Journal of Sustainability Science and Management
Volume 15 *Number* 6, August 2020: 137-158

eISSN: 2672-7226

THE IMPACT OF BASIC TRAINING ON SEAFARERS' SAFETY KNOWLEDGE, ATTITUDE AND BEHAVIOUR

AMIR SYAWAL KAMIS[1,3], AHMAD FAIZAL AHMAD FUAD*[2], MOHD SAIFUL IZWAAN SAADON[2] AND MOHD NAIM FADZIL[2]

[1]Faculty of Ocean Engineering Technology and Informatics, [2]Faculty of Maritime Studies, Universiti Malaysia Terengganu, 21030 Kuala Nerus, Terengganu, Malaysia. [3]Pre-sea Nautical Studies Department, Akademi Laut Malaysia 78200, Kuala Sungai Baru, Melaka.

**Corresponding author: faizalfuad75@gmail.com*
Submitted final draft: 14 January 2020 *Accepted: 12 February 2020* http://doi.org/10.46754/jssm.2020.08.012

Abstract: Standards of Training, Certification, and Watchkeeping (STCW) Basic Training (BT) is mandatory for every seafarer before starting to work on board merchant ships. The knowledge, attitude, and behaviour (KAB) theory explains that knowledge enhances one's attitude, thus leading to improved behaviour. Accordingly, this study determined the effects of BT on seafarers' shipboard safety KAB. The process commenced by ascertaining whether the BT course offered in the Maritime Institutes was on par with BT contents provided by the International Maritime Organisation (IMO). For data collection and filtration purposes, the factors, filtering elements, and filtered model (FFF model) were utilised to measure safety education and KAB. Following this, a measurable questionnaire was developed for this particular study survey. The data collected were then analysed by using the Principal Component Analysis (PCA) and Confirmatory Factor Analysis (CFA), which involved the use of SPSS and AMOS SPSS. Essentially, data obtained from the respondents successfully established the impacts of BT on the KAB, which revealed its role in improving the seafarers' KAB. Therefore, the factors identified in this study are expected to be utilised in maritime institutions as BT syllabus incorporates domains aimed to instil the right attitudes among seafarers.

Keywords: Standards of training, certification, and watchkeeping for seafarers (STCW), basic training (BT), shipboard safety, knowledge, attitude, behaviour.

Abbreviations:
BT – Basic Training
CFA – Confirmatory Factor Analysis
EMSA - European Maritime Safety Agency
IMO – International Maritime Organisation
KAB – Knowledge Attitude Behaviour
MAIB - Marine Accident Investigation Branch
PCA – Principal Component Analysis
STCW - Standards of Training, Certification, and Watchkeeping for Seafarers

Introduction

Safety is a critical growth factor in any industry, but the proper implementation of safety procedures is not observed due to strict regulations. In a previous study, almost 20% of its participants agreed that they did not comply with the correct procedures to perform certain tasks at work, while more than 40% have agreed that they checked the checklist boxes provided without following the actual procedures (Andrei *et al*., 2018). In general, these non-compliant actions are closely related to various human factors, such as laziness, complacency, and others. Accordingly, most marine accidents are documented to be caused by human errors (Gregory & Shanahan, 2010; Lappalainen & Tapaninen, 2014) and at a higher rate compared to mechanical-related marine accidents (Roberts *et al*., 2014).

One of the methods thus highlighted for improving attitudes towards safety is by conducting training programmes. Training plays an essential role in shaping behaviours which can either directly or indirectly influence safety (Andrei *et al*., 2018). Following this, work-related procedures are made a requirement in order to reduce the occurrence of major accidents on board as insufficient training has been identified as the main factor causing occupational-related mishaps (Roberts *et al*., 2014). Therefore, training programmes and education for seafarers on safe behaviour when on board should be included in such work-related procedures (Jensen & Oldenburg, 2019).

Accident statistics

Statistics have shown that the occurrence of accidents on board increases annually (Napoleone, 2016). The scholar has also noted that a minimum of 14.4% and up to a maximum of 18.4% of accidents occur on board annually, whereby the number rises continuously. From 2003 to 2012, related accidents caused 49 out of 66 fatalities in the British shipping sector in which the deck ratings were mostly affected (Roberts *et al*., 2014). Meanwhile, the total number of lives lost during the periods 2011-2016 was 60, with a decrease in the year 2016 (EMSA, 2017). In total, 405 accidents were recorded between 2011 and 2017 resulting in 683 fatalities, where crew members felt under the most affected category with 555 mortalities (EMSA, 2017).

Similarly, from 1993 to 1997, 317 accidents occurred involving seafarers aged 34 years and below, whereby 278 cases were reported of involving crew members who spent less than 90 days on board (Hansen *et al*., 2002). Hence, it is imperative that new seafarers undergo various trainings and attend courses in accordance with the International Maritime Organisation (IMO) requirements as a form of preventive measure (IMO, 2017).

Examples of accidents related to personal survival covered in Table A-VI/1-1 STCW 2017

At about 1415hrs on 20 November 2017, single-handed creel boat Varuna was found stranded and unmanned on Eilean nan Naomh (MAIB, 2018). It was reported that even after an extensive sea, land, and air search and a rescue mission was carried out, the owner remained missing (MAIB, 2018). Three weeks later, his body was found washed ashore at Staffin Bay on the Isle of Skye (MAIB, 2018).

Prior to that, 25 March 2014 marked the date when an accident occurred on board Diamond fishing vessel. It resulted in the loss of a crew member in West Burra Firth, Shetland (MAIB, 2016), whereby the report highlighted one of the safety issues as the lack of crew training, specifically for sea survival.

Examples of accidents related to fire prevention and firefighting covered in Table A-VI/1-2 STCW 2017

Marine Accident Investigation Branch (MAIB), has reported that on 22 January 2000, a watch keeping officer on the fishing vessel Be Ready discovered a fire in the galley while fishing 30 miles north-west of the Orkney Islands, Scotland (MAIB, 2000). While passing the galley on the way to muster station, none of the crew had shut the A60 fire door although the fire could be seen through the open galley door (MAIB, 2000).

Another case occurred on 01/05/2014 on board Dieppe Seaways, which was on fire on the approach to, and subsequently alongside the Port of Dover, United Kingdom (UK), (MAIB, 2016). As such, safety issues highlighted during the incidents included: (1) Lack of detailed maintenance records to enable inspection that was focused on high-risk areas, and (2) Lack of ship/shore fire fighting co-ordination (MAIB, 2016). In order to avoid the same incident from repeating, the report recommended for the company to provide more specific shipboard fire-fighting trainings or drills for exercising combined command and control and enhancing risk perception with respect of ship construction and associated hazards (MAIB, 2016).

Examples of accidents related to first aid covered in Table A-VI/1-3 STCW 2017

Wrongful medical kit handling technique on board can lead to death and severe injury. One of the incidents reported by the Daily Mail detailed a patient who required transfer from a cruise ship onto a rescue boat ~~was~~ but dropped into the cold sea (Daily Mail, 2011). She was initially diagnosed with internal bleeding when she needed to be transferred ashore but it ended with loss of life when dropped into the freezing water (Daily Mail, 2011).

A casualty was reported on board the passenger ship Sapphire Princess and recorded a fatal drowning in the ship's pool while in the East China Sea (MAIB, 2016). According to the report, safety issues that arose were: (1) No dedicated pool attendant, (2) Lack of first aid training, and (3) No documented risk assessment for swimming pool safety.

Examples of accidents related to personal safety and social responsibilities covered in Table A-VI/1-4 STCW 2017

A Malaysian International Shipping Corporation (MISC) tanker named MT Bunga Alpinia was destroyed by fire while loading methanol in Labuan Malaysia (Luin, 2012). Apart from the death of ship crew and damage to the company's property in the incident, the event indirectly caused economic losses due to activity disturbances around the Patau-Patau Power Station area (Luin, 2012). The cause of the fire could be traced to either one of three possibilities: (1) human error, (2) faulty safety systems, or (3) combination of both (Luin, 2012).

Similarly, MAIB (2016) has reported that while shooting gear on board a potter, a deckhand was caught and entangled in the gear. According to the case study, he was dragged overboard and remained submerged for roughly 15 minutes before a pot hauler was used to pull him to the surface. He remained suspended on the hauler for about 40 minutes until a lifeboat arrived to give assistance as other crew members were unable to retrieve him back on board (MAIB, 2016).

Basic training and KAB theory

One of the mandatory courses required to ensure all seafarers are ready to serve on board is Basic Training (BT) (ITF, 2010). Undergoing BT is necessary for seafarers working on board any type of ships to ensure their ability to perform their duty and designated responsibilities safely (ITF, 2010). The training exposes these individuals to the proper techniques of wearing a life jacket, instils board survival crafts, and to educate regarding the proper abandon ship procedure. Furthermore, BT includes training on fire prevention and actions to be taken during such incident, as well as first aid procedure and personal safety and responsibility (IMO, 2017).

In BT, the knowledge received should improve student attitude and behaviour based on the knowledge, attitude, and behaviour (KAB) theory (Fabrigar *et al*., 2006). The adaptation of this approach has been studied in several areas, such as drug and alcohol education (Goodstadt, 1978). Goodstadt (1978) has mentioned that the first sub-model focuses on knowledge and behaviour relationship, whereby the link between knowledge and the manner in which an individual behaviour can be amplified in a situation where informing people of drug abuse and its dangers may aid in preventing and reducing drug-related issues. The scholar has further underlined the second construct of the KAB model to expect attitudes that are strictly connected to behaviour. Even though the method is complex, it provides a more inclusive understanding of the cognitive constructs related to improvement and transformation (Schrader & Lawless, 2004). To date, the KAB method can be thus considered as a reliable method for appraising seafarer changes after completing BT (Schrader & Lawless, 2004).

The Problem Statement, Conceptual Model, and Hypothesis

Even though BT is expected to develop safety attitude and behaviour among new seafarers, the resulting documentation of accidents on board ships has reported otherwise (EMSA, 2017; Hansen *et al*., 2002; Napoleone, 2016; Roberts *et al*., 2014). Therefore, it is reasonable to assume that the effects of BT on seafarer safety KAB elements need to be checked. Currently, no study has been conducted in assessing the impact of BT on KAB yet. Hence, this research intends to show the relationship between BT and knowledge, attitude and behaviour, which will lead to a positive development in shipboard safety knowledge, shipboard safety attitude, and shipboard safety behaviour in merchant shipping. Following this, the research hypotheses are shown below (Figure 1):

Development of Hypotheses

Basic Training (BT)

In this particular context, BT is a training session that prepares novice seafarers with different skills of importance in helping them to cope with their assigned duties and responsibilities. The training also equips these individuals with the necessary knowledge related to health and safety while on board.

Hence, the following hypotheses are proposed:

H1: BT will improve seafarers' shipboard safety knowledge.

H2: BT will improve seafarers' shipboard safety attitude.

H3: BT will improve seafarers' shipboard safety behaviour.

Seafarers' shipboard safety knowledge

Gausdal and Makarova (2017) have described shipping as a risky and dangerous industry. In relation to this statement, equipping seafarers with the appropriate shipboard safety knowledge ensures that they are aware of the importance of keeping themselves and other people safe.

Hence, the following hypotheses are proposed:

H4: Seafarers' shipboard safety knowledge will improve seafarers' shipboard safety attitude.

H5: Seafarers' shipboard safety attitude will improve seafarers' shipboard safety behaviour.

H6: Seafarers' shipboard safety knowledge will improve seafarers' shipboard safety behaviour.

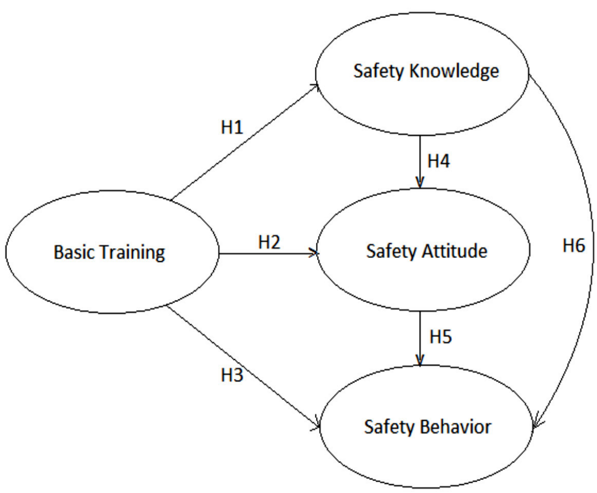

Figure 1: Conceptual model for research (Chang & Liao, 2009)

Methodology

The flow chart of research activities is shown in Figure 3. The first step of the methodology was to obtain the BT course content through a literature review, which was undertaken via specific references. The courses included were:

i. STCW Code
ii. IMO Model Course 1.13 Elementary First Aid
iii. IMO Model Course 1.19 Proficiency in Personal Survival Technique
iv. IMO Model Course 1.20 Fire Prevention and Fire Fighting
v. IMO Model Course 1.21 Personal Safety and Social Responsibility

The information required from the literature consisted of BT Course's main topic and subtopics in which the purpose of such content identification was for distinguishing the content of safety education provided.

Then, the second step called for identifying all factors related to safety education, knowledge, attitude, and behaviour by reviewing associated literature. This step was completed by firstly distinguishing and identifying safety education factors via reviewing the BT model courses in related journals and manuals. All identified factors were then listed in a generic list. Subsequently, the second stage of the second step was to establish the filtering elements in order to filter factors of relevance to the study. Here, the adapted FFF model is developed accordingly (Figure 2) (Kumar & Dange, 2012). The filtering elements were ascertained by combining the literature review and referring to experts. Meanwhile, the third stage for this particular step filtered the factors identified according to the established filtering elements by using the FFF model.

Next, the third step was developing a survey questionnaire for the study based on the filtered factors related to safety education and KAB of shipboard safety (Matoskova, 2016). The sub-factors and items of the factors otherwise expressed by several 'manifested' items in the questionnaire, which were thus known as the 'latent' variable, were later identified accordingly (Joshi *et al*., 2015).

The standard response to the questionnaire designed was the 6-point Likert scale. The Likert scale produces the ordinal data utilised to measure the participant opinions or perceptions subsequently, which are related to the single 'latent' variable (Joshi *et al*., 2015). When measuring behaviour needs on a range, a rating scale is deemed as more useful in which such device can measure individuals' behaviours and attitudes in order to produce empirical data (Leedy & Ormrod, 2010). In this study, the 6-point Likert scale was selected as it would yield a definite response. Furthermore, the 6-point scale analysis was in support of the requirement for factor analysis, which necessitated a 4-point scale at the very least. As such, the higher points of the Likert scale, the better suitability of the ordinal data for factor analysis purposes (Piaw, 2009). The conceptual analysis was drafted as verified by the factor analysis, which linked all safety education (BT course content) factors with those of KAB.

The fourth and subsequent step in the process was data collection, whereby the survey was conducted in three maritime training centres located in Peninsular Malaysia, namely Ranaco Marine, Pelita Akademi, and Akademi Laut Malaysia. All three institutions were selected due to their status as the top three maritime academies in the peninsular region in terms of student enrolment.

Finally, the fifth step was data analysis in which the initial stage entailed undertaking the Principal Component Analysis (PCA) by using the Varimax rotation. PCA was performed during the pilot survey and then utilised to determine the correlation between the developed items (i.e. questions) and the constructs of the respective factors (Piaw, 2009). Moreover, performing this procedure was essential to lessen the number of items into a smaller set. Generally, its main purpose is analysing the structure of items observed with the construct and factor variables (Abdi & Williams, 2010). To generate a simpler version of the dataset description, cross-loading items that cause any confusion were discarded. Factors with eigenvalue 1.0 and above were selected, while values below 1.0 would be discarded (Piaw, 2009). Following the complete selection of the list of items for the full survey, the set reliability was tested by determining the Cronbach's alpha prior to item finalisation. Upon attaining satisfactory Cronbach's alpha values, the second stage of data analysis was carried out via Confirmatory Factor Analysis (CFA). This is a procedure conducted for testing hypotheses via statistical means in order to identify the commonality among the variables (Hoyle, 2000). It was previously used to test all hypotheses on the correlation among the variables and conceptual model developed.

Preliminary Results

Preliminary Result for The First Step of Study: Identifying BT Course Content (Safety Education is Represented by BT Course Content)

BT consisted of four courses, namely: (1) Elementary First Aid, (2) Personal Survival Techniques, (3) Proficiency in Fire Prevention and Fire Fighting, and (4) Personal Safety and Social Responsibilities Courses. IMO (2017) has stated that seafarers working any ranks on board a ship and involved in pollution prevention and safety duties due to the nature of the ship's business should obtain a proper BT safety training prior to being assigned to any duties (Table 1, Factors).

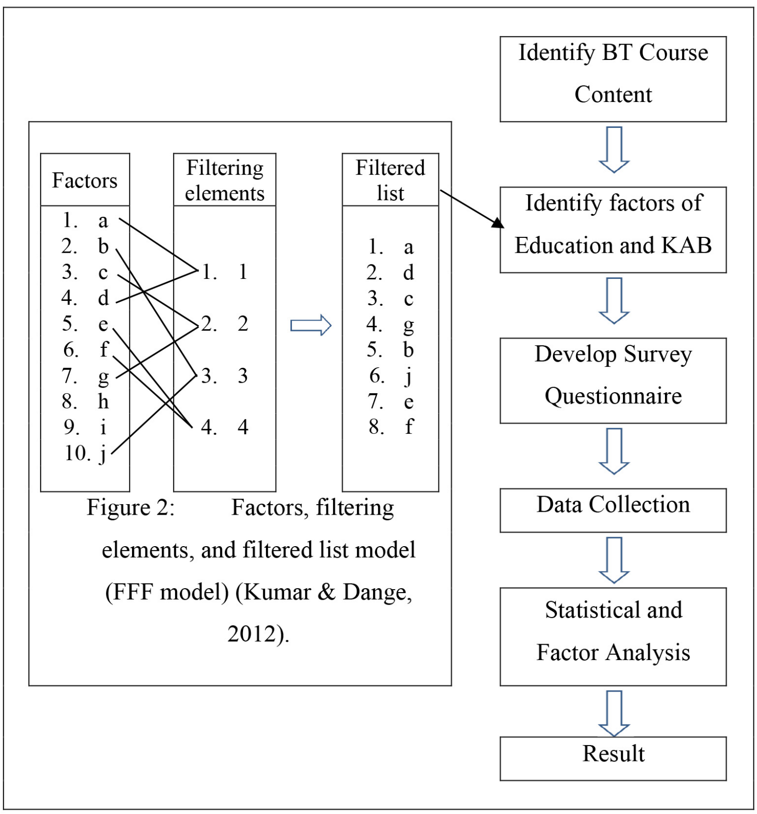

Figure 2: Research Methodology

Preliminary Result for the Second Step of Study: Identify the Factor of Knowledge, Attitude, and Behaviour

This subsection explains the identified factors and the manner in which they were distinguished for survey items development.

Knowledge

Shipboard safety knowledge factors and sub-factors were derived from the same sources of shipboard safety education. Therefore, the identified shipboard safety education and knowledge are ~~as~~ listed in Table 1:

Attitude

All factors with the potential to measure attitude were gathered. The identified factors were: "perception"; "belief" (Chang & Liao, 2009); "disposition"; contributions"; "dislike"; "gender discrimination"; "personality prerequisites" (van Rensburg *et al*., 1999); "technology for all" (BPTV, 2017; van Rensburg *et al*., 1999); "uncertainty avoidance" (Huang *et al*., 2015; Lu *et al*., 2016); "teamwork"(Lu *et al*., 2016; Röttger *et al*., 2016; Wu *et al*.,, 2017); "leadership" (BPTV, 2017; Lu *et al*., 2016; O'Connor *et al*., 2002; Röttger *et al*., 2016); "long-term orientation"; "power distance"; "masculinity/femininity" (Lu *et al*., 2016); "management safety commitment"; "fatalism" (Wu *et al*., 2017); "work pressure" (Röttger *et al*., 2016; Wu *et al*., 2017); and "personal safety responsibility" (Wu *et al*., 2017). These factors are arranged in the generic list of factors as shown in Table 2.

Table 1: Safety Education and Knowledge from BT Course Module

Factors (BT course content)	Sub-factors	Authors
1. Personal Survival Techniques	Survival at sea Survival Equipment	Table A-VI/1-1 STCW (IMO, 2017) IMO Model course 1.19
2. Fire Prevention and Fire Fighting	Minimise the risk of fire Fight and extinguish the fire	Table A-VI/1-2 STCW (IMO, 2017) IMO Model course 1.20
3. Elementary First Aid	Immediate action Follow up action	Table A-VI/1-3 STCW (IMO, 2017) IMO Model course 1.13
4. Personal Safety and Social Responsibility	Pollution prevention Safe working practice Effective communication Effective human relation Necessary act to control fatigue	Table A-VI/1-4 STCW (IMO, 2017) IMO Model course 1.21

Table 2: Filter generic list of attitude factors to yield the final list by using the FFF model

Generic list of factors	Filtering elements	Final filtered list
1. Perception	Related to:	1. Perception
2. Belief	1. Shipboard safety	2. Belief
3. Disposition	2. Shipboard (i.e. deck, engine, catering) operation	3. Disposition
4. Contributions		4. Contributions
5. Dislike	3. Navigation	5. Personality prerequisites
6. Gender discrimination	4. Stowage and handling of cargo	
7. Personality prerequisites		6. Uncertainty avoidance
8. Technology for all	5. hip operation control	7. Teamwork
9. Uncertainty avoidance	6. Managing persons on board	8. Leadership
10. Teamwork	7. Marine engineering	9. Management safety commitment
11. Leadership	8. Maintenance and repair	
12. Long-term orientation		10. Work pressure
13. Power distance	9. Electrical, electronics, and control engineering	
14. Masculinity/femininity		
15. Management safety commitment	10. Radio communication	
16. Fatalism		
17. Work pressure		
18. Personal safety responsibility		

Subsequently, the factors were filtered using the FFF model by means of interviews with maritime field experts. Filtration ensures that the trainings in Table 2 are acceptable and utilisable to measure shipboard safety attitude. Table 3 explains further the process of selecting and rejecting factors.

Table 3: Reason for Acceptance or Rejection

Generic list	Status	Reason
1. Perception	Accepted	Seafarers need for positive opinion is based on shipboard safety
2. Belief	Accepted	Seafarer's feeling of being sure that shipboard safety is important
3. Disposition	Accepted	A natural tendency to do something towards shipboard safety or develop awareness regarding shipboard safety
4. Contributions	Accepted	Something that seafarers can do to achieve shipboard safety together with other people or the possibility that shipboard safety can help seafarers and other people
5. Dislike	Rejected	The dislike is found to be in the same category (i.e. redundant) as belief (feeling)
6. Gender discrimination	Rejected	Gender discrimination is not related to shipboard safety in measuring attitude
7. Personality prerequisites	Accepted	A seafarer is one who is depicted by the manner one behaves, feels, and thinks; as their attitude towards safety will be affected.
8. Technology for all	Rejected	Technology for all is a concept not related to shipboard safety in measuring attitude
9. Uncertainty avoidance	Accepted	Seafarers will try to avoid something that is not known or certain for safety purposes
10. Teamwork	Accepted	The need for seafarers working together effectively to achieve zero accident
11. Leadership	Accepted	Seafarers' characteristics of shipboard safety that make them good leaders
12. Long-term orientation	Rejected	Long-term orientation is not related to ship's operation in measuring attitude towards shipboard safety
13. Power distance	Rejected	Power distance is not related to ship's operation in measuring attitude towards shipboard safety
14. Masculinity/ femininity	Rejected	Masculinity/femininity is not related to ship's operation in measuring attitude towards shipboard safety
15. Management safety commitment	Accepted	Management safety commitment will affect the attitude of seafarers towards shipboard safety (i.e. management always engage with seafarers regarding safety)
16. Fatalism	Rejected	Fatalism is not related to ship's operation in measuring attitude towards shipboard safety
17. Work pressure	Accepted	Work pressure will indirectly affect the attitude towards safety due to fatigue/stress
18. Personal safety responsibility	Rejected	Personal safety responsibility is found to be in the same category (i.e. redundant) as belief (feeling), disposition, personality prerequisite, teamwork, leadership, and management safety commitment

Behaviour

All factors with the potential to measure behaviour were gathered. The identified factors were: "attentiveness" (Chang & Liao, 2009); "cautiousness" (Chang & Liao, 2009; Gregory & Shanahan, 2010; Lu *et al*., 2016); "team working" (Gregory & Shanahan, 2010; Lu *et al*., 2016; OCIMF, 2018; O'Connor *et al*., 2002; Röttger *et al*., 2016); "communication and influencing" (BPTV, 2017; Gregory & Shanahan, 2010; OCIMF, 2018; O'Connor *et al*., 2002; Röttger *et al*., 2016); "leadership and managerial skills" (BPTV, 2017; Lu *et al*., 2016; OCIMF, 2018; O'Connor *et al*., 2002; Röttger *et al*., 2016); "situational awareness" (OCIMF, 2018; O'Connor *et al*., 2002; Röttger *et al*., 2016); "decision-making" (Gregory &

Shanahan, 2010; OCIMF, 2018; O'Connor *et al.*, 2002; Röttger *et al.*, 2016); "result focus" (Lu *et al.*, 2016; OCIMF, 2018); "learn and develop" (BPTV, 2017; Gregory & Shanahan, 2010; Håvold *et al.*, 2015); "take risk"; "make mistake"; "fatigue" (Gregory & Shanahan, 2010); "power distance"; and "masculinity/ femininity" (Lu *et al.*, 2016). All factors representing behaviour are listed in the generic list in Table 4.

Next, the factors were filtered using FFF model by means of interviews undertaken with maritime field experts to ensure that the factors could be accepted to measure shipboard safety behaviour. The finalised factors are listed in Table 4. Table 5 explains further on the process of selecting and rejecting factors.

Pilot study

The pilot study was conducted on 52 BT participants from various shipping companies. Its objectives were to assess the reliability of the questionnaire set and reduce the number of items by PCA. The initial reliability test of the set questionnaire was tested by determining the Cronbach's alpha of the sections, while sampling adequacy was tested by Kaiser-Meyer-Olkin (KMO) Bartlett test (see Table 6). The samples are deemed as adequate if the KMO value is more than 0.60 (Kaiser & Rice, 1974).

Table 4: Filter generic list of behaviour factors to yield the final list by using the FFF model

Generic list		Filtering elements		Final list
1. Attentiveness		Related to:		1. Team working
2. Cautiousness		1. Shipboard safety		2. Communication and influencing
3. Team working		2. Shipboard (i.e. deck, engine, catering) operation		3. Situational awareness
4. Situation awareness		3. Navigation		4. Decision-making
5. Leadership and managerial skills		4. Stowage and handling of cargo		5. Result focus
6. Communication and influencing		5. Ship operation control		6. Leadership and managerial skills
7. Decision-making	⇨	6. Managing persons on board	⇨	7. Learn and develop
8. Results focus		7. Marine engineering		
9. Learn and develop		8. Maintenance and repair		
10. Take risk		9. Electrical, electronics, and control engineering		
11. Make a mistake		10. Radio communication		
12. Fatigue				
13. Power distance				
14. Masculinity/ femininity				

Meanwhile, the significance of Bartlett's test of sphericity value less than 0.05 specifies that correlations that occur between the variables are sufficient (Hair *et al*., 2014).

Table 5: Reason for Acceptance or Rejection

Factor	Status	Reason
1. Attentiveness	Rejected	Same category (redundancy) of situational awareness.
2. Cautiousness	Rejected	Same category (redundancy) of situational awareness x
3. Team working	Accepted	The factor is acceptable in determining the behaviour of seafarers who work effectively in a team.
4. Communication and influencing	Accepted	Shipboard safety can be improved by information sharing between people, places, and interactions with others.
5. Leadership managerial skills	Accepted	The correct leadership, managerial skills or styles are able to enhance shipboard safety
6. Situation awareness	Accepted	Always paying attention and being aware of the surrounding will enable the seafarers to improve on shipboard safety
7. Decision-making	Accepted	Decision-making consists of a few stages which involve collecting information and proper planning before the final action is taken in order to improve shipboard safety.
8. Results focus	Accepted	Focusing on a result will avoid an unsafe act.
9. Learn and develop	Accepted	Seafarers are willing to learn (from others or self-mistake) and develop their skills.
10. Take risk	Rejected	In terms of safety, taking a risk is hazardous. Seafarers are trained to minimise risks.
11. Make a mistake	Rejected	Making a mistake is categorised as a component of learning and developing (9)
12. Fatigue	Rejected	Fatigue can affect behaviour, but it is classified as immeasurable in terms of behaviour in shipboard safety
13. Power distance	Rejected	Power distance is not related to ship's operation in measuring behaviour towards shipboard safety
14. Masculinity/ femininity	Rejected	Masculinity/femininity is not related to ship's operation in measuring behaviour towards shipboard safety

Table 6: Reliability test, Cronbach's Alpha (α), and KMO-Bartlett test before PCA

Variables	Cronbach's Alpha α	N of items	Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy	Bartlett's Test of Sphericity		
				χ^2	Df	Sig.
Shipboard Safety Education	0.935	23	0.749	1351.110	253	.000
Shipboard Safety Knowledge	0.934	23	0.607	1585.431	253	.000
Shipboard Safety Attitude	0.890	26	0.697	1377.693	325	.000
Shipboard Safety Behaviour	0.914	55	0.695	5910.284	1275	.000

Principal component analysis (PCA) and item reduction

PCA was carried out to identify producible components from the set and could be further used to reduce items. Two stages were to be followed with the purpose of item reduction. In the first stage, PCA and Varimax rotations were performed to determine the components of the items in which those with a load less than 0.6 will be ignored. The number of components is determined by a scree plot, with eigenvalue more than 1 (Hair *et al*., 2014). In the second stage, the final lists of items were chosen based on its relation to the factors identified using FFF model for the particular item set. Reliability test was performed earlier and after PCA to ensure the reliability of items before finalising the questionnaire in order to ensure its suitability for the full survey. The rationale for performing the reliability test twice was to determine the items that were either to be deleted or included in the survey.

Loadings used in this design consisted of: (1) Lower limit = .40; (2) Moderate level = .60; and (3) Well-defined value = .80 (Guadagnoli & Velicer, 1988). The following criteria were thus chosen to select items for the full survey, namely: (1) Items with a value of more than 0.6 (moderate level), and (2) Items related to the factor.

Reliability test and finalised items for the full survey

Reliability test via Cronbach's alpha is a measure of reliability ranging from 0 to 1 in which values between 0.60 to 0.70 are considered as the low limit of adequacy (Hair *et al*., 2014). The Cronbach's alpha values identified for the set items represented all four constructs selected for the final survey and ranged between 0.717 to 0.804; they exceeded 0.70, which was the common lower limit deemed as suitable (Hair *et al*., 2014). Table 9 shows the final list of items selected for the full survey and the reliability test results for the set.

Table 7: Final items selected for the full survey and Cronbach's alpha for the set

Construct		**Factors**	**The final list of selected items**	**Factor loading**	**Reliability Test**	
					N of items	**Cronbach's Alpha**
Education	1.	Elementary first aid	SE13 SE17	0.719 0.891	9	0.756
	2.	Personal safety and social responsibility	SE21	0.866		
	3.	Fire prevention and fire fighting	SE10	0.859		
	4.	Fire-fighting and Life-saving appliances	SE6 SE7	0.750 0.787		
	5.	Survival equipment	SE4	0.811		
	6.	Personal survival technique	SE1 SE3	0.731 0.834		

Knowledge	1.	Elementary first aid	SK15 SK17 SK18	0.803 0.787 0.940	10	0.804
	2.	Fire prevention and fire fighting	SK7 SK8 SK21	0.647 0.710 0.749		
	3.	Personal survival technique	SK1 SK2 SK3	0.701 0.804 0.775		
	4.	Personal safety and social responsibility	SK20	0.899		
Attitude	1.	Perception on teamwork and leadership	SA2 SA9 SA10 SA17 SA19	0.608 0.869 0.605 0.682 0.904	13	0.754
	2.	Management safety commitment	SA14 SA22 SA24	0.695 0.805 0.803		
	3.	Work pressure	SA3 SA25	0.779 0.679		
	4.	Uncertainty avoidance	SA15	0.802		
	5.	Contribution	SA1 SA11	0.763 0.965		
Behaviour	1.	Learn and develop	SB53 SB54 SB55	0.888 0.861 0.901	19	0.717
	2.	Leadership and managerial skill	SB7 SB10 SB11 SB35 SB42	0.917 0.822 0.941 0.711 0.682		
	3.	Situational awareness	SB20 SB22 SB34 SB41	0.854 0.829 0.628 0.622		
	4.	Result focus	SB29 SB37 SB40	0.964 0.972 0.969		
	5.	Decision-making	SB8 SB24	0.619 0.815		
	6.	Team working	SB1	0.873		
	7.	Communication and influencing	SB15	0.604		

Full survey empirical results

Participant demographics

All 384 surveys obtained were deemed valid, yielding a response rate of 100%. In particular, 61.2% of the participants were aged between 21-30 years old, while the remaining were 20 years old or less. Meanwhile, 84.6% of the respondents were male, whereas 15.4% were female in gender. In terms of nationality, 84.1% or a majority of them were Malaysian citizens, while foreign nationals made up the remaining 15.9%. A majority of 74.2% were professionals with maritime-related backgrounds, such as fishermen, boatmen, mooring crew, and workers in the shipyard. The remaining 26.3% were either not involved in maritime-related careers or had experience working in the maritime industry. In terms of education, 54.9% of them enrolled in diploma programmes, 41.1% successfully obtained certificates, and the remaining 3.9% previously enrolled in degree programmes. As for the duration of service, 70.1% of the respondents served for four years and less, while 20.3% served for 5 to 10 years. Last but not least, the remaining 9.6% either served outside the maritime field or did not gain any working experience (Table 8).

Table 8: Demographic profile of the participants (N = 384)

Variable	N	%
1. What is your age group?		
20 years and below	149	38.8
21-30 years	235	61.2
2. What is your gender?		
Male	325	84.6
Female	59	15.4
3. What is your nationality?		
Malaysian	323	84.1
Others	61	15.9
4. What is your current occupation?		
Engineer	3	.8
Manager / administrator	2	.5
Consultant	1	.3
Executive	1	.3
Ship/marine surveyor	2	.5
Ship officer (deck/engine)	1	.3
Enforcement officer (marine/coast guard)	47	12.2
Naval architect/marine	2	.5
Accountant	1	.3
Physician	3	.8
Lawyer/legal officer	2	.5
Others relevant to maritime	218	56.8
Not relevant	101	26.3

5. What is your background?		
Professional maritime	285	74.2
Professional non-maritime	31	8.1
Non-professional	68	17.7
6. Please state your highest educational achievement among the options given below.		
Certificate	158	41.1
Diploma	211	54.9
Bachelor's degree	15	3.9
7. What is your duration of service in the occupation?		
Less than 5 years	269	70.1
5-10 years	78	20.3
Not relevant	37	9.6

Confirmatory Factor Analysis (CFA)

In general, CFA is utilised to test the designed hypotheses regarding the degree of which the indicator variables represent the latent variables by using AMOS SPSS. This is undertaken by determining the convergent validity of the constructs in the ensuing analysis (Schumacker & Lomax, 2010). The convergent validity should be supported by: (1) standardised factor loading (standardised regression weight); (2) p-value; (3) construct or composite reliability; and (4) average variance extracted (AVE) (Hair *et al*., 2014). In this study, the p-values and standardised factor loadings for the items were found to be significant, with $p < 0.001$ (*** = $p < 0.001$) (see Table 9). Furthermore, the construct reliability results ranged from 0.844 to 0.949, thereby determined as good construct reliability due to the values exceeding the recommended critical value of 0.7 (Hair *et al*., 2014). Meanwhile, the AVE for all constructs ranged between 0.401 to 0.495, which was less than the value of 0.5 overall as recommended (Hair *et al*., 2014). However, the convergent validity was considered adequate as AVE value of 0.4 was typically acceptable if the composite reliability (construct validity) was higher than 0.6 (Fornell & Larcker, 1981). Before the data from SPSS was transferred to AMOS SPSS, Mahalanobis distance calculation was carried out to identify any outliers in which 67 outliers were identified and unselected from the SPSS data.

The following four constructs successfully verify the current research's conceptual model (Figure. 1): shipboard safety education, shipboard safety knowledge, shipboard safety attitude, and shipboard safety behaviour. The factors used to measure the constructs are listed in Table 9.

Table 9: CFA, Convergent validity test

Construct/factors	Item	Standardise factor loading	p-Value *** p < 0.001	Construct reliability	Average variance extracted
Education					
1. Elementary first aid	SE13	.719	***	0.844	0.401
	SE17	.713	***		
2. Personal safety and social responsibility	SE21	.541	***		
3. Fire prevention and fire fighting	SE10	.593	***		
4. Fire-fighting and life-saving appliances	SE6	.681	***		
	SE7	.713	***		
5. Survival equipment	SE4	.704	***		
6. Personal survival technique	SE1	.430	***		
	SE3	.591	***		
Knowledge					
1. Elementary first aid	SK15	.749	***	0.899	0.472
	SK17	.736	***		
	SK18	.736	***		
2. Fire prevention and fire fighting	SK7	.731	***		
	SK8	.723	***		
	SK21	.675	***		
3. Personal survival technique	SK1	.681	***		
	SK2	.593	***		
	SK3	.634	***		
4. Personal safety and social responsibility	SK20	.589	***		
Attitude					
1. Perception on teamwork and leadership	SA2	.735	***	0.904	0.425
	SA9	.677	***		
	SA10	.588	***		
	SA17	.629	***		
	SA19	.685	***		
2. Management safety commitment	SA14	.713	***		
	SA22	.705	***		
	SA24	.669	***		
3. Work pressure	SA3	.708	***		
	SA25	.393	***		
4. Uncertainty avoidance	SA15	.598	***		
5. Contribution	SA1	.675	***		
	SA11	.630	***		

Behaviour						
1.	Learn and develop	SB53	.671	***	0.949	0.495
		SB54	.715	***		
		SB55	.740	***		
2.	Leadership and managerial skill	SB7	.686	***		
		SB10	.714	***		
		SB11	.742	***		
		SB35	.687	***		
		SB42	.730	***		
3.	Situational awareness	SB20	.778	***		
		SB22	.782	***		
		SB34	.751	***		
		SB41	.748	***		
4.	Result focus	SB29	.683	***		
		SB37	.516	***		
		SB40	.681	***		
5.	Decision-making	SB8	.751	***		
		SB24	.635	***		
6.	Team working	SB1	.623	***		
7.	Communication and influencing	SB15	.678	***		

Discussion

This research aimed to investigate whether the current BT course was sufficient to improve shipboard safety and the impact it posed on seafarers' safety KAB after completing the course. Previous studies e.g. (Bolaños *et al*, 2016; Chang & Liao, 2009; Goodstadt, 1978; Lu *et al*., 2016; O'Connor *et al*., 2002; Röttger *et al*., 2016; van Rensburg *et al*., 1999; Wu *et al*., 2017) have recommended the use of KAB approaches due to their extensive utilisation in other research. To answer the research questions, it was necessary to know which elements could be used to justify whether seafarers' shipboard safety KAB had improved. The elements or otherwise known as factors were determined by: (1) gathering factors from various fields to ensure that no possible factors were omitted; (2) filtering gathered factors using the FFF model so that they were personalised to measure only shipboard safety, and selecting factors based on the FFF model by maritime industrial experts; (3) performing PCA on filtered factors to refine them after the pilot study; and (4) performing CFA on the refined factors to determine the relationship between BT and shipboard safety KAB.

With reference to CFA outcomes, this study indicates that the factors contributing to shipboard safety education construct for seafarers are: "Elementary First Aid", "Personal Safety and Social Responsibility", "Fire Prevention and Fire-Fighting", "Fire-Fighting and Life-Saving Appliances", "Survival Equipment", and "Personal Survival Technique" (IMO, 2017). Meanwhile, the shipboard safety knowledge construct is supported by: "Elementary First Aid", "Personal Safety and Social Responsibility", "Fire Prevention and Fire-Fighting", and "Personal Survival Technique" factors. Accordingly, these are the four constructs that are stipulated in the STCW (IMO, 2017).

In contrast, the shipboard safety attitude construct consists of five factors. This study underlines the suggestion that shipboard safety knowledge taught during a BT course can improve its participants' attitude on "Perception on Teamwork and Leadership", "Management Safety Commitment", "Work Pressure", "Uncertainty Avoidance", and "Contribution". Due to the development of shipboard safety attitude, CFA results showed that BT course, made up of the seven factors of "Learn and Develop", "Leadership and Managerial Skill", "Situational Awareness", "Result Focus", "Decision-making", "Team Working", and "Communication and Influencing", was capable of building a safety behaviour among seafarers. This study found that upon completion of the course, all seven factors of safety behaviour on board were improved indirectly through the BT course despite the participants not being taught about these factors during the session.

These findings suggest that informing the participants directly to exercise all seven factors is advisable as it increases their awareness of such factors. Furthermore, teaching them the core abilities or soft skills is necessary as they aid the students for seizing opportunities offered in the global economy. These core abilities will also help them to create and build the human capital in order to enhance the knowledge, skills, ethics, and morals required for overcoming any challenges (BPTV, 2017).

In general, core abilities or soft skills need to be taught to the students in order to create and build the human capital capable of enhancing the knowledge, skills, ethics, and morals required for overcoming any challenges and seizing opportunities offered in the global economy (BPTV, 2017). Employability and marketability are assessed based on outstanding academic achievements, while high-tech skills are based on one's ability to communicate effectively, lead task undertakings as a team, and think critically (BPTV, 2017).

Therefore, the significance of these factors in real-life situations can be incorporated during the course. For instance, the instructor can emphasise the importance of 'communication and influencing' when conducting safety-related role plays. This element is particularly crucial as communication failure contributes from 20% to 30% of accident occurrences (Gregory & Shanahan, 2010). Incorporating the factor in the role plays will remind the participants that they are responsible for keeping themselves and their team members safe. This study also showed that improving safety on board extended beyond reminding seafarers to wear their safety helmets or adhere to instructions. For them to stay safe on board, exercising all seven factors is not an option. Moreover, the knowledge of these factors needs to be complemented with the appropriate attitude or soft skills (OCIMF, 2018).

Conclusion

Contribution

The study contributed to the field of maritime science in several ways. First, the empirical technique used to assess the impacts or effects of BT on seafarers' safety KAB contributes to the nature of shipboard safety education. This is a particularly influential and actual means of affecting and setting seafarers' safety knowledge, attitude, and behaviour as their preparation prior to working on board a ship. Just like drinking water quenches thirst, education will theoretically improve their KAB. However, in determining whether the current BT is enough to enhance shipboard safety KAB, this approach is found to be important as the findings will help to determine the type and amount of training and exposure needed to provide seafarers with an adequate knowledge on safety.

Secondly, this study positions a recommendation to training institutions that provide BT course and any shipboard safety education programmes in general. The seven domains of "Learn and Develop", "Leadership and Managerial Skill", "Situational Awareness", "Result Focus", "Decision-making", "Team Working", and "Communication and Influencing" can be emphasised during training to set the right attitude among the seafarers, which will later improve their safety behaviour on board. The current study also points to the need for soft skills among them as they can improve their safety on board (OCIMF, 2018).

This research verified the consistency of the current KAB findings versus previously undertaken studies, thereby contributing significantly to the efforts in understanding that education would improve KAB.

Suggestions for future research

Identifying the root cause of accidents

Identifying the root cause of accidents involving seafarers is crucial as it can resolve issues by aiming for the identified factors instead of merely treating the symptoms. The outcomes of the root cause analysis, if used, would allow accidents to be prevented and for the identified root causes to be subjected for correction and elimination purposes. In the context of this study, the research showed that the participants developed positive attitude and behaviour after completing BT. However, other external factors might be affecting these seafarers' attitude towards safety and their behaviour while working on board, thus causing accidents regardless.

It is suggested that research on the root cause of shipboard accidents expand the focus on other possibilities, such as human weakness in handling equipment or management factors. It can be further concluded that studies on the human factors that may affect seafarers' education on the safety knowledge, attitude, and behaviour are important for the total development of shipboard safety.

Impact of ship safety KAB according to curriculum-based application

The current BT is delivered conventionally using classroom theory and the participants are exposed to its practical elements via workshop/ training ground. The impact of BT on KAB can be evaluated if the course is developed by other curriculum-based applications, such as Science, Technology, Engineering and Mathematics (STEM) education or Technical and Vocational Education and Training (TVET) education. STEM and TVET both position the key agenda of producing skilful technical professionals. In particular, STEM education exposes their students to real-world problems and focuses on preparing them to be skilful individuals in STEM-related careers (Wichaidit *et al*., 2019). Meanwhile, TVET education shapes the human workforce towards meeting the requirements set by the job market (Abdullah *et al*., 2019). In the context of seafarers, STEM and TVET educations need to be aligned with BT aims in order to engage the students with the required industrial skills and produce competent seafarers. Nevertheless, BT is a six-day course; implementing the application may not be possible and it is recommended that the curriculum-based applications are applied in the current syllabus.

Acknowledgements

This research was supported by the School of Ocean Engineering, Universiti Malaysia Terengganu and Akademi Laut Malaysia.

References

Abdi, H., & Williams, L. J. (2010). Principal component analysis. *Wiley Interdisciplinary Reviews: Computational Statistics*, *2*(4), 433–459. https://doi.org/10.1002/wics.101

Abdullah, S. A., Saud, M. S., & Kamin, Y. (2019). M-learning for technical and vocational education training (TVET). *International Journal of Recent Technology and Engineering*, *8*(3), 7236–7239. https://doi.org/10.35940/ijrte.C6291.098319

Andrei, D., Grech, M., Crous, R., Ho, J., Mcilroy, T., Griffin, M., & Neal, A. (2018). Assessing the determinants and consequences of safety culture in the maritime industry A report based on the findings of research grant LP130100215.

Bolaños, E. K., Boone, J. R. M., Lauresta, E. V. M., & Calinao, J. R. G. (2016). Effectiveness of basic safety training as perceived by Filipino Seafarers. *Laguna Journal of International Tourism and Hospitality Management*. Retrieved from http://lpulaguna.edu.ph/wp-content/

uploads/2017/07/EFFECTIVENESS-OF-BASIC-SAFETY-TRAINING-AS-PERCEIVED-BY-FILIPINO-SEAFARERS.pdf

BPTV. (2017). Core Ability implementation guidelines. Putrajaya, Malaysia: Kementerian Pendidikan Malaysia.

Chang, Y., & Liao, M. (2009). The effect of aviation safety education on passenger cabin safety awareness. *Safety Science*, *47*(10), 1337–1345. https://doi.org/10.1016/j.ssci.2009.02.001

Daily Mail. (2011). Janet Richardson dies after being dropped in sea during botched rescue attempt on cruise ship | Daily Mail Online. Retrieved November 20, 2018, from https://www.dailymail.co.uk/news/article-1379884/Janet-Richardson-dies-dropped-sea-botched-rescue-attempt-cruise-ship.html

EMSA, E. M. S. A. (2017). *Annual Overview of Marine Casualties and Incidents 2017*. Retrieved from http://emsa.europa.eu/emsa-documents/latest/item/3156-annual-overview-of-marine-casualties-and-incidents-2017.html.

Fabrigar, L. R., Petty, R. E., Smith, S. M., & Crites, S. L. (2006). Understanding knowledge effects on attitude-behavior consistency: The role of relevance, complexity, and amount of knowledge. *Journal of Personality and Social Psychology*, *90*(4), 556–577. https://doi.org/10.1037/0022-3514.90.4.556

Fornell, C., & Larcker, D. F. (1981). Evaluating Structural Equation Models with unobservable variables and measurement error. *Journal of Marketing Research*, *18*(1), 39–50. https://doi.org/10.1177/002224378101800104

Gausdal, A. H., & Makarova, J. (2017). Trust and safety onboard. *WMU Journal of Maritime Affairs*, *16*(2), 197–217. https://doi.org/10.1007/s13437-017-0126-z

Goodstadt, M. S. (1978). Alcohol and drug education: Models and outcomes. *Health Education Monographs*, *6*(3), 263–279. https://doi.org/10.1177/109019817800600301

Gregory, D., & Shanahan, P. (2010). *The Human Element: A Guide to Human Behavior in The Shipping Industry*. The Stationery Office (TSO). Retrieved from https://www.tso.co.uk

Guadagnoli, E., & Velicer, W. F. (1988). Relation of Sample Size to the Stability of Component Patterns. *Psychological Bulletin*, *103*(2), 265–275. https://doi.org/10.1037/0033-2909.103.2.265

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2014). *Multivariate Data Analysis* (7th ed.). Pearson Education Limited. Retrieved from https://www.pearson.com/us/higher-education/program/Hair-Multivariate-Data-Analysis-7th-Edition/PGM263675.html.

Hansen, H. L., Nielsen, D., & Frydenberg, M. (2002). Occupational accidents aboard merchant ships. *Occupational and Environmental Medicine*, *59*(2), 85–91. https://doi.org/10.1136/oem.59.2.85

Håvold, J. I., Nistad, S., Skiri, A., & Ødegård, A. (2015). The human factor and simulator training for offshore anchor handling operators. *Safety Science*, *75*, 136–145. https://doi.org/10.1016/j.ssci.2015.02.001

Hoyle, R. H. (2000). Confirmatory Factor Analysis. *Handbook of Applied Multivariate Statistics and Mathematical Modeling* (pp. 465–497). Elsevier. https://doi.org/10.1016/B978-012691360-6/50017-3

Huang, C., Beatson, A., & Lings, I. (2015). The role that cognition plays in attitude formation : An alternative model for the determinants of attitude. *Journal of Management Research*, *7*(3), 85. https://doi.org/10.5296/jmr.v7i3.7376

IMO. (2017). *International Maritime Organization. (2017). STCW: Including 2010 Manila amendments : STCW Convention and STCW Code : International Convention on Standards of Training, Certification and Watchkeeping for Seafarers.*

ITF. (2010). STCW: A Guide for Seafarers. *International Transport Workers' Federation,*. Retrieved from https://www.mptusa.com/pdf/STCW_guide_english.pdf

Jensen, H., & Oldenburg, M. (2019). Potentially traumatic experiences of seafarers. *Journal of Occupational Medicine and Toxicology*, *14*(1), 4–9. https://doi.org/10.1186/s12995-019-0238-9

Joshi, A., Kale, S., Chandel, S., & Pal, D. K. (2015). Nature of tip-sample interaction in dynamic mode atomic force microscopy. *Likert Scale: Explored and Explained Ankur*, *36*(12 A), 7354–7357. https://doi.org/10.9734/BJAST/2015/14975

Kaiser, H. F., & Rice, J. (1974). Little Jiffy, Mark Iv. *Educational and Psychological Measurement*, *34*(1), 111–117. https://doi.org/10.1177/001316447403400115

Kumar, V., & Dange, U. (2012). A study of factors affecting online buying behavior: A conceptual model. *SSRN Electronic Journal.* https://doi.org/10.2139/ssrn.2285350.

Lappalainen, J., & Tapaninen, U. (2014). MARITIME PERSONNEL ' S SAFETY ATTITUDES, (February).

Leedy, P. D., & Ormrod, J. E. (2010). *Practical Research: Planning and Design*. *Practical Research - Planning & Design*. https://doi.org/10.1161/STROKEAHA.113.003048

Lu, C., Hsu, C., & Lee, C. (2016). The Impact of Seafarers' Perceptions of National Culture and Leadership on Safety Attitude and Safety Behavior in Dry Bulk Shipping. *International Journal of E-Navigation and Maritime Economy*, *4*, 75–87. https://doi.org/10.1016/j.enavi.2016.06.007

Luin, J. C. C. (2012). *Press Statement - One More Lesson in Safety*. *THE INSTITUTION OF ENGINEERS, MALAYSIA* (Vol. September). Retrieved from http://www.myiem.org.my

MAIB. (2000). *Report of the investigation of the fire on board the fishing vessel Be Ready*. Retrieved from https://www.gov.uk/maib-reports

MAIB. (2016). Marine Accident Invetigation Branch (MAIB) Annual Report 2015, (July 2016). https://doi.org/10.1186/s12957-015-0640-4

MAIB. (2018). *Fatal man overboard from fishing vessel Varuna west of Camusterrach on the north-west coast of Scotland*. *MAIB Accident Report* (Vol. 2008). Retrieved from https://www.gov.uk/maib-reports/man-overboard-from-creel-fishing-vessel-varuna-with-loss-of-1-life

Matoskova, J. (2016). Measuring knowledge. *Journal of Competitiveness*, *8*(4), 5–29. https://doi.org/10.7441/joc.2016.04.01

Napoleone, P. (2016). Accidents on board merchant ships. Suggestions based on Centro Internazionale Radio Medico (CIRM) experience. *International Maritime Health*, *67*(1), 21–23. https://doi.org/10.5603/IMH.2016.0005

OCIMF. (2018). *Behavioural Competency Assessment and Verification for Vessel Operators* (1st ed.). OCIMF. Retrieved from https://www.ocimf.org/media/112105/Behavioural-Competency-Assessment-and-Verification.pdf

O'Connor, P., Hörmann, H., Flin, R., Lodge, M., Goeters, K., & JARTEL Group, T. (2002). Developing a method for evaluating crew resource management skills: A European perspective. *The International Journal of Aviation Psychology*, *12*(3), 263–285. https://doi.org/10.1207/S15327108IJAP1203_5

Piaw, C. Y. (2009). *Statistik Penyelidikan Lanjutan Ujian Regresi, Analisis Faktor dan Analisis Sem*. Kuala Lumpur.

Roberts, S. E., Nielsen, D., Kot owski, A., & Jaremin, B. (2014). Fatal accidents and injuries among merchant seafarers worldwide. *Occupational Medicine*, *64*(4), 259–266. https://doi.org/10.1093/occmed/kqu017

Röttger, S., Vetter, S., & Kowalski, J. T. (2016). Effects of a classroom-based bridge resource management training on knowledge, attitudes, behaviour and performance of junior naval officers. *WMU Journal of Maritime Affairs*, *15*(1), 143–162. https://doi.org/10.1007/s13437-014-0073-x

Schrader, P. G., & Lawless, K. A. (2004). The knowledge, attitudes, & behaviors approach how to evaluate performance and learning in complex environments. *Performance Improvement*, *43*(9), 8–15. https://doi.org/10.1002/pfi.4140430905

Schumacker, R. E., & Lomax, R. G. (2010). *A beginner's guide to structural equation modeling* (3rd ed.). New York: Routledge/Taylor & Francis Group.

van Rensburg, S., Ankiewicz, P., & Myburgh, C. (1999). Assessing South Africa learners' attitudes towards technology by using the PATT (Pupils' Attitudes Towards Technology) questionnaire. *International Journal of Technology and Design Education*, *9*(2), 137–151. https://doi.org/10.1023/A:1008848031430

Wichaidit, S., Assapun, S., Putwattana, N., Joongpan, C., Tabthong, S., & Chowicharat, E. (2019). The STEM flower: The designing tool for effective STEM instruction. https://doi.org/10.1063/1.5094013

Wu, X., Yin, W., Wu, C., & Li, Y. (2017). Development and validation of a safety attitude scale for coal miners in China. *Sustainability*, *9*(12), 2165. https://doi.org/10.3390/su9122165