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Ocean Navigational Skills and Professional Training: An empirical analysis on Tamil Nadu Deep-sea fishermen, India

S. Viswanathan[1,*], Ashutosh Apandkar[2], K. Sivasam[3]

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ABSTRACT

There is always a chance that the rise in mishaps for deep-sea fishing may be related to the fishermen's lack of formal professional training. This raises the issue, "Are the fishermen's navigational skills sufficient to prevent the mid-sea collision and to adapt to the latest technological development in the deep-sea fishing industry?"
The goal of the study was to determine their navigational skills, which involved 405 deep-sea fishermen from geographically dispersed fishing harbours of Tamilnadu, India. Data from the fishermen were gathered using a structured questionnaire; the dependent variables being navigational skill, while the independent factors were age, formal education, and sea experience.
The demographic variables and the navigational skill were analysed by percentage analysis. Perception analysis and unstructured interview were also carried out. Chi square test was employed to test the hypothesis "Formal education has influence on the self-taught navigational skill of the Tamilnadu fishermen" and it was rejected.
This demonstrated that irrespective of formal schooling, additional professional training is required to improve fishermen's navigational knowledge, and in turn to improve deep-sea fishermen's navigational skills.

1. Introduction.

The fishermen often fish close to the coast, but occasionally they venture farther afield to the Exclusive Economic Zone in pursuit of fish. Fishing on the high seas requires more advanced preparation for vessel management, navigation, and fishing techniques in addition to a multiday stay at sea and interaction with other international maritime traffic. Navigation is the act of moving a ship from one place to another or the science of finding a way from one place to another. Such a movement needs the direction of the travel, its own position and moving speed at all times to orient itself and manoeuvre the ship by overcoming the adverse effects of the external factors. Because of the vastness of the sea, disorientation is frequently inevitable. It takes extraordinary abilities for man to navigate the seas.

Ancient navigators used the wind, waves, and direction of the waves, as well as heavenly bodies(Tyson, 2007). Charts depicting the earth's surface have been created recently, and grid representations are frequently used in two-dimensional depictions of earth's surface. These grid systems are used by contemporary electronic devices to indicate a ship's position at sea. The sophisticated navigation systems of today's marine navigation comprise a 360-degree compass system, a grid-based position representation, contemporary electronic equipment for transmitting this data, and the technical know-how to employ this technology for a variety of navigational purposes (Boopendranath, 2012).

Technical knowledge and abilities as well as non-technical abil-

[1]Associate Professor, School of Nautical Studies, Indian Maritime University, Chennai-600119, India, email ? viswanathans@imu.ac.in.
[2]Principal, TS Rahaman, Nhava, Raigarh, Panvel, Navi Mumbai ? 410206, India, email - a.apandkar@tsrahaman.org.
[3]Professor, School of Marine Engineering and Technology, Indian Maritime University, Chennai -600119, India, email - ksivasami@imu.ac.in.
[*]Corresponding author: S. Viswanathan. E-mail Address: viswanathans@imu.ac.in.

ities including interpersonal and cognitive skills are needed for safe and efficient navigation. The navigator uses cognitive skills to help with situational awareness and decision-making. Interpersonal skills support teamwork, leadership, and communication and they become prerequisite for vessel management. There are three phases to developing navigational skills. The foundation for the second level of navigational skills is the first stage, which is navigational knowledge. One could acquire knowledgethrough self-study at work or through theoretical learning. In the case of the marine fishing sector, the ability to navigate is self-taught because there is no formal training is available to the fishermen at present and it also requires experience and rudimentary understanding. These skills are refined in the third stage, known as the navigational attitude, which focuses on building capacities to enable sustainable work execution. These three stages thus encompass the complete process of skill development.

Today's fishermen are self-taught, having learned from both their own experiences and those of their forebears. Ability to operate as a team, be self-motivated, learn from mistakes, have the proper attitudes, and be self-assured is the necessary qualities for the fishermen's fishing expedition to be sustainable. The main areas include fishing techniques, vessel construction, and fishermen's navigational processes and the fishermen are self-taught in these skills. When it comes to the marine fishing sector in India, the fishermen learn how to navigate at sea from their personal experience. Because there is no theoretical knowledge transfer involved, the fishermen may not have completely updated the navigational knowledge that they have learned at sea. It could be evident through the researcher's observation that through the side light fittings in their craft's. The vessel is equipped with red and green lights on the port and starboard sides, respectively. However, because of the fitting of lights require theoretical knowledge to understand the criteria, these lights do not comply with the range and arc of visibilities standards as specified in the Collision regulations – 1972[4]. On the other hand, the skills are developed out at sea. If the fishermen do not apply their mindset to the proper use of their skills in order to maintain sustainability, even their learned skills will not be sufficient for a sustainable fishing enterprise. As a result, the fishing industry's requirements on navigational skills are being met, often not taking into account recent advancements in the sector. Consequently, the industrial requirements and the extent of their maritime exposure limit the abilities that the self-taught fisherman can acquire.

Going great distances in quest of fish becomes inevitable due to the diminishing fisheries resources near shores and the growing fishing vessels counts. This means that the international regulations must be complied much like merchant fleets do. Additionally, the rising number of maritime collisions involving fishing vessels raises a variety of concerns. It is vital that sectors with shared platforms function in a comparable manner to ensure a safe and effective output. All kinds of vessels, including fishing vessels, must navigate on an equal footing in the maritime environment for a safe operation. Competent and certified sailors who have undergone a rigorous training programme, standard evaluation procedure, and certification process serve the merchant vessels[5]. However, fisherman who operate aboard fishing vessels are self-taught and do not go through any such training.

In examining the cause of the recent surge in maritime mishaps and motivating fishermen to pursue successful far away fishing, the inquiry that needs to be addressed is whether self-taught fisherman possess enough navigational abilities comparable to those of merchant vessel seafarers who undergo competency evaluations.

Problem statement: Is the self-taught navigational skills of the fishermen are sufficient for safe navigation of the vessel at sea?

Hypothesis: Formal education influences the self-taught navigational skill of the fishermen.

Objective: To determine the socio-demographic characteristic and the navigational skill level of the fishermen.

The study's findings may reveal the degree of self-taught fishermen's navigationalproficiency. The outcome could be examined to see whether the fishermen's navigational abilities are sufficient for the expanding deep-sea fishing sector for a safe and sustainable navigation and fishing operation or further structured training is required for improving their navigational skills. The policy-makers could be approached with suggestions for any remedial actions.

2. Theoretical Framework.

2.1. Navigational skills of the fishermen.

The self taught process in navigation of the fishermen could be traced back to very early ages. Ancient open navigation in Indian water was carried out with the help of star and sun azimuth besides using wind direction was according to the seasons(Tripati, 2015). Similar technique was used all over the world also. Early navigation in north sea was carried out with the help of lead line to measure the depths, used stars for finding direction and position at sea(Kemp and D'Olier, 2016).

Spatial orientation is an important skill in determining one's own position during the navigation. Perception, attention, memory, and decision-making must all be dynamically integrated in the multimodal process of spatial navigation (Ekstrom, Arnold and Iaria, 2014). Moreover, maintaining the representation of our true position and our intended destination requires that we orient ourselves within space (Merhav and Wolbers, 2019).(Seminati et al., 2022) reports that though using a multisensory GPS (Global Positioning System) in a virtual reality games could be beneficial to improve navigation performance, it could reduce the spatial orientation abilities of the personnel. Similarly,

[4]Convention on The International Regulations for Preventing Collision at sea – 1972 specifies that side light means a green light on the starboard side and a red light on the port side each showing an unbroken light over an arc of the horizon of 112.5º and so fixed as to show the light from right ahead to 22.5º abaft the beam on its respective side.

[5]Standards of Training Certification and Watch keeping – 1995 sets the training standards and watch keeping requirements for the seafarers working on board sea going vessels and India has adopted the convention and implemented the certification and training process for Indian Seafarers.

modern positioning system could help the navigator of accurate position and direction which may lead to spatial disorientation when such equipment fails. The standard spatial techniques for navigation activities are those based on maps and beacons (Liu et al., 2022) and it does, however, demonstrate how our dependence on these navigational aids is deteriorating our spatial abilities. According to (Huston and Hamburger, 2023) there is a correlation between a decline in social interaction and navigation abilities (i.e., cognitive skills) and an increase in the usage of navigation aids. It is the individual and thus a character-dependent interaction that needs to be taken into consideration, not the navigation system itself. Even at the most basic level of spatial cognition, it is evident that improper or incorrect use of navigation systems affects our capacity for spatial cognition.

2.2. Self-learning abilities.

Self-taught is having knowledge or skills acquired by one's own efforts without formal instruction or training. In general the self-taught learner has the gap of direct communication with their teacher and the modern communication tools could be used to enhance the communication with the teachers effectively (Role et al., 2002). Generally, these learners are self-directed and are often Collaborative, Participant and Independent (Siew Foen Ng, 2010). Moreover, for the lifelong learner, Information and Communication Tools (ICT) are important for assisting in the self-learning process. Besides using the ICT tools such as desktops, laptops, tablets and also phones, they could be able to safely find valuable and verifiable information on the Internet and be creative (Graham Rich, 2017).As the knowledge and skills were passed through generations, competition and experience as a fisherman in a location close to the centre of fishing activity also enhanced the fishermen's self learning capacity in Indonesia (Zulkarnaen, 2021). Further, in the self-learning process, self learned knowledge is difficult to be explained (Ervik et al., 2022) and the learner could not create the necessary feed-back which will eliminate the feel of isolation of self-taught learner and motive them in the learning process. Further, the self-taught learners naturally have higher "interpersonal skills" and "learning skills" (Shobeiri, 2023). In the case of fishermen in marine fishing industry, the self-taught fishermen learn from their experience alone and or from their ancestor. The skills they learn at sea are unique as they could only be learnt at sea. Similarly, the navigational knowledge is gained through the interaction with environment as it is done for the skills.

2.3. Training needs.

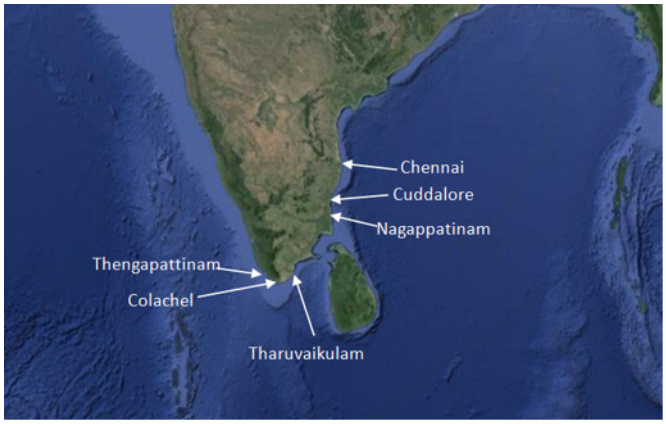
According to (Kaul, Thiagarajan and Balasubramaniam, 1987), though the self-taught fishermen of Kerala ensures their skills are updated, more trainings are needed to improve their income and the socio demographic factors as they were inter correlated with trainings.(Alvarez Perez et al., 2009) reports that in Philippines, though the marine industry is self-taught, training to the fishermen on practical navigation and seamanship is necessary for ensuring productivity and food security besides enhancing knowledge, skills and competencies. Further, a study conducted by (Bolong et al., 2014) in learning how to use the Global Positing System revealed that though 42.9 per cent of the Malaysian fishermen needed 'teacher' in training them how to use GPS, 47.9 per cent of them practiced the technique of 'trial and error' in order to enhance their GPS skills. Awareness and training programs for the fishermen were stressed in the state of Kerala (Saha, 2014) and Indonesia (Ogunremi, 2016) as there were absence of education and inadequate alternative sources of livelihood. In Indonesia, support was given by Food and Agriculture Organisation in the form and training and capacity building for reducing Illegal, Unreported and Unregulated (IUU) fishing (Tarigan, 2018).Thus, in order to increase the job opportunities for fishermen worldwide, raise the calibre of the crew members of fishing vessels, and get international recognition for their crew members, Indonesia adapted the STCW-F (Pramoda et al., 2021) and training their fishermen.

3. Methods and measures.

3.1. Study location.

Six fishing harbours from Tamilnadu, India, spread geographically, were used for the investigation, which involved 405 samples. The fishing harbours on the Coromantel Coast were Chennai (125), Nagappatinam (40), and Cuddalore (15), while the fishing harbours on the Gulf of Mannar Coast was Tharuvaikulam (51) and in the Malabar Coast they were Colachel (54) and Thengappatinam (125). The geographical dispersion of the research region allowed for coverage of the entire state of Tamilnadu without sacrificing demographic accuracy.

Figure 1: Schematic diagram showing the relative of the antecedent, independent and dependent variables.



Source: Google maps.

3.2. Sampling.

Data on socio-demographics traits and answers to the questions about navigational skills were gathered from the fishermen using a standardised questionnaire. Perception analysis was occasionally conducted during the data gathering process using an unstructured approach as well. In this study, four categories of the navigational skills were the dependent factors, and age, education, and experience were the independent variables.

3.3. Instruments.

The investigation focuses on navigational skills of the fishermen that are divided into technical and non-technical categories. Technical skills are the ones that directly relate to a vessel's navigation, such as equipment operation and navigational technical skills. Conversely, non-technical skills are those that use interpersonal and cognitive skills to assist the total navigational capabilities.

The subdivided 4 skills were assessed through 10 questions each on an ordinal scale. The navigational technical skill was assessed by the following 10 navigation related questions as shown in table 1. The responses were taken into an ordinal scale of "none", "little", "medium" and "full".

Table 1: Questions used in assessing the navigational technical skills of the respondents.

S. No	Navigational technical questions
1	Reading of latitude and longitude from GPS
2	Reading of inter-cardinal direction (NE, SE, SW, NW) from the compass
3	You can find distance of other vessels
4	Finding out the arrival time (ETA) to the way point
5	Finding out distance travelled from noon to noon
6	Able to use shore objects such as light house, break water head, towers, buoys, beacons etc. for navigation
7	Avoid restricted areas, offshore structures, and underwater construction when navigating.
8	Able to use of transit bearings for positioning of vessel
9	Able to use celestial objects such as sun, star for finding time at sea
10	Able to use celestial objects such as sun, stars, planets, moon for finding direction at sea

Source: Authors.

The navigational equipment operational skills were assessed through the following 10 equipment operational related questions as shown in table 2. The respondents answered in an ordinal scale of "never seen", "never operated", "can operate" and "operate and maintain".

Table 2: Questions used to assess the equipment operational skill of the respondents.

S. No	Equipment operational questions
11	GPS
12	Echo-sounder
13	AIS
14	Magnetic compass
15	Electronic chart / chart plotter
16	Radar
17	Navtex, Navic, GEMINI
18	Barometer
19	Anemometer
20	VHF

Source: Authors.

The cognitive skill which is the part of the non-technical skill was assessed through the following 10 questions related to situational awareness, decision making and work management as given in table 3. The responses were taking into ordinal scale of "never", "At times", "Most times" and "Yes always".

Table 3: Questions used to assess the cognitive skill of the respondents.

S. No	Cognitive skill questions
21	You keep good look out ahead and astern at all times
22	You determine the direction of travel of other vessels as soon as it was detected
23	You use binocular for searching for targets
24	You check for sound signal of other vessels in restricted visibility
25	You keep a watch on AIS to look for other vessels
26	You do not ask others for taking avoiding action
27	you always take action n crossing situation
28	You avoid collision by change of course alone
29	You use wind, wave and current to reach faster
30	You consider weather condition when hauling net

Source: Authors.

The interpersonal skill of the respondents was assessed through asking following 10 questions related to the communication, leadership and team work onboard vessels as shown in the table 4. The answers were assessed through ordinal scale of "never", "At times", "Most times" and "Yes always".

Table 4: Questions used to assess the interpersonal skill of the respondents.

S. No	Interpersonal skill questions
31	You share navigational information with other navigators
32	You call other vessel for changing course, when they are not taking action
33	You report to owner when damage to vessel and equipment occurs
34	You contact shore office for getting help during rough weather
35	When a collision situation occurs, you observe 2nd driver's action.
36	When in open sea you give navigational duty to other personnel for training
37	Keep additional lookout in traffic area
38	When you do mistakes, your share with others so that it does not occur again.
39	When other navigating personnel does a good job you appreciate them for the good work
40	You consult others when taking navigational decision in rough weather

Source: Authors.

3.4. Participants.

The researcher visited the fishing harbour regularly and chosen the fishing vessel and selected the respondents conveniently. Only those fishermen who involved in the navigation of the vessel were taken into account for the study. Usually, just one fisherman known as the engine driver is in charge of navigation; he may occasionally receive assistance from another fisherman, known as the second driver, who is able to assist the engine driver. Since drivers are the ones who make navigational decisions and are intimately involved in the process, this could increase accuracy.

3.5. Result analysis.

Percentage analysis was employed to present the result in bar diagram besides using mean, medium and mode to represent the centre tendency. Score was assigned to each question in an ordinal scale of 1 to 4 and sum of the score was used to test the hypothesis against the category of the respondents based on their school education. Chi square test was employed to test relationship between the demographic characteristics and the self-taught navigational skills.

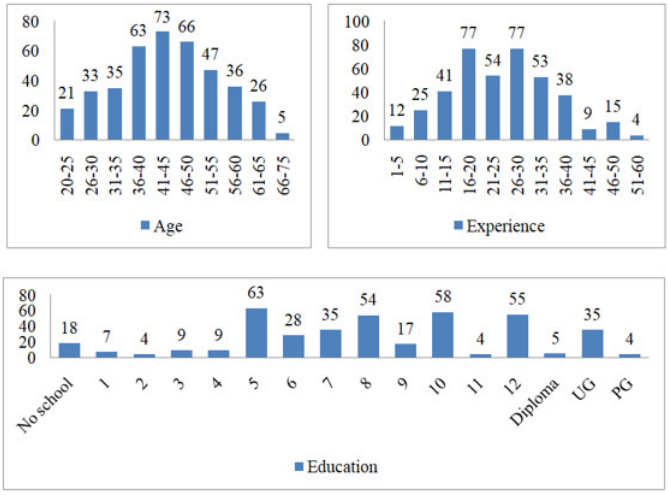
4. Results.

The demographic characteristics of the respondents and their navigational skill result are given below.

4.1. Age.

The average, median, and mode age of the respondents were found to be 44, 44, and 42respectively. This resembles the average age (40 years) of the fishermen in Nigeria, Akwa ibom state studied by(Frank et al., 2019).In Alexandria, Egypt, (El-Saadawy et al., 2014) reported in his study on the occupational health hazard among the fishermen that 40% of the fishermen are beyond 40 years old. Referring to the figure 2, the medium age group (41–45) accounted for 18% of the respondents (73) and was followed by 46–50 (16.3%) and 36–40 (15.6%). Of the respondents, 5.2% (22) were younger than 25 years old and were in charge of the entire vessel's operation when at sea. This is similar to (Ansuya, Majula and Jane Maria Serrao, 2014) study in Udupi district of India and she reported that majority of the fishermen (40%) is from 31 to 40 age group. Five (1.2%) of the responders were also older than 66. From the study it is clear that, most of the fisher youth join the sea for fishing at the age of around 18 years without pursuing higher studies and work up to 70 years.

Figure 2: Age, Experience and Education of the respondents.



Source: Author.

4.2. Experience.

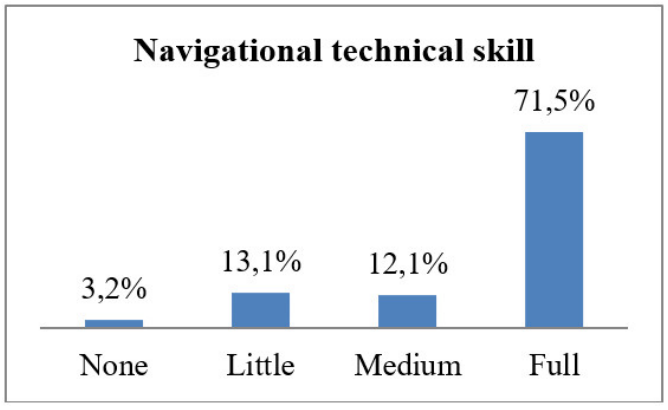
The average, median, and mode of the respondents' experiences were determined to be 26, 25, and 20 years, respectively. Referring to the figure 2, in the 16–20 and 26–30 year groups, there was a higher level of experience (19.0%) each. Four respondents had more than 51 years in the experience group. From the study, it is clear that the fishermen set the fishing profession as their carrier. It becomes their livelihood. Further, the marine fishing industry has very experienced fisher group.

4.3. Education.

The average, median, and mode of the respondents' school completion times were found to be 8, 8, and 5 years, respectively. Referring to the figure 2, thirty-three respondents, or 15.6%, have finished the fifth grade. Correspondingly, the percentages of completed respondents in classes 8, 10, and 12 were 13.3%, 14.3%, and 13.6%, respectively. Of the respondents, 4.4% (18) had never attended school. 10.9% of the respondents, or 44 people, had completed higher education and work in the fishing sector.(Ansuya, Majula and Jane Maria Serrao, 2014) reported in her study in Udupi dist. that higher primary is the education level of 30% of the fishermen. In Alexandria city, Egypt, 26% of the fishermen have underwent primary education as reported by (ElSaadawy et al., 2014) on his study on the occupation health among the fishermen. It is inferred from that study that the formal education level in the industry is low. It is also a good sign that higher educated fishermen also available in the industry, which could help them to acquire the navigational knowledge efficiently.

4.4. Navigational technical Skill.

Figure 3: Navigational technical skill of the respondents.

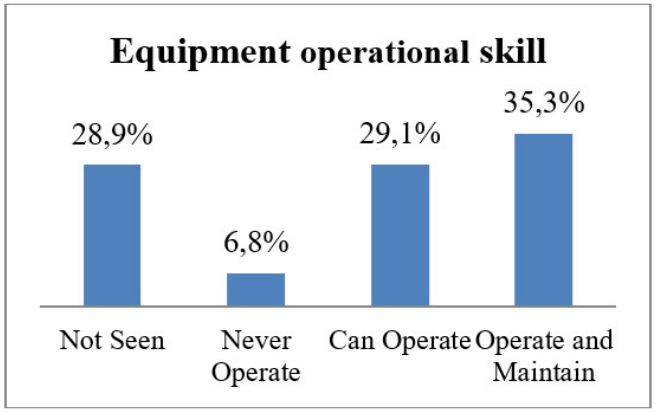


Source: Author.

Navigational technical skill refers to the application of various calculations related the navigation of the vessel. Over 71% of the respondent's answer was found that they could do a complete job. The technical skill plays a major role in safe and efficient completion of the voyage of the vessel. More over the skill is gained through their own experience and hit and trial methods. There are lacks identified in the navigational technical skill. 16% of the responses were belonging to none or little technical skill. This lacking could be due to their exposure limit at sea which could be a deciding factor for their knowledge and skill development. The short comings could be overcome through theoretical knowledge from in the form of structured training. Further, according to (Ervik, Østern and Strømme, 2022b), in a self-taught industry, the navigational knowledge and skill of the fishermen were self taught and that could not be explained by them and did not have any relevance to the school studies. So, the schooling does not have any relevance in the navigational knowledge of the fishermen.

4.5. Equipment operational skill.

Figure 4: Equipment operational skill.



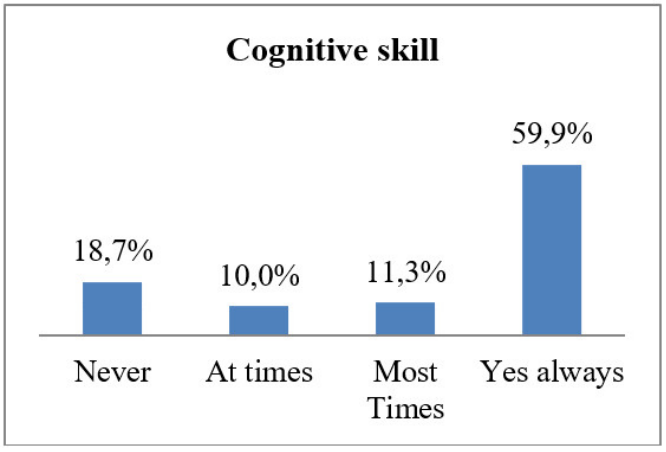
Source: Author.

The equipment operational skill spreads nearly evenly from "not seen" to "operate and maintain". The result showed that VHF (Very High Frequency) Radio, GPS (Global Positioning System), AIS (Automatic Identification System) and Electronic charts were very commonly used navigational equipment among the respondents. 35% of the respondents could operate and maintain the equipment. This they could have learnt by themselves as there are no formal training was provided to the respondents. (Omar, Zobidah et al., 2011) reported that in Malaysia, GPS is one of the most preferred ICT tool used by the fishermen for position and identifying location of fishes. However, many of the modern electronic equipment such as RADAR (Radio Detection and Ranging), SONAR (Sound Navigation and Ranging), NavIC (Navigation in Indian Constellation) messaging services, Navtex, barometer and anemometer were not installed onboard the vessel nor they were aware of such equipment.(Benard and Dulle, 2017) reported that in Zanzibar, 82.5% of the respondents never used SONAR. Moreover, these equipments are important or navigational decision making when engaged in deep sea fishing operations. Further it is the need of the hour for the fishermen to start using these meteorological equipments or services for onboard decision making to avoid adverse weather conditions.

4.6. Cognitive skill.

Cognitive skills are the one which is inbuilt within oneself. On an average, close to 60% of the respondent's answer was "Yes always" for the questions on cognitive skills. The situational awareness among the respondents was poor in some area (59% of the respondents do not use binocular). This could be as they do not carry binocular for keeping a better look out. On the other hand 82% of the respondents try to find out the direction of the travel of any other vessel as soon as they are detected. Moreover, keeping a watch for a sound signal during restricted visibility is also poor as the restricted visibility condition at sea is generally a rare phenomenon. This also revealed that their knowledge and skill developed and limited in relation to their exposure at sea.

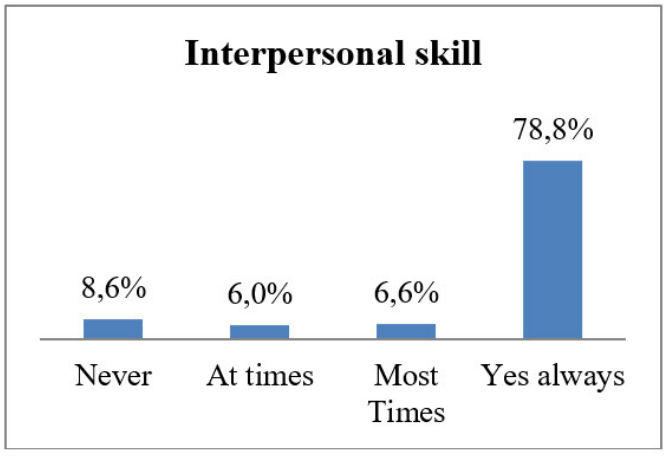
Figure 5: Cognitive skill of the respondents.



Source: Author.

4.7. Interpersonal skill.

Figure 6: Interpersonal skill of the respondents.



Source: Author.

78.8% of the responses were "Yes always" in the case of the interpersonal skill. Leadership and the team work are directly related to the successful operation which in turn makes a good financial success. In this study, sharing the navigational information to the other driver, reporting any damages to the boat owner and appreciating the colleague when have done a good job are the questions which received over 95% of the responses as "yes always". This indicated their efficient team work on board vessel. However, on communication skill, 25% of the responses to asking for help from shore authorities during rough weather were "never". This could be due to non-availability of communication equipment or their high confident level in handling the situations by themselves arising at sea.

It could be concluded that the navigational skills could be developed to the requirements of the industry even when there are no formal training program is available. However, the self-taught skills gets refined with the help of two associated factors, knowledge and attitudes which are necessary to support the skill to be tuned so that even at the time of emergency, it can be advantages to the vessel.

4.8. Hypothesis testing.

The researcher tested the influences of the formal education with the self-taught navigational skill of the fishermen by establishing the following hypothesis. Chi Square tool was used for carrying out such test. The hypothesis and null hypothesis were set as below.

H0 = Formal education does not influence the self-taught navigational skill of the fishermen

H1 = Formal education influences the self-taught navigational skill of the fishermen.

Table 5: Hypothesis testing.

Category	Navigational Skill	Equipment Operational skill	Cognitive skill	Interpersonal skill	Chi Square	Critical value
10th and below	35.7	25.1	30.8	35.6	0.91	7.815
Beyond 10th	33.6	32.8	32.5	35.6		

Source: Authors.

Referring to table 5, the χ^2value 0.91is less than the critical value of 7.815 and hence the H0 is accepted. So, the formal education did not influence the self-taught navigational skill of the fishermen. It revealed that formal education's contribution in developing navigational skills is insignificant. Also, it could be concluded that self-taught navigational skill could be polished with the help of sound navigational knowledge which could be developed with the help of professional training only and not by the formal education. However, basic schooling is necessary which can support the theoretical background to help to acquire navigational knowledge and further that could help the skills to be properly polished in line with the industry requirements. In short, the study shows that the school education is irrelevant for the present self-taught navigational skills of the fishermen. However, in order to gain the navigational knowledge, schooling may be necessary through which language skills could be developed to enhance the navigational knowledge and further; the navigational skills could be developed.

Conclusions.

The marine fishing industry is very dynamic and navigation of the vessel becomes an important task performed on board vessel. As many of the industry training sector is unorganised, marine fishing is one such industry where there are no formal professional trainings, provided neither prior joining the work nor during the working at sea. To make their livelihood, they have to learn the required skills themselves and update as and when required. Further the fishermen need set of skills for making it as their carrier. Navigational skills are the prime most one. These skills are learned by the fishermen while working at

sea from their experience and passed from generation to generation as it is self-taught. Moreover, when the knowledge gained through the theoretical studies are experimented in the field the skills are further developed and tuned. However, the fishermen's nautical knowledge is learned from their experience same as the skills. This makes the navigational knowledge limited to their exposure level as well. Further the attitude ensures effective use of the skills. The attitudes are the personnel qualities that can be enhanced through awareness program.

Form the study; it is also clear that, in absence of the professional training for the fishermen, they could develop skills required for maintaining their livelihood through self-taught methods. However, the lack in the navigational knowledge due to poor education, limits the skill development to a certain level, where they could not further refine their skills to the need of emergency handling. This was evident through the losses to the Ockhi cyclone. Many vessels were lost along with fishermen due to their poor decision making skills on the weather updates(FAO, 2019) and an increase in collision incidents near the International Maritime Traffic Route (IMTR) off the South West coast of India (www.thehindu.com). The reasons are poor navigational skill due to non displaying correct night signals and lack of watch keeping procedures.

When there is no formal training is available for the enhancing the skill in the isolated profession like marine fishing, the self learning becomes inevitable as the good catch is the primary requirement for making their livelihood. So, the industry personnel gain abilities them self or from their earlier generation in order to sustain in the industry. When doing so, they could gain knowledge, skill and attitude to the level of their exposure in to the sea and the area of operation.

It was also noted through unstructured questionnaire that no structured training existed for the fishermen to enhance the skill required for sea voyages. So, the knowledge and skills acquired by the respondents were all self-taught. When the fishermen grow older and experienced, they become better skilled and matured in navigational procedure compliance. However, their ability to gain navigational knowledge becomes poor. (Merhav and Wolbers, 2019)studied the aging and the updating of the navigational memories and revealed that the deficit in updating navigational memories in older adults was selective to the egocentric navigational condition. They further found that spatial learning and memory often show substantial inter-individual differences, and particularly in aging. So, the self-learning to gain navigational knowledge is poor in the case of experienced fishermen. Further the knowledge is the base for acquiring skills. The fishermen acquired navigational skills from their own experience and it is self taught. So, when the knowledge base is poor and hence the skill level also has a gap. This brings the gap in the skill level of the fishermen. According to (Uebel et al., 2024),the self-directed learning skills can be developed in the presence of a one-to-one mentoring relationship with a research supervisor with structured guidelines and support from the faculty, and membership of a research team. Further, the self-taught atmosphere motivates the fishermen to develop skills and attitudes as they directly depend on the profit that they make through efficient operation of the vessel at sea. The marine fishing industry is self-taught as there are no formal training is provided to them to enhance their knowledge and skills at sea. Recent collision incidents involving fishing vessels are a great concern and the developing of the deep-sea fishing industry is not taking with a full speed as expected due to challenges in the industry.

So, the self-capacity and the level of formal and non-formal education of the traditional fishermen needs to be improved to meet the industrialisation and sustainable fishing(Zulkarnaen, 2021). Similar study could be extended to the safety and operation of the fishing vessels in the self taught condition to understand the overall efficiency of the fishing vessels. The policy makers may plan for training programs which could enhance their navigational knowledge and intern the navigational skills and attitude for safe and efficient operation of the fishing vessels.

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