Engineering Sciences
ISSN: 1308-7231 (NWSAENS)
ID: 2019.14.4.1A0440

Status : Research Article
Received: 11.06.2019
Accepted: 10.10.2019

Kaan Koyuncu
Piri Reis University, kaankoyuncu7@gmail.com, İstanbul-Turkey
Leyla Tavacıoğlu
İstanbul Technical University, tavaciog@itu.edu.tr, İstanbul-Turkey

DOI	http://dx.doi.org/10.12739/NWSA.2019.14.4.1A0440	
ORCID ID	0000-0001-7984-692X	0000-0002-9919-8226
CORRESPODING AUTHOR	Leyla Tavacıoğlu	

USAGE OF MARITIME SIGN LANGUAGE ON BOARD

ABSTRACT

Seafarers must be able to communicate effectively in English at sea and in port to ensure the safety and security of ships, crew and passengers. International Maritime Organization (IMO) adopted English as the official language to solve the communication problems. Research shows that the usage of English by seafarers is not encouraged and they have difficulty in communicating not only among themselves but also with the outside agencies. In this paper, it is indicated that the interactions onboard are not only verbal, but also non-verbal that can be realized through Maritime Sign Language, the purpose of which is to enhance onboard communication. In addition, it aims to increase the safety on board and interaction among crew members through the usage of simplified, standardized and universalized sign language, which proves to be much more efficient in loud working environments or in the cases where verbal means of communication are inadequate. Within the scope of this research, descriptive statistics, reliability of questionnaire, ANOVA with Tukey's test for non-additivity, Hotelling's T-Squared test, Chi-Square, and Factor analysis are utilized for the interpretation and analysis of quantitative data. Therefore, quantitative research design was used through a self-reported questionnaire to collect data about the participants' sea experience, cultural factors, and verbal and non-verbal communication skills and to investigate the relation between these factors. As the result analyses conducted, the study indicates that Maritime Sign Language is beneficial for the marine language.

Keywords: Sea Language, Maritime Sign Language, SMCP, Deck, Non-Verbal

1. INTRODUCTION

Maritime language has gained great importance in the last 40 years. Especially, different maritime committees over the years have reached a common ground to introduce a language for the maritime sector, which can be understandable for both seafarers and the other agents within the maritime industry. The intention of this decision is to ensure the safety of navigation, environment protection and realization of other operational procedures. As in many other sectors all over the world, the committees decided English to be used as the operational language. At the same time, according to Ziarati et al. (2011), English is defined as a marine language at the international language level and it is used in every occasion such as ship-to-ship, ship-to-shore and among crew member [1 and 2]. English is the common language used in the sea and this is widely accepted by the maritime industry. Therewithal, an official working language for seafarers was embraced by the International Maritime Organization (IMO) in 1995.

How to Cite:
Koyuncu, K. and Tavacıoğlu, L., (2019). Usage of Maritime Sign Language on Board, Engineering Sciences (NWSAENS), 14(4):183-199, DOI: 10.12739/NWSA.2019.14.4.1A0440.

Seafarers, who are proficient in English, can carry out their occupational duties while socializing with multinational crew, which in––return, contributes to safe, secure and clean shipping while increasing the quality and efficiency of on board working environment [3].

The amendments in SOLAS emphasize the necessity of a common working language on board to ensure the safety at sea. Regulation No. 1/14 on open corporate responsibilities at STCW requires all crew members of a ship to coordinate activities effectively in an emergency situation and to have communication skills on a common ground. Following the publication of the International Maritime Organization (IMO) statistics, the communication problem became clear when it was found that 80% of marine accidents had been caused by human error and that almost half of the marine accidents had been related to the communication errors [4, 5, and 6]. By its nature, marine language must be simple, easy to understand and, most importantly, standardized to make communication easier in maritime industry. As a natural requirement of seafaring, the whole communication takes place between ships and shore stations and among the crew members on board. Efficient communication will help to prevent possible perils to vessels, persons on board as well as to the environment. An alternative to the verbal communication is the sign language, which is necessary for all seafarers for many reasons. According to the 2006 report published in UK, even though the total number of accidents showed a decrease, the accidents resulting from human errors increase, which indicates a proportional raise in the number of accidents caused by personal error [7]. Even though a common language is used, working on board can be exhausting and troublesome due to the lack of hierarchy in shipboard management and efficient decision-making process. Difficulties in communication may pose a significant challenge for the multinational crews [8], the linguistic competence development of whom is getting more and more important with the rise of globalization [9]. The ability to recognize-crew's cultural predispositions is an important factor in preventing marine accidents involving human errors. The disadvantage of having a multi-lingual crew on board is difficulty in building an effective communication. Since marine accidents are not recorded properly, total number of accidents at sea related to the lack of a common language is unknown [10].

Maritime human factor researches are typically conducted through the analysis of accident reports and they all rely on the fact that humans as operational members of a system- are prone to making errors [11]. These errors can be categorized into four groups as slips, mistakes, lapses, and violations. However, the main question is the risk level of these errors and the answer of it can be e given only after understanding the nature of tasks and assessing the level of criticality of the errors, which makes it necessary to take variables in an operation such as fatigue, environmental conditions, workload, psychological/physical state of the individuals and communication into consideration [12 and 13]. Culture consists of clear and implicit patterns of behavior gained and communicated through the symbols that constitute the concrete achievements of works of art and whose cultural element is the traditional, i.e. historically derived and chosen ideas and in particular cultural systems, which can on the other hand be thought of as the act of production and as the conditioning elements of future actions [14].

According to Ricard (1993), efficient intercultural communication is "the ability of an individual or group of people to gain insight through verbal or nonverbal exchange and intercultural

interaction". In order to reach the desired intercultural communication competency, seafarers must have well-defined skills such as valuation, observation, listening, speaking and acting. These critical skills vary according to cultural background and personal characteristics [15]. The two most important factors affecting communication are language and culture. These two barriers cannot be separated because they are influenced by each other [16]. Institutions have also significant a role in fighting against mobbing. In addition to technical trainings, institutions should also provide their personnel with trainings focusing on a variety of issues such as ethical values and behaviours in business life, communication, emotion-based relationship development, hypnotic resting, and hypnotic speech etc., which eventually increase the quality of communication [17].

2. RESEARCH SIGNIFICANCE

This study is looking for answers to the following questions:

- Does the lack of crew's communication skills in 'Maritime English' play a negative role in the occurrence of marine accidents?
- Do seafarers need to have a basic understanding of the culture of the other seafarers while working with a multinational crew?
- Do seafarers have difficulty with verbal communication?
- Would it be possible to apply maritime sign language method on board?

3. MARITIME SIGN LANGUAGE

The disadvantage of verbal maritime communication is that the multinational crew is sometimes unable to communicate effectively which may lead to management problems of personnel on board ships [18]. Many of us use forms of sign language at work. We make use of use non-verbal communication means such as gestures all the time without even noticing. Doctors and nurses in the operating table constantly use non-verbal communication as they usually wear masks and have to work in loud environments. When they aren't able to communicate through speech alone, people often will use facial expressions and indications when they need to talk to each other. The sign language is so common in the daily life that it is mostly used unconsciously [19]. It is argued that when the number of employees increases in a firm, the need for managerial support, leadership commitment and internal spreading of knowledge through verbal and non-verbal communications increases as well [20]. Hand signals are often used regardless of the language you speak on board the ship. There are universal signals for mooring operations that are used and understood worldwide. For instance; crossed forearms make fast, a vertical movement of arms by the side of the body with palms facing up-let go, vertical movement of arms in front of the body with palms down-slack away, one arm rotated above the head-heave up. Ship is a closed and complex system that involves a great deal of interaction and communication among the crew [21].

3.1. Content of the Maritime Sign Language

Support was received from sign language experts to adapt and implement the sign language to maritime. In regard with the maritime sign language, 221 sign language words/motions to be used during the operations of deck and machine space departments were created. During the selection of these words, three important criteria were taken into account;

- they are easy to recognize and understand
- they don't lead to any misunderstanding
- they will be used on board by all nations

In addition, these words were selected from Standard Marine Communication. Phrases (SMCP), which have been recommended to be taken as criteria of common working language standards to make a contribution to navigation and crew safety and environmental protection.

3.2. Limitations of the Maritime Sign Language

It is obvious that this study has limitations that may affect the outcome. The aim of this chapter is to discuss some of these limitations, which have been identified by the researcher. The limitations stated below derive from the lack of an adequate literature on the subject and cultural and linguistic barrier being the topic the study.

- Bridge communication is not included
- These study and words are suggestive, can be improved with feedback
- Only 74 words for Deck Department, 147 words for Machinery Space Operation which are chosen from the SMCP are used.

3.3. Deck Department

These words are Maritime English terms that will easily be used by all seafarers in anchorage operations, cargo handling, manoeuvring, daily deck operations, and emergency situations. Some examples are mentioned below:

Figure 1. Chain stopper

Figure 2. Anchor

The following messages can be shared via gestures during the anchor operations: Anchor at Water's Edge, Anchor Hawsed, Anchor in Sight, Drop-anchor, Heave up Anchor, Chain Stopper, Dragging, Heave up, Lower, Hold-Stop, Windlass, and Clean Tidy.

Example: In anchor operations, while we are working on noisy environment such as using windlass, we can use these words to avoid the communication problem.

Figure 3. Sounding

Figure 4. Hatch Covers

The following messages can be shared via gestures in cargo-handling operations: Bilge, Cargo Cranes, Cargo Hook, Draft, Hammer, Hatch Covers, Launch, Manhole, Sounding, Stevedore, Ventilator, Lashing, Heave up, Lower, Hold-Stop. Example: These words can be used when needed to open the hatch covers or when necessary to take sounding during the cargo handling operation.

3.4. Machinery Space Operation

These words are Maritime English terms that can effectively and easily be used by all seafarers in the noisy working environment, bunkering operations, handling operations, daily machinery operations and emergencies situations. Some examples are mentioned below:

Figure 5. Pump

Figure 6. Barge

Figure 7. Start Up

Figure 8. Leakage

The following messages can be shared via gestures in bunkering, loading and discharging operations: Avoid, Activate, Air, Alarm Panel, Absorb, Bunker, Clockwise, Ejector, Enclosed, Explosion, Fuel-Tank, Lubricant, Mixing-Tank, Plug, Poppet-Valve, Purifier, Water-tube, Start up, Sludge, Seawater, Separator, Septic-Tank, Service-Tank, Settling-Tank, Open, Crankcase, Crankcase-Pressure, Crankcase-Vacuum.

Example: These words can be used when needed to inform about the condition of operation while bunkering operation or when it is necessary to start up pump while discharging operation.

4. METHOD

4.1. Design of the Questionnaire

In this section, the methodological aspects of the research are presented. First, the design of the study is specified, and then the participants are described. Finally, the data collection procedure and data collection tools are explained. The purpose of this study is to examine the opinions of the senior cadets, Oceangoing Watchkeeping Officers, Oceangoing Watchkeeping Engineers about Maritime Sign Language who have had sea training periods or on board experiences and have sufficient knowledge about the seafaring officer education system.

4.2. Research Design

Within the scope of this research, descriptive statistics, reliability of questionnaire, ANOVA with Tukey's test for non-additivity, Hotelling's T-Squared test, Chi-Square, and Factor analysis are utilized for the interpretation and analysis of quantitative data. Therefore, quantitative research design was used through a self-reported questionnaire to collect data about the participants' sea experience, cultural factors, and verbal and non-verbal communication skills and to investigate the relation between these factors.

4.3. Participants

The participants involved in this study are the senior cadets, Oceangoing Watchkeeping Officers, Oceangoing Watchkeeping Engineers who were mostly Turkish Seafarers (Male; 317 Female; 27 n=344; age range: 19 to 30 years) who also have had sea training periods or on board experiences and have sufficient knowledge about the seafaring officer education system.

4.4. Data Collection

This quantitative research was aimed to measure and evaluate the significance of the Maritime Sign Language on board. The survey was conducted within a three-month period with 344 participants between January 2017 and March 2017. Participants were informed by showing the sign language words before the questionnaire. Leading questions were avoided; unbiased questions were preferred.

4.5. Data Collection Tools

Considering the nature of seafaring job it was very difficult to reach all seafarers and we worked with a sample because of the time and cost constraints. Simple random sampling method was used in this study. The samples were selected from students or graduated seafarers studying at Piri Reis University, Istanbul Technical University, 9 Eylül University and Karedeniz Technical University which provide maritime education in Turkey. Questionnaire is applied via face to face interview, google forms and e-mail. Research sample is

constituted of 344 seafarers from two different departments; 58.1% Deck Department 41.9% Engine Department.

4.6. Limitations

The primary limitations of this research study are as follows:

- The research questions are simple and easy to understand in order to ensure accurate interpretation of questions by seafarers.
- The study is limited to the selection of a relatively small population (n=344) compared to the total number of Turkish Seafarers who agree to participate in the research. (n=?)
- The study is mostly limited to Turkish Seafarers. (297 out of 344 are Turkish seafarers, 47 Erasmus students)

4.7. Assumptions

Two assumptions are made with respect to this study.

- All participants will answer the questionnaire truthfully.
- All participants can read and understand each question carefully and select the most appropriate answer that best describes them.

4.8. Questionnaire

Data has been collected using Likert type scales. The questionnaire was composed of 37 questions, having five options in Likert scale. These are; 1-Irrelevant, 2-Not Very Important, 3-Moderate, 4-Quite Important, 5-Essential 1-Completely Disagree, 2-Somewhat Disagree, 3-Neutral, 4-Somewhat Agree, 5-Completely Agree. 1-Impossible 2-Very Difficult 3-Moderate, 4-Fairly Easy, 5-Very Easy. The questions directed to the respondents can be examined in two categories. In the first part, questions are asked about the demographic information and sea experiences of the participants who participated inthe questionnaire. Second part, questions are about language requirements for performing duties on board communication. The questions 1-13 focus on the role of speaking more than one language on board, determining the importance of English communication in ship life and operations. Questions 14-17 are aimed to determine whether participants had difficulty in expressing themselves in English and understanding the message coming from a non-native or native English? Speaker during ship-to-ship, ship to shore or ship to third parties' verbal communication. Questions 18-21 are directed to the participants so as to learning their opinions on a ship having a multinational crew. Questions 22-25 are related to the role of communication, maritime English, and intercultural communication in maritime accidents. Questions 25-37 were asked to determine the opinions of participants about verbal communication, non-verbal communication, and maritime sign language.

5. DATA ANALYSIS AND RESULTS

5.1. Descriptive Statistics of the Participants

The departments, classes, gender, internship period and sea experiences of 344 respondents are given below. 58.1% of the respondents are deck department and 41.9% are in machinery department. Since the number of students in the deck department is always more than in the machine department, the sample used in this study is naturally shaped accordingly.

Table 1. Department of participants

	Frequency	Valid Percent
Deck	200	58.1
Machinery	144	41.9
Total	344	100.0

5.2. Reliability of the Questionnaire

In the SPSS 24 program, 37 items were entered as Likert scale using Reliability analysis and the reliability of the questionnaire was found as Cronbach's Alpha 0.911. The reliability coefficient obtained for this questionnaire of 37 questions is quite acceptable. It is a good sing that the questions were interpreted and replied similarly by all the participants, which points out to the homogeneity of the questionnaire. A reply to the questions of the homogeneity of the questionnaire is interpreted the same by everyone so that is a sign. When we look at the total correlations of the adjusted item, it is seen that it changes between 0.065 and 0.566 that is all positive.

Table 2. Reliability of the questionnaire

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.911	0.912	37

It is desired that the correlation values do not get negative values because this would be a situation that disrupts the additivity property of the scale. The general alpha coefficient is 0.911. If the alpha coefficient is increased in the case of extraction, which reduces the reliability of the questionnaire, it should be removed from the scale. If a question is removed from the scale in the same way and the alpha value falls below the overall alpha value, then the reliability decreases, which points out to the indispensability of that question for the scale.

In parallel with the above explanations, we can say that there is no question that affects the reliability coefficient negatively or, in other words, reduces the reliability of the questionnaire. Consequently, all the questions were decided to be kept in the model. As seen on the Table 4, the mean change interval for 37 questions was 1.140 and the change interval for variance was 0.548. The averages of the correlations between the implementation the mean of inter-item is 0.179, while the mininum correlation is -0.082 and the maximum correlation is 0.769.

Inter-item correlations are an important element in conducting item analysis of a set of test questions. It investigates to what extent a point's scores are related to the scores of all other points in the scale. It provides an assessment of item redundancy by putting forththe extent to which items on a scale are assessing the same content [22]. Ideally, the average inter-item correlation for a set of items should be between 0.20 and 0.40, suggesting that while the items are homogeneous at reasonable levels, they contain sufficiently unique variances that they are not isomorphic to each other.When the question groups are examined, it was seen that there is a relationship between same question groups and there is no meaningful relationship with different question groups (Table 5).

Table 3. Item-total statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
B1a	140.76	256.305	0.357	0.559	0.910
B1b	140.50	254.834	0.448	0.559	0.908
B1c	140.39	252.152	0.481	0.393	0.908
B1d	139.95	266.592	0.065	0.119	0.913
B2a	140.82	253.975	0.416	0.336	0.909
B2b	139.99	251.863	0.566	0.601	0.907
B2c	140.15	251.114	0.559	0.654	0.907
B2d	140.15	251.011	0.555	0.644	0.907
B2e	139.93	253.564	0.543	0.701	0.907
B2f	139.93	255.340	0.479	0.514	0.908
B2g	139.85	255.161	0.503	0.577	0.908
B2h	139.75	256.277	0.505	0.778	0.908
B2ı	139.76	255.503	0.537	0.786	0.907
B3a	140.63	254.269	0.546	0.517	0.907
B3b	140.89	259.244	0.328	0.327	0.910
B3c	140.62	254.662	0.512	0.486	0.907
B3d	140.65	254.869	0.474	0.461	0.908
B4a	140.60	256.982	0.412	0.402	0.909
B4b	140.51	257.137	0.402	0.401	0.909
B4c	140.75	258.169	0.324	0.267	0.910
B4d	140.64	258.079	0.293	0.555	0.911
B5a	140.57	254.958	0.403	0.337	0.909
B5b	140.42	253.136	0.469	0.486	0.908
B5c	140.13	254.880	0.437	0.516	0.908
B5d	140.49	255.224	0.390	0.621	0.909
B6p1a	140.67	258.291	0.401	0.492	0.909
B6p1b	140.70	254.011	0.559	0.666	0.907
B6p1c	140.63	253.784	0.510	0.491	0.907
B6p1d	140.51	255.242	0.470	0.496	0.908
B6p2a	140.54	255.077	0.462	0.394	0.908
B6p2b	140.60	254.958	0.480	0.460	0.908
B6p2c	140.38	255.782	0.468	0.433	0.908
B6p2d	140.53	254.436	0.472	0.417	0.908
B6p3a	140.19	256.560	0.420	0.586	0.909
B6p3b	140.17	255.608	0.476	0.516	0.908
B6p3c	140.18	256.510	0.434	0.643	0.908
B6p3d	140.24	256.743	0.386	0.547	0.909

Table 4. Summary item statistics

	Mean	Min.	Max.	Range	Max./Min.	Variance	N of Items
Item Means	3.900	3.395	4.535	1.140	1.336	0.100	37
Item Variances	0.830	0.582	1.130	0.548	1.942	0.023	37
Inter-Item Covariance's	0.179	-0.082	0.769	0.851	-9.406	0.011	37

Table 5. Inter-item correlation matrix

Inter-Item Correlation Matrix

	B1a	B1b	B1c	B1d	B2a	B2b	B2c	B2d	B2e	B2f	B2g	B2h	B2ı	B3a	B3b	B3c	B3d	B4a	B4b	B4c	B4d	B5a	B5b	B5c	B5d	B6p1a	B6p1b	B6p1c	B6p1d	B6p2a	B6p2b	B6p2c	B6p2d	B6p3a	B6p3b	B6p3c	B6p3d
B1a	1,000	,679	,446	-,012	,305	,218	,156	,146	,203	,153	,110	,145	,147	,234	,237	,218	,193	,186	,225	,068	,041	,251	,164	,093	,077	,197	,265	,236	,266	,137	,070	,109	,135	,073	,091	,029	-,013
B1b	,679	1,000	,480	-,037	,249	,295	,258	,247	,306	,245	,216	,205	,251	,281	,221	,282	,259	,146	,160	,112	,062	,202	,199	,113	,107	,179	,299	,265	,279	,191	,139	,167	,214	,159	,189	,121	,090
B1c	,446	,480	1,000	,005	,257	,295	,260	,252	,290	,245	,220	,298	,304	,324	,132	,288	,225	,219	,158	,176	,156	,194	,235	,165	,219	,211	,308	,329	,268	,199	,219	,162	,202	,151	,196	,207	,157
B1d	-,012	-,037	,005	1,000	-,043	,028	-,097	-,023	-,037	,000	,017	,007	,055	,102	,041	-,072	,054	-,015	-,046	,021	,087	,012	,102	,150	,053	,062	,035	,065	,039	,086	,120	,116	,063	,076	,090	,060	,026
B2a	,305	,249	,257	-,043	1,000	,417	,357	,381	,353	,276	,276	,196	,190	,092	,068	,221	,169	,178	,246	,086	,074	,250	,141	,147	,152	,215	,281	,233	,213	,149	,183	,142	,257	,124	,189	,146	,145
B2b	,218	,295	,295	,028	,417	1,000	,620	,650	,586	,549	,519	,460	,451	,297	,140	,292	,330	,155	,209	,154	,105	,240	,210	,239	,161	,183	,215	,248	,201	,198	,173	,183	,157	,146	,242	,210	,170
B2c	,156	,258	,260	-,097	,357	,620	1,000	,686	,679	,549	,557	,450	,432	,286	,125	,386	,235	,216	,252	,137	,066	,149	,123	,158	,149	,274	,329	,308	,189	,230	,255	,197	,193	,119	,224	,201	,223
B2d	,146	,247	,252	-,023	,381	,650	,686	1,000	,669	,492	,562	,425	,442	,259	,118	,338	,254	,226	,271	,154	,098	,178	,205	,211	,180	,188	,303	,310	,202	,166	,179	,213	,231	,134	,164	,184	,125
B2e	,203	,306	,290	-,037	,353	,586	,679	,669	1,000	,556	,700	,445	,418	,194	,098	,300	,252	,230	,284	,140	,047	,154	,133	,092	,087	,285	,291	,292	,194	,224	,167	,231	,179	,125	,184	,117	,142
B2f	,153	,245	,245	,000	,276	,549	,549	,492	,556	1,000	,524	,512	,539	,297	,108	,243	,252	,120	,207	,079	,010	,137	,123	,178	,149	,174	,232	,205	,218	,152	,155	,144	,157	,110	,169	,149	,146
B2g	,110	,216	,220	,017	,276	,519	,557	,562	,700	,524	1,000	,485	,467	,260	,133	,296	,263	,206	,236	,109	,009	,080	,172	,161	,086	,203	,258	,244	,227	,175	,169	,251	,178	,122	,219	,146	,135
B2h	,145	,205	,298	,007	,196	,460	,450	,425	,445	,512	,485	1,000	,857	,316	,172	,321	,329	,219	,230	,141	,109	,080	,152	,186	,153	,099	,190	,178	,169	,204	,188	,159	,155	,158	,197	,210	,231
B2ı	,147	,251	,304	,055	,190	,451	,432	,442	,418	,539	,467	,857	1,000	,339	,173	,308	,311	,233	,258	,127	,156	,110	,154	,216	,176	,189	,287	,216	,196	,209	,210	,189	,160	,172	,221	,238	,199
B3a	,234	,281	,324	,102	,092	,297	,286	,259	,194	,297	,260	,316	,339	1,000	,458	,472	,506	,249	,204	,272	,172	,240	,243	,318	,202	,226	,288	,286	,349	,260	,277	,312	,276	,164	,189	,220	,182
B3b	,237	,221	,132	,041	,068	,140	,125	,118	,098	,108	,133	,172	,173	,458	1,000	,336	,386	,165	,149	,166	,038	,172	,155	,101	,035	,231	,264	,219	,293	,140	,145	,144	,194	,049	,131	,114	,059
B3c	,218	,282	,288	-,072	,221	,292	,386	,338	,300	,243	,296	,321	,308	,472	,336	1,000	,483	,313	,216	,251	,124	,148	,110	,177	,148	,237	,360	,343	,298	,213	,343	,230	,278	,102	,210	,128	,150
B3d	,193	,259	,225	,054	,169	,330	,235	,254	,252	,252	,263	,329	,311	,506	,386	,483	1,000	,196	,154	,142	,115	,174	,280	,241	,199	,190	,258	,237	,320	,205	,226	,186	,137	,201	,146	,151	,175
B4a	,186	,146	,219	-,015	,178	,155	,216	,226	,230	,120	,206	,219	,233	,249	,165	,313	,196	1,000	,482	,344	,194	,263	,248	,147	,208	,135	,241	,180	,274	,167	,202	,184	,158	,124	,153	,172	,145
B4b	,225	,160	,158	-,046	,246	,209	,252	,271	,284	,207	,236	,230	,258	,204	,149	,216	,154	,482	1,000	,345	,267	,142	,140	,193	,223	,157	,201	,203	,127	,117	,195	,182	,136	,161	,154	,112	,140
B4c	,068	,112	,176	,021	,086	,154	,137	,154	,140	,079	,109	,141	,127	,272	,166	,251	,142	,344	,345	1,000	,203	,176	,197	,170	,209	,136	,169	,104	,056	,169	,263	,174	,192	,122	,117	,138	,134
B4d	,041	,062	,156	,087	,074	,105	,066	,098	,047	,010	,009	,109	,156	,172	,038	,124	,115	,194	,267	,203	1,000	,171	,265	,371	,701	,078	,083	,118	,044	,136	,171	,077	,153	,184	,109	,146	,150
B5a	,251	,202	,194	,012	,250	,240	,149	,178	,154	,137	,080	,080	,110	,240	,172	,148	,174	,263	,142	,176	,171	1,000	,414	,316	,280	,267	,282	,182	,265	,260	,178	,165	,187	,176	,227	,146	,155
B5b	,164	,199	,235	,102	,141	,210	,123	,205	,133	,123	,172	,152	,154	,243	,155	,110	,280	,248	,140	,197	,265	,414	1,000	,546	,345	,202	,274	,237	,199	,269	,224	,257	,271	,333	,320	,265	,266
B5c	,093	,113	,165	,150	,147	,239	,158	,211	,092	,178	,161	,186	,216	,318	,101	,177	,241	,147	,193	,170	,371	,316	,546	1,000	,521	,061	,181	,210	,192	,258	,208	,183	,269	,204	,281	,173	,162
B5d	,077	,107	,219	,053	,152	,161	,149	,180	,087	,149	,086	,153	,176	,202	,035	,148	,199	,208	,223	,209	,701	,280	,345	,521	1,000	,084	,178	,174	,154	,149	,176	,120	,228	,191	,130	,131	,177
B6p1a	,197	,179	,211	,062	,215	,183	,274	,188	,285	,174	,203	,099	,189	,226	,231	,237	,190	,135	,157	,136	,078	,267	,202	,061	,084	1,000	,649	,403	,307	,219	,223	,180	,198	,112	,189	,109	,080
B6p1b	,265	,299	,308	,035	,281	,215	,329	,303	,291	,232	,258	,190	,287	,288	,264	,360	,258	,241	,201	,169	,083	,282	,274	,181	,178	,649	1,000	,614	,555	,314	,322	,315	,319	,170	,274	,170	,095
B6p1c	,236	,265	,329	,065	,233	,248	,308	,310	,292	,205	,244	,178	,216	,286	,219	,343	,237	,180	,203	,104	,118	,182	,237	,210	,174	,403	,614	1,000	,535	,300	,287	,307	,300	,172	,231	,141	,128
B6p1d	,266	,279	,268	,039	,213	,201	,189	,202	,194	,218	,227	,169	,196	,349	,293	,298	,320	,274	,127	,056	,044	,265	,199	,192	,154	,307	,555	,535	1,000	,290	,179	,318	,309	,183	,204	,143	,097
B6p2a	,137	,191	,199	,086	,149	,198	,230	,166	,224	,152	,175	,204	,209	,260	,140	,213	,205	,167	,117	,169	,136	,260	,269	,258	,149	,219	,314	,300	,290	1,000	,514	,397	,395	,307	,304	,260	,231
B6p2b	,070	,139	,219	,120	,183	,173	,255	,179	,167	,155	,169	,188	,210	,277	,145	,343	,226	,202	,195	,263	,171	,178	,224	,208	,176	,223	,322	,287	,179	,514	1,000	,436	,414	,319	,325	,383	,279
B6p2c	,109	,167	,162	,116	,142	,183	,197	,213	,231	,144	,251	,159	,189	,312	,144	,230	,186	,184	,182	,174	,077	,165	,257	,183	,120	,180	,315	,307	,318	,397	,436	1,000	,505	,364	,378	,350	,307
B6p2d	,135	,214	,202	,063	,257	,157	,193	,231	,179	,157	,178	,155	,160	,276	,194	,278	,137	,158	,136	,192	,153	,187	,271	,269	,228	,198	,319	,300	,309	,395	,414	,505	1,00	,295	,287	,315	,238
B6p3a	,073	,159	,151	,076	,124	,146	,119	,134	,125	,110	,122	,158	,172	,164	,049	,102	,201	,124	,161	,122	,184	,176	,333	,204	,191	,112	,170	,172	,183	,307	,319	,364	,295	1,000	,592	,673	,584
B6p3b	,091	,189	,196	,090	,189	,242	,224	,164	,184	,169	,219	,197	,221	,189	,131	,210	,146	,153	,154	,117	,109	,227	,320	,281	,130	,189	,274	,231	,204	,304	,325	,378	,287	,592	1,000	,577	,529
B6p3c	,029	,121	,207	,060	,146	,210	,201	,184	,117	,149	,146	,210	,238	,220	,114	,128	,151	,172	,112	,138	,146	,146	,265	,173	,131	,109	,170	,141	,143	,260	,383	,350	,315	,673	,577	1,000	,670
B6p3d	-,013	,090	,157	,026	,145	,170	,223	,125	,142	,146	,135	,231	,199	,182	,059	,150	,175	,145	,140	,134	,150	,155	,266	,162	,177	,080	,095	,128	,097	,231	,279	,307	,238	,584	,529	,670	1,000

Table 6. Additivity of scale

		Sum of Squares	df	Mean Square	F	Sig.
Between People		2495.450	343	7.275		
Between Items		1241.212	36	34.478	52.980	<0.001
Residual	Non-additivity	0.020[a]	1	0.020	0.031	0.859
	Balance	8035.794	12347	0.651		
	Total	8035.815	12348	0.651		
Total		9277.027	12384	0.749		
Total		11772.477	12727	0.925		

Grand Mean=3.90
Tukey's estimate of power to which observations must be raised to achieve additivity=.964
H_0: The scale is non-additive
H_1: The scale is additive
Interpretation: According to the results of the analysis made, 37 questions are additive (p=0.859>0.05)

Table 7. Question averages

Hotelling's T Squared	F	df1	df2	Sig
1050.374	26.200	36	308	<0.001

H_0: There is no difference between question averages
H_1: There is a difference between the question averages
Interpretation: For the question averages test, the Hotelling T^2 test statistic was used and the question averages were different from each other at the 5% error level (p<0.05) This result also means that the related questions are not understood or interpreted differently by different participants. In other words, questions have a distinctive feature

As a result, the reliability coefficient of our 37-question questionnaire was 0.911, which means that our scale is highly reliable. It turns out that the question averages are different from each other. In addition, the scale is additive.

5.3. Evaluation of Categorical Variables

The cross-tabulation procedure is used to investigate the relationship among two or more categorical variables. However, the number of categories should be small and categories must be independent. It is aimed to highlight nine questions that have a critical importance in the survey and see the significance eof Sign Language for Deck and Machinery departments. Also, according to answers of the seafarers, it is intended to analyze the significance level of the answers given by machine and deck officers participating in the questionnaire.

Noticeably, there is a clear relationship between the participant's department and the answer to the question. This item is designed with the aim of finding out opinions of participants on misunderstanding due to lack of communication and its probability to lead to an accident. Deck department agreed more than the machinery department on the existence of a positive relation between these two variables.

Table 8. The misunderstanding due to lack of communication may cause accident

Department	Irrelevant	Not Very Important	Moderate	Quite Important	Essential	Total
Deck	4(2%)	2(1%)	35(17.5%)	64(32%)	95(47.5%)	200(100%)
Machinery	3(2%)	10(7%)	23(16%)	49(34%)	59(41%)	144(100%)
Total	7(2%)	12(4%)	58(17%)	113(32%)	154(45%)	344(100%)

H_0: There is no relationship between the participant's department and the answer to the question.
H_1: There is a relationship between the participant's department and the answer to the question.
(Likelihood ratio p=0.044<0.05)

Table 9. Communicating verbally in a noisy working environment is difficult

Department	Completely Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Completely Agree	Total
Deck	1(0.5%)	16(8 %)	61(30.5%)	94(47%)	28(14%)	200(100%)
Machinery	2(1.5%)	8(5.5%)	66(46%)	57(39.5%)	11(7.5%)	144(100%)
Total	3(0.9%)	24(7.1%)	127(36%)	151(44%)	39(12%)	344(100%)

H_0: There is no relationship between the participant's department and the answer to the question
H_1: There is a relationship between the participant's department and the answer to the question

The analysis results show that there is a relationship between the participant's department and the answer to the question. The seafarers on the deck seem to have more difficulty in utilizing verbal communication than machinery department.

This could be interpreted as the seafarers who work in the machinery space get adapted to working in a noisy environment. (Likelihood ratio p=0.027<0.05).

Table 10. Maritime sign language will be useful in the machinery space operation

Department	Completely Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Completely Agree	Total
Deck	1(0.5%)	5(2.5%)	26(13%)	88(44%)	80(40%)	200(100%)
Machinery	2(1.4%)	9(6.3%)	32(22.2%)	53(36.8%)	48(33.3%)	144(100%)
Total	3(0.9%)	14(4.1%)	58(16.9%)	141(41%)	128(37.2%)	344(100%)

H_0: There is no relationship between the participant's department and the answer to the question
H_1: There is a relationship between the participant's department and the answer to the question

Lastly, the efficacy of using maritime sign language during the machinery space operation is questioned and the result indicates that, there is a strong relationship between the participant's department and the answer to the question: there is a significant difference between the departments in that deck department favours the usage of sign language considerably more than the machinery section. (Likelihood ratio p=0.043<0.05).

5.4. Factor Analysis

In the SPSS program, the items to be analysed in the "Factor Analysis" dialog box using the Analyse >> Data Reduction >> Factor menus are entered in the "variables" box, then the "varimax" option is marked in the "rotation" dialog.

Table 11. KMO and Bartlett's test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.866
Bartlett's Test of Sphericity	Approximate Chi-Square	5002.443
	df	528
	Sig.	<0.001
H_0=Our data do not comply with factor analysis H_1=Our data show conformity to factor analysis		

The KMO value and the Bartlett test were used to check whether factor analysis could be performed on the statistical attitude scale items. The H_0 hypothesis of "universe correlation matrices unit matrix" is rejected seeing the value of KMO is 0.866 and significance value found in the Bartlett test is $\alpha<0.001$, indicating that the sample size is enough to apply factor analysis to attitude scale.

Table 12. Total variance explained

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
1	8.492	25.733	25.733	4.334	13.134	13.134
2	2.961	8.973	34.706	2.937	8.901	22.035
3	2.241	6.789	41.495	2.545	7.713	29.748
4	1.986	6.018	47.513	2.445	7.408	37.157
5	1.504	4.558	52.071	2.430	7.364	44.520
6	1.444	4.376	56.447	2.316	7.018	51.538
7	1.337	4.052	60.499	2.195	6.651	58.189
8	1.116	3.383	63.882	1.879	5.693	63.882
9	.922	2.793	66.675			
10	.849	2.573	69.248			
11	.806	2.442	71.689			
12	.740	2.242	73.931			
13	.705	2.136	76.067			
14	.627	1.899	77.966			
15	.600	1.819	79.785			
16	.583	1.766	81.551			
17	.572	1.734	83.285			
18	.533	1.616	84.901			
19	.503	1.525	86.426			
20	.483	1.462	87.889			
21	.455	1.380	89.268			
22	.424	1.284	90.552			
23	.392	1.189	91.741			
24	.353	1.071	92.812			
25	.337	1.021	93.832			
26	.310	.940	94.772			
27	.302	.915	95.687			
28	.284	.861	96.548			
29	.258	.782	97.331			
30	.247	.748	98.079			
31	.239	.725	98.804			
32	.207	.628	99.432			
33	.188	.568	100.000			
Extraction Method: Principal Component Analysis						

Examining the total explained variance, eight factors, which are larger than the eigenvalue of 1, are seen on the scale. Here, the result shows that eight factors measure the likelihood of the survey by 63%.

Table 13. Rotated component matrix

	Component							
	1	2	3	4	5	6	7	8
B2e	0.828							
B2c	0.803							
B2d	0.803							
B2b	0.769							
B2g	0.758							
B2f	0.720							
B2a	0.425							
B6p3c		0.838						
B6p3d		0.813						
B6p3a		0.812						
B6p3b		0.736						
B6p1b			0.825					
B6p1a			0.751					
B6p1c			0.692					
B6p1d			0.620					
B5d				0.845				
B4d				0.760				
B5c				0.749				
B5b				0.557				
B6p2b					0.702			
B6p2d					0.700			
B6p2a					0.693			
B6p2c					0.662			
B3a						0.731		
B3d						0.724		
B3b						0.704		
B3c						0.561		
B1a							0.866	
B1b							0.820	
B1c							0.627	
B4b								0.742
B4a								0.719
B4c								0.650
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization[a]								
a. Rotation converged in 6 iterations								

Table 13 shows that factors are distributed into the eight components deduced from the results of the analysis. The components or titles found in the analysis can be listed as follows;

- Importance of English communication in ship operations and life, named factor 1,
- Importance of the Maritime Sign Language, named factor 2
- The importance of verbal communication on board, and the ability of respondents to express themselves in this loud working environment and in ship operations, gather under the same roof, named factor 3,
- In factor 4, The role of communication, culture and multi-national crew in ship accidents, named factor 4,
- Usage, if required, of the maritime sign language, named factor 5,
- Ship-to-ship, ship-to-shore, or ship to third parties communication, named factor 6,
- In factor 7, Under the heading, Difficulty of using more than one language on board, named factor 7,
- Cultural interaction of multinational crew, named factor 8.

6. CONCLUSION

In this study, it was found out that the communication plays a vital role in the shipping industry. In particular, the English language is the main means of communication at ports, on board and in the marine industry. Nowadays, seafarers are well aware of the importance of the English language as operational language at sea. Therefore, many seafarer candidates go to educational institutions where the seminars are taught in English. For this reason, candidates should develop their language skills in order to express themselves. In addition, even though the cultural differences may not be possible to be eliminated completely, English competency would be quite helpful in getting over such obstacles and solving many problems in the shipping sector.

In this study, it was intended to create a new approach or a new alternative to verbal communication. In literature, there is a serious gap in non-verbal communication. This important gap can be filled with this study under the title of maritime sign language. The fact that there is no previous study on this subject makes this work the first in the literature.

Sign language can prove to be very effective in building communication, especially in loud working environments. In this study, it is shown that Maritime Sing Language can be utilized as a very efficient communication instrument in the cases that verbal communication falls short of meeting the needs of information exchange. The aim of the Maritime Sign Language is to ensure the marine language to be used functionally, in which it appears to be successful considering the results of this study. Therewithal, it is likely to increase interaction between the safety of ship and crew using a simplified, standardized and universalized sign language in loud working environments or where communication is inadequate. It was stated by the participants that there was a lack of communication in noisy environments and this lack of communication could cause accidents (Table 8-9). It is thought that the lack of communication may lead to more serious problems in the ships where the crew is multicultural.

As a result of the survey, it seems that the deck department and the machinery department have a positive attitude towards the usage of the sign language.

Finally, from 40 years ago until today, the shipping sector has shown a steady improvement with regard to the optimization of communication tools. It is thought that maritime language will bring a whole new dimension and dynamic to the industry thanks to its easy learnability. It seems that the sign language can be an alternative to the conventional communication methods and be helpful in abolishing some cultural barriers that hinder communication.

7. SUGGESTIONS FOR FURTHER RESEARCH

Maritime Sign Language can be optimized for seafarers by organizing workshops and a universal consensus can be reached for a simplified, standardized and globalizedsign language. Also, its usage can be encouraged as a reference for other business areas having problems in building communication:

- This work can be developed as an alternative language proposal which will be presented to IMO.
- Maritime Sign Language can be added to the course catalog for seafarers.

- Through a software integration, a universal source can be created rendering maritime sign language accessible for anyone and anywhere.

ACKNOWLEDGEMENTS

This paper is also one of the preliminary researches of our project "Usage of Maritime Sign Language on Board", financed by ITU Scientific Research Project Funds.

REFERENCES

[1] Ziarati, M., Ziarati, R., Bigland, O.B.O., and Acar, U., (2011). Communication and Practical Training Applied in Nautical Studies, International Maritime English Conference, At Constanta, Romania, 41.
[2] Ziarati, R., Ziarati, M., and Çalbaş, B., (2009). Improving Safety at Sea and Ports by Developing Standards for Maritime English. Bridge Conference, Finland.
[3] Wang, Y. and Fu, Y., (2007). Language Barriers in Maritime Communication and Countermeasures in Teaching. International Maritime English Conference, Netherlands.
[4] SOLAS, Ch V.
[5] STCW Code Table A-III/1.
[6] IMO Resolution, A.850(20).
[7] Maritime and Coastguard Agency Annual Report and Accounts (2005-2006) [Internet]. 2018 [cited 2018 Sep 15]. Available from: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/282966/mca-annual-report-accounts-2005-2006.pdf.
[8] Cole, C., (1999). The Impact of Multicultural and Multilingual Crews on Maritime Communication. A Paper Presented at the Maritime English Workshop (WOME 10) Croatia.
[9] Halid, E. and Genova, B., (2011). Cultural Factors Involved in Maritime Communication. Volume: I, Number: 2, Nautical and Environmental Studies.
[10] Čulić-Viskota, A., (2007). Cultural and Linguistic Differences as Factors of Ineffective Communication. International Maritime English Conference, IMEC 19.
[11] Umut, T., Tavacıoğlu, L., and Bolat, P., (2017). Age and Experience Based Neurocognitive Performance of Seafarers. NWSA: Engineering Sciences, 12(3):168-177.
[12] Macrae, C., (2009). Human Factors at Sea: Common Patterns of Error in Groundings and Collisions, Maritime Policy and Management, 36(1):21-38.
[13] Wiegmann, D. and Shappell, S., (1999). Space, Medicine E. Human Error and Crew Resource Management Failures in Naval Aviation Mishaps: A Review of US Naval Safety Center data, 1147-51.
[14] Kroeber, A.L. and Kluckhohn, C., (1952). Culture: A Critical Review of Concepts and Definitions. Peabody Museum of American Archeology and Ethnology, Harvard University, XLVII:1. Cambridge, Massachusetts, U.S.A.
[15] Ricard, V.B., (1993). Developing Intercultural Communication Kills. Malabar, FL: Krieger. HM 258.R47.
[16] Dzugan, G., (1998). An Investigation into Multicultural Communication and Its Effect on maritime safety: Implications for Maritime Trainers (Unpublished Master's Thesis). World Maritime University, Malmo, Sweden.
[17] Yıldırım, H. and Tavacıoğlu, L., (2017). Behavioral Dimensions of Seafarers and Self-Confidence Analysis, Eurasian Academy of Sciences Eurasian Business & Economics Journal, 9(9):33-44, ISSN: 10.17740.

[18] Enhancing Safety for Navigation by Using Pictography, (2015). (Access: 15 September 2018). Available from: http://www.maritimesymposium-rotterdam.nl/uploads/Route/COMPIC.pdf.
[19] Sign Language in the Workplace, (2012). (Access: 15 September 2018). Available from: http://www.signedlanguage.co.uk/sign-language-workplace.html.
[20] Mörek, U., Tavacıoğlu, L., aand Bolat, P., (2016). The Role of Human Organizational Factors on Occupational Safety; A Scale Development Through Tuzla Region Dockyards, Constanta Maritime University Annals, 4:159-165, Nautica.
[21] Kılıç, K. and Tavacıoğlu, L., (2016). Influence of Emotional Intelligence on the Work Performance of Seafarers, Constanta Maritime University Annals, 2:213-220, Nautica.
[22] Cohen, R.J., Swerdlik, M.E., and Phillips, S.M., (1996). Psychological Testing and Assessment: An Introduction to Tests and Measurement: Mayfield Publishing Co.