

DEVELOPMENT OF MARITIME EDUCATION AND TRAINING THROUGH HUMAN-WARE UPGRADING

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Abstract: The need for a new approach in Maritime Education and training (MET) has become essential, competency based training and formal education does not have the same effect on seafarers as it did ten years ago. The vast development in technology and new discoveries in neuroscience are introducing new tracks through which MET systems could be upgraded and enhanced. Considering the mental health of seafarers and developing their cognitive and intellectual capabilities through education, parallel to the application of new lifestyle choices, could upgrade seafarer's mental capacities and intelligence, to be much more efficient in acquiring, memorizing & recalling knowledge, and thus better enable them to take proper decisions to reduce the potential of human error.

1 INTRODUCTION

Statistics of marine accidents trends have shown a decrease in accident rates during the past five years. Mostly, results of accident investigations and researches have declared that human errors have the responsibility of more than 85% of the causes behind marine accidents. Despite the International Maritime Organization's predominant role in the development and amendment of its instrument's to reduce and control that problem. Yet, the human element is still making mistakes that inherently, have the potential to lead to more accidents.

Quoting Einstein, "*We cannot solve our problems with the same thinking we used when we created them*" [2]. The solution cannot be applying the same remedy if the result is not changing; it is time to try a new prospective, or at least approach from a different angle of thought. To enhance marine officer's performance and efficiency, their cognitive and intellectual capabilities have to reach a certain level of intelligence and must be cognitively assessed periodically, empowered & made to benefit from the wealth of knowledge & experience that has become available through technology, modern day communication and new researches in neuroscience.

While Humanware is defined in IT as "*hardware or software that is built around user capabilities and user needs. This often involves creating a particular visual or physical interface for a given set of users*"[22]. However, for the purpose of this

paper, Humanware means “the Mental capabilities of workers especially those working in difficult occupation like seafarers: that could be upgraded or reshaped through education and training to be much more efficient to perform certain tasks properly or increase the cognitive abilities to ensure efficient mental functioning and response. The adaptation of Humanware will be through its internal software (brain plasticity and external software (brain training).

Equally important, mental health is “*the result of the interaction between biological, psychological and social factors and increasing evidence point to work related factors that play a key role in the development of mental health issues in the workplace*”[7]. According to the World Health Organization, key factors include workload, lack of control, monotonous work tasks, role ambiguity, conflict, poor interpersonal relationships, poor working conditions, and inequity [7].

Mental ability represents a person’s “brain power” in different aspects of competency, including verbal, mathematical, spatial, and logical reasoning, which is one of the most important components of functional abilities for a worker [5].

2 MENTAL HEALTH OF SEAFARERS

Seafaring is a high-risk occupation with a unique working environment from the physical and psychosocial point of view. Ships’ crews are facing different challenges that acutely influence their mental health and behavior which include; solitude, dangerous settings, poor working conditions, lengthy periods away from home and family, limited options & free time, poor work relations, lack of shore leaves, intercultural differences and job insecurity, all which have been linked to stress, anxiety, fatigue, depression, alcohol and substance abuse and poor mental health [15].

In addition seafarers are facing latent difficulties in the surrounding working environment they live in for prolonged periods of time such as noise, vibration, temperature changes, electro-magnetic fields and isolation, all of which can be directly related to dangers such as accidents, injuries and diseases [8].

This working environment with its many psychological & physiological variants incorporates many health problems, including suicide, depression, anxiety, alcohol or drug dependence. Psychological health also relates very strongly to many life-style associated health problems found in the other thematic categories; such as cardiovascular disease, diabetes and sexually transmitted disease [16].

Mental sub-health is one of a series of sub-health status, and mainly implies unexplained mental fatigue. The mental sub-health warning mood includes disorders, panic, anxiety, low self-esteem, nervous, reckless, even suicidal thoughts. Seafarers’ mental health status seriously affects the efficiency and the success or failure of their jobs. Such poor mental or psychological state makes them prone to accidents [26].

Psychiatric illness is associated with several specific areas of impairment that may be relevant to work at sea like: impaired information processing ability: attention/concentration, vigilance impaired, visual-spatial functioning with increased latency of motor responses, poor impulse control, including increased risk taking,

poor judgment, including a reduced ability to predict and anticipate reduced problem solving ability, indecisiveness [11].

3 MEDICAL EXAMINATIONS FOR SEAFARERS

Every seafarer holding a competency certificate issued under the provisions of the International Convention on Standards of Training, Certification, Watch keeping for Seafarers Convention (STCW) who is serving at sea must also hold a valid medical certificate issued in accordance with (STCW) regulation I/9 and of section A-I/9 of the STCW Code [10].

Guidelines on seafarers' medical examinations are mainly focusing on vision, hearing and physical standards, where, the mental health requirements are included in brief. These guidelines applied worldwide, with no specific requirements measuring the cognitive and intellectual capabilities of seafarers especially at management level. On the other hand, when reviewing aviation pilot's medical examination standards regarding mental health, it is found that required standards have more comprehensive requirements with regards to mental health, yet still they too do not include specific requirements for cognitive and intellectual capabilities [10].

The Mini-Mental Status Examination (MMSE) is a widely used brief, standardized method for assessing cognitive mental status for aviation Pilots. It allows a gross assessment of orientation, attention, immediate and short-term recall, language, and the ability to follow simple spoken or written commands [9].

4 A SURVEY TO GRANT THE DECLINATION OF COGNITIVE CAPABILITIES INFLUENCED BY SEAFARERS WORKING CONDITIONS AND AGING

A survey of 200 samples have been distributed to candidates attending upgrading studies and mandatory short courses in addition to student's in the final semester for graduation, that they ought to have at least 12 months sea service.

The survey contains only one very simple intelligence quotient (IQ) model to measure the numerical capacity of seafarers at management and operation level and correlate answers to sea service, age and time that has been taken to answer. The Statistical Package for the Social Sciences (IBM-SPSS) software has been used in the statistical analysis of data.

Survey Results were as follows:

Table 1: Results of Survey to measure Link between Age, Sea service and its Impact on Seafarers' Capacity to think and solve Problems in Short Time

96% of samples were answered in one minute or less				
Age between	20-30	30-40	40-50	50-60
Percentage of correct answer	98%	94%	76%	62%

From the previous table it is obvious that correct samples of young officers between (20-30) years old with five years sea service or less were 98%. About the same results were detected for those officers with age ranging from (30 to 40) years

old with sea service less than 10 years. For elder officers, the correct answers were dramatically decreased to 76%, for those have age ranging between (40 to 50) years old and reached 62% for those over 50 years old with sea-service exceeding 15 years. Results of the survey clearly indicate that there is a link between marine officer's age, sea service and their cognitive ability and capabilities to solve problems in a short time.

5 COGNITIVE CAPABILITIES AND SKILLS

Cognition is defined as *“all the processes that an organism uses to organize information. This includes cognitive abilities like memory, attention, language, visual and spatial processing, logic and reasoning, interpersonal and intrapersonal reasoning. It has been scientifically proved that cognitive abilities can be improved upon by certain interventions”*[17].

Cognitive capabilities are usually distinguished into two different kinds of intelligences, the fluid intelligence and crystallized intelligence. Fluid intelligence relates to innate abilities that people are genetically endowed with. These include, for example, the ability to reason, the level of comprehension, or the capability of processing information, and are usually not influenced to a great extent by environmental factors. Where crystallized intelligence means the explicitly or implicitly learned knowledge or behavior [21], therefore, it covers any specific knowledge of facts. Unlike fluid intelligence, crystallized intelligence is determined through environmental factors like education or experience. Education improves the crystallized component of cognitive skills, both in the short- and long-term [21], there is evidence that cognitive speed and memory performance decline with age, but that crystallized abilities remain largely intact in those who survive for long-term follow-up [6]. In older ages, fluency or experience with a task can reduce brain activity levels. But, the brain also declines the more we stop using it and with age. Studies have shown that learning can be an effective way to counteract the reduced functioning of the brain [3].

6 BRAIN PLASTICITY (INTERNAL SOFTWARE)

New researches in neuroscience showing that minds still have the opportunity to change and grow cognitively. [13] and [25] defined the brain plasticity as *“the brain's ability to change and adapt as a result of experience, environmental events, and the actions that have been taken, lead to changes in the brain”*. The brain is continually making more connections based on how the individual interacts with the environment. That means humans can influence the rate of cell growth, and can also affect identified factors that enhance or impair neurogenesis. Plasticity can occur as a result of learning, and memory formation, or as a result of damage to the brain.

The brain continues to create new neural pathways and alter existing ones in order to adapt to new experiences, learn new information, and create new memories. The interaction between the environment and genetics also plays a role in shaping the brain's plasticity, then the brain structure and cognitive skills can be improved through an appropriate exercise.

There are two types of neuroplasticity: Functional plasticity in which the brain has the ability to move functions from a damaged area of the brain to other undamaged areas, and the structural plasticity that is the brain's ability to actually

change its physical structure as a result of learning [13]. Neuroplasticity is linked to the concept of competitiveness: if exercising the mental functions is stopped, the corresponding map is automatically assigned to other functions that are continued to play and the past one is forgotten [3].

7 BRAIN BASED EDUCATION

The fault with persons is, not that they have not good minds, that they are not naturally bright, but merely that their minds are not trained, not systematized, not reduced to order. Brain-Based Education (BBE) can be viewed as techniques used to enhance teacher instruction, learning processes and student intellectual and cognitive capabilities. These strategies can also be used to enhance students' ability to learn using ways in which they feel most comfortable, neurologically speaking [4]. The primary goal of the Mind, Brain, and Education field is to join biology, cognitive science, development, and education in order to create a sound base of education. When the brain structural changes occur they alter the functional organization as learning organizes and reorganizes the brain. It was added, that different parts of the brain might be ready to learn at different times [14].

Using of intense emotions associated with competition, or challenge can stimulate the release of adrenaline, which strongly enhances memory in learning. "Challenge, feedback, novelty, and coherence are crucial ingredients for rewiring the brain". A basic component of brain-based learning is that our emotions influence our ability to learn. Our brains are constantly striving to make connections between intellect and emotions [25].

However, learning engages the entire physiology of the body so the brain and the body are engaged in learning. The search for meaning occurs through patterning, and emotions are critical to patterning. The brain processes parts and wholes simultaneously, while learning involves both focused attention and peripheral perception. Learning is enhanced by challenge and inhibited by threat [25].

Repetition of information strengthens connections in the brain and the brain encodes information most efficiently when content is repeated in multiple ways. Active Learning Rather than allowing learners to become passive recipients of information, when people learn by doing, they become energized, they stick with the content, and they learn more. This increases the blood flow around the body, improving learners' memory, retrieval, and confidence [1].

Low energy levels are unavoidable if students remain seated for long periods of time. In BBE environments, role play, energizing online discussions and quick games can all add sensory stimuli to raise blood pressure and adrenalin levels to eliminate drowsiness, reduce restlessness, and reinforce information. Allowing learners to do some exercises on their own to better understand abstract ideas, write an essay or work with an interactive simulation are also helpful strategies [1].

When learners see something new, dopamine levels increase in the brain as students know the stimuli has the potential to reward them in some way. This motivates learners to seek out the reward. There are a huge number of opportunities to introduce novelty in courses simply by being creative; for instance, developers can use fresh examples, surprise learners with new data or present a scenario that's

completely unpredictable. Or, even engage students through games and simulations that require learners to apply the information in unfamiliar contexts [1].

However, the Principles of Brain-Based Learning could be summarized as: the brain is in parallel a processor performing many tasks simultaneously, including thinking and feeling.

8 MENTAL TRAINING (EXTERNAL SOFTWARE)

General mental activities, can improve performance, as well as long-term mental health, while relaxations techniques help to regulate the activation of brain. There are two aims of developing humanware cognitive capabilities, by enhancing learner mental capacities and properly utilize knowledge, skills and proficiencies.

Mental training consists of learning strategies to memorize information while tackling brain's spatial navigation system to remember objects or propositional contents. There are various other methods for memory enhancements such as use of rhyming, recalling colorful or emotional scenes, recalling number series or letters and studding in groups [17]. On the other hand, to enhance learner mental capacities, learners should be engaged in problem solving cases, root causes analysis, and using video games/virtual/augmented reality (V/AR) modules.

9 CONCLUSIONS

Despite efforts taken by the maritime industry stakeholder's to eliminate accidents at sea, the human factor remains the main cause of marine accidents. Maritime education and training systems still mainly depend on competency-based training without any interest in the intellectual and cognitive capacities of officers – especially - at management level.

Brain-based learning can enhance education and training efficiencies and on the other hand enhance student intellectual and cognitive capabilities, thus improve the reception of knowledge and develop the mental performance of students to become better equipped and able to make the right decision and minimize human error thus reducing accidents tally as well as their potential.

10 RECOMMENDATIONS

- 1- It is necessary to change the consolidated mental attitudes about learning and about teaching, bearing in mind the complexity of the new hybrid, ubiquitous and liquid learning scenarios.
- 2- Transform old educational models to new, more flexible & creative models that reflect the mental capacities of students.
- 3- Build on new methodologies in teaching to use newly established fact-finding models (such as the iceberg model, fault tree and accident pyramid) to assist in creating databases of real life events.
- 4- Fully exploit modern day familiarity with all digital gadgets, as well as their relative affordable-ness to create real life scenarios utilizing modern day technologies and concepts such as artificial intelligence (AI) and virtual/augmented reality (V/AR) modules to enhance their mental capabilities and intellectual skills in real-time and in their local environments.

- 5- Officers at management level should undergo mental intellectual profiling/mapping to determine whether they are capable of demonstrating the cognitive, emotional and environmental capabilities required for their positions. This testing should be further enforced by periodic checks on a scheduled, structured basis.
- 6- Refresher courses should be administered for cognitive and intellectual capacities every two years.
- 7- On-board training and exercising should be enforced and inspected.
- 8- Learning Environment to be brought to the fore-front to allow the shaping of student achievement as learning is enhanced when the environment accommodates the needs of the learner and the instructor.

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