still in the attempt of having standardized pronunciation to avoid miscommunication, researcher sees that there is an opportunity to utilize International Phonetic Alphabet (henceforth IPA) which has proven itself in accommodating foreign language learners to understand sound and spelling of their targeted language. IPA is widely adopted by dictionaries around the world to guide pronunciation

Table 2. Pronunciation guidance by Thailand in a NOTAM

Waypoint	**Pronunciation**	**Waypoint**	**Pronunciation**
ALBOS	AL BOSS	BAROK	BAH ROK
BATOK	BAH TOK	BLUES	BLUES
BONVO	BONG VOH	CONGA	KONG GAH
CORUS	KOR RUSS	JROCK	JAY ROCK
DOLNI	DOL NEE	LATIN	LAH TIN
ENKAA	ENN KAH	OSUKA	OH SOO KAH
FUNKY	FUNG KEE	INNDY	IN DEE
KASNI	KAS NEE	LEBIM	LAY BIM

Table 3. Pronunciation guidance by Indonesia in AIP

Phrases	**Pronunciation**
CALL SIGN	KOL SA-IN
WILCO	VILL-KO
CAN NOT	KANN NOTT
REPEAT	REE-PEET
AM LOST	AM LOST
MAYDAY	MAYDAY
HIJACK	HI - JACK
LAND	LAAND

CONCLUSION AND SUGGESTION

The waypoint pronunciation is an important part which is worth having special attention in providing air traffic service to promote the higher level of flight safety. The fact that waypoint is transmitted frequently in the communication to give direction to pilot and less English spelling knowledge within ATC in MATSC has create an urgency to overcome the situation. By looking back at Reason's theory that an organizational accident maybe triggered by things that are sometime considered as trivial yet the consequences are unmeasurable, waypoint pronunciation cannot be treated as unimportant thing.

ATC's knowledge on English sound and spelling has a direct impact to the accuracy of pronunciation, this includes waypoint pronunciation. Because the aviation language used in Indonesia is English, all waypoint should be pronounced according to English convention. The lack of educational material on English sound and spelling and supported by the absence of labio-dental fricative sound both voiced and voiceless [f, v] in ATC's L1 have made the opportunity of mispronunciation bigger.

Air-ground communication is the primary means of communication utilized by air traffic service unit to provide the service to its customers. It is expected that the exchange of information will run smoothly to maintain an orderly flow of air traffic. An interrupted communication process may create a difficult situation which will interfere flight safety. Hence, ensuring the exchange of waypoint information between ATC and pilot to be unproblematic will become an effort to at least minimize the opportunity of miscommunication to occur. By minimizing the opportunity of miscommunication, it will automatically promote the regularity and safety of air traffics.

The main point is that ATC personnel have to realize that each phonetic feature relates to each other and describe the sound produced. Determination of how the articulation of the various sounds of language to make alphabet phonetic has been done by experts making it easier for someone to learn and pronounce sounds that do not exist in their mother tongue. For example, in

English there is a significant difference between the sounds of tin and thin, and between they and day, while in Indonesia is not. By studying English phonetics, ATC attendances will be able to pronounce the two sounds correctly. The researcher point here is that error in connecting error analysis to prove that the error occurred since there is no phonetic similarity in both languages.

After analyzing the data and finishing the research, there are some suggestion as an output of this research to some parties as follows:

a. Directorate General of Civil Aviation of Indonesia

It is suggested that DGCA as Indonesian authority to provide a standard and guidance in assigning waypoint name as well as providing a standard to read a waypoint. This is to ensure that all waypoint users will not face any difficulties in exchanging it.

b. ICAO

It is suggested that ICAO will have a review to its document, especially Annex 10 Volume II Communication Procedures Including those with PANS Status - Seventh Edition. ICAO, 2016, 5-9. This is to ensure ATC to have their own strategy in solving the waypoint exchange problem.

It is also suggested that ICAO will have guidance or recommendation regarding an assignment of waypoint name (5LNC) to consider local linguistic limitation or restriction so that waypoint name will not interfere the process of air-ground communication.

c. Air Navigation Service Providers

This research maybe transferable to other ATS unit, it is suggested that the similar effort to recognize local limitations are considered to assign waypoint name to avoid miscommunication on ATS unit concerned. It is also suggested that ANSP will conduct a special training on English sound and spelling accordingly.

d. ATC and Pilot

It is encouraged to both ATCs and pilots to learn about English sound and spelling which has been widely available on the internet. This is to improve knowledge and awareness on English sound and spelling so that waypoint information will not be a problem in air-ground communication.

e. ATC and Pilot Initial Training Institution

It is suggested to training institutions for both ATC and pilot to start including a subject of English sound and spelling in their syllabus. This will improve ATC's and pilot's capability in mastering English language as well as their ability to accurately pronounce waypoints.

f. Procedure Designers

It is suggested to procedure designers to consider local language limitations in assigning waypoint name. This is to avoid a difficulty to pronounce done by either ATCs or pilots. Furthermore, it is also suggested that procedure designers to avoid assigning a similar or almost homophony names close to each other so that miscommunication can be avoided.

g. Next Researcher

For the sake of aviation safety, it is encouraged to other researchers to continue this research and make this research result as a starting point. It is also encouraged for other researchers to start their research with the same topic and adjusted with their local wisdom and condition.

REFERENCES

Barshi, E. and Farris, C. Misunderstandings in ATC Communication. Routledge. (2016)

Gurtov, A., Polishchuk, T., Wernberg, M. Controller-Pilot Data Link Communication Security Department of Computer and Information Science, Linkoping University. Multidisciplinary Digital Publishing Institute (2018)

Kim, H. and Billington, R. Pronunciation and Comprehension in English as a Lingua Franca Communication: Effect of L1 Influence in International Aviation Communication. The University of Melbourne; Oxford University Press 2016, Applied Linguistics 2016: 1-25 (2016).

Kadaruddin, Arafah, B., Djuwairiah, A., Iska. Word Wall Media: An Effective Teaching to Enrich Students' Vocabulary in Secondary Level of Education. International Journal of Advanced Science and Technology, Vol. 29, No. 5. (2020)

Nitayaphorn, P. Message from the Sky: Radiotelephony in Air-Ground Communication. Pertanika J. Soc. Sci. & Hum. 22 (S): 59 - 74 (2014)

Arafah, B. and Hasyim, M. Linguistic Functions of Emoji in Social Media Communication. Opción, Año 35, Regular No.24 558-574 (2019)

Arafah, B. and Hasyim, M. The Language of Emoji in Social Media. KnE Social Science Journal, DOI: 10.18502/kss.v3i19.4880 (2019)

Kaharuddin, A. and Arafah, B. Using Needs Analysis to Develop English Teaching Materials in Initial Speaking Skills for Indonesian College Students of English. The Turkish Online Journal of Design, Art and Communication TOJDAC Special Edition (2017)

Wutun, A.A., Arafah, B. and Yassi, A. H. Local Culture in English Language Teaching: Learners' Perspectives. International Journal of English and Education ISSN: 2278-4012, Volume:7, Issue:3 (2018)

Kaharuddin, Hikmawati, Arafah, B. Needs Analysis on English for Vocational Purpose for Students of Hospitality Department. AICLL 2019 The Second Annual International Conference on Language and Literature Volume 2019. (2019)

Sunardi, Akil, M., Arafah, B., and Salija, K. Looking at the Shared Conception of Teaching Literature in an Indonesian ELT Setting. Journal of Language Teaching and Research, Vol. 9, No. 2, pp. 316-327. (2018)

Kamridah, Yassi, A. H., Arafah, B. and Imran, N. Correlation between Level of Anxiety and Public Speaking Performance through Systematic Learning Approach in Foreign Language. International Journal of Science and Research (IJSR) Volume 5 Issue 9. (2016)

Arham, R., Yassi, A. H. and Arafah, B. The Use of Role Play to Improve Teaching Speaking. International Journal of Scientific and Research Publications, Volume 6, Issue 3. (2016)

Hole, Y., & Snehal, P. & Bhaskar, M. (2018). Service marketing and quality strategies. Periodicals of engineering and natural sciences,6 (1), 182-196.

Hole, Y., & Snehal, P. (2019). The significance of pilgrimage tourism to sustainable development with special reference to the Indian context. African Journal of Hospitality, Tourism and Leisure. 8 (3), 1-11

Kim, H. 2018. What Constitutes Professional Communication in Aviation: Is Language Proficiency Enough for Testing Purposes?. Language Testing 2018, Vol. 35. (2018)