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The Psychomotor and Affective Learning in Navigation Science Using Simulation Technology

Zulkifly Mat Radzi, Mohd Afizi Mohd Shukran

Universiti Pertahanan Nasional Malaysia, Sungai Besi Camp, 57000 Kuala Lumpur, Malaysia

Abstract: This paper is to discuss on the effective used of simulation technology in the teaching and learning in Navigation Science. This methodology is used to improve the level of taxonomy in psychomotor and affective domains for the teaching and learning at Institutions of Higher Learning (IHL). It also enables the evaluation of students' generic skills in the areas of practicals, communications, leadership, teamwork, work ethics, attitudes, professionalism, critical thinking, problem solving and decision making. The use of simulation technology is a contemporary way as compared to the traditional method of lecture, tutorial and laboratory works at IHL. This paper will discuss on the use of Ship's Navigation Simulator in the teaching and learning of Navigation Science in the Bachelor of Science in Maritime Technology at National Defence University of Malaysia. This alternative method is found to be effective in producing quality graduates to meet the human resources requirement in the shipping and maritime operation.

Key words: simulation technology, taxonomy, psychomotor, affective, generic skills, Navigation Science.

INTRODUCTION

Institute of Higher Learning (IHL) will have to take the effort to produce quality graduates for the requirements of the nation building. A graduate must have various forms of generic skills or soft skills apart from acquiring the knowledge on the subject matter. The teaching and learning methodology must incorporate a high level of taxonomy on cognitive, psychomotor and affective domains (MQA, 2009). However, this paper will only discuss on the methodology used to improve the level of taxonomy in psychomotor and affective learning in Navigation Science at IHL.

The levels of capacity building that need to be developed by IHL in the shipping and maritime operation before students graduate are stated in **Figure 1**. Basically there are three levels of capacity to be developed by IHL. The first level is the development of basic infrastructure such as classrooms, seminar rooms, a co-curriculum centre and a resource centre. IHL must have enough lecturers, tutors and laboratory assistants for this level. The second level shall consist of navigation laboratory that provides the plotting instruments, nautical charts and nautical publications. It shall also have the computer-based training software for navigation, seamanship and maritime communications training. For the third level, the IHL must have a Ship Navigation Simulator equipped with a radar, compass, global positioning system, echo sounder, speed log, electronic chart, engine and steering control system. The students must undergo training using the Ship Navigation Simulator before they are sent onboard ship for the industrial training.

Integrated Approach to Teaching and Learning:

An integrated approach needs to be developed to ensure the psychomotor and affective domains are able to be implemented effectively (Constantinescu, 2003). The lecturers are not only to deliver the subject's matter but they must also be able to link them with values that will benefit the students. Interactions with students should be encouraged to enhance the understanding of the subject's matter taught in the class room (Jin Wu *et al*, 2005). The requirement of generic skills or soft skills must be included in the teaching and learning in order to produce the right graduates for the maritime agencies and industries (MOHE, 2011).

Various methods of teaching and learning can be implemented to improve the cognitive, psychomotor and affective domains for Navigation Science. Some of the approaches are case study, problem-based learning, computer-based training, industrial training, practical training and learning through simulation (Wu Jianhu, 2004). The methodology should include individual and collective training. It must comply with the curriculum and syllabus of the academic programme. The methodology used must be creative, reflective and interactive to attract the interest of the students. The approach must be able to achieve the highest level of cognitive, psychomotor and affective domains (Constantinescu, 2001). Finally, the students should be examined and assessed for their performances.

Corresponding Author: Zulkifly Mat Radzi, Universiti Pertahanan Nasional Malaysia, Sungai Besi Camp, 57000 Kuala Lumpur, Malaysia
E-mail: zulkifly@upnm.edu.my

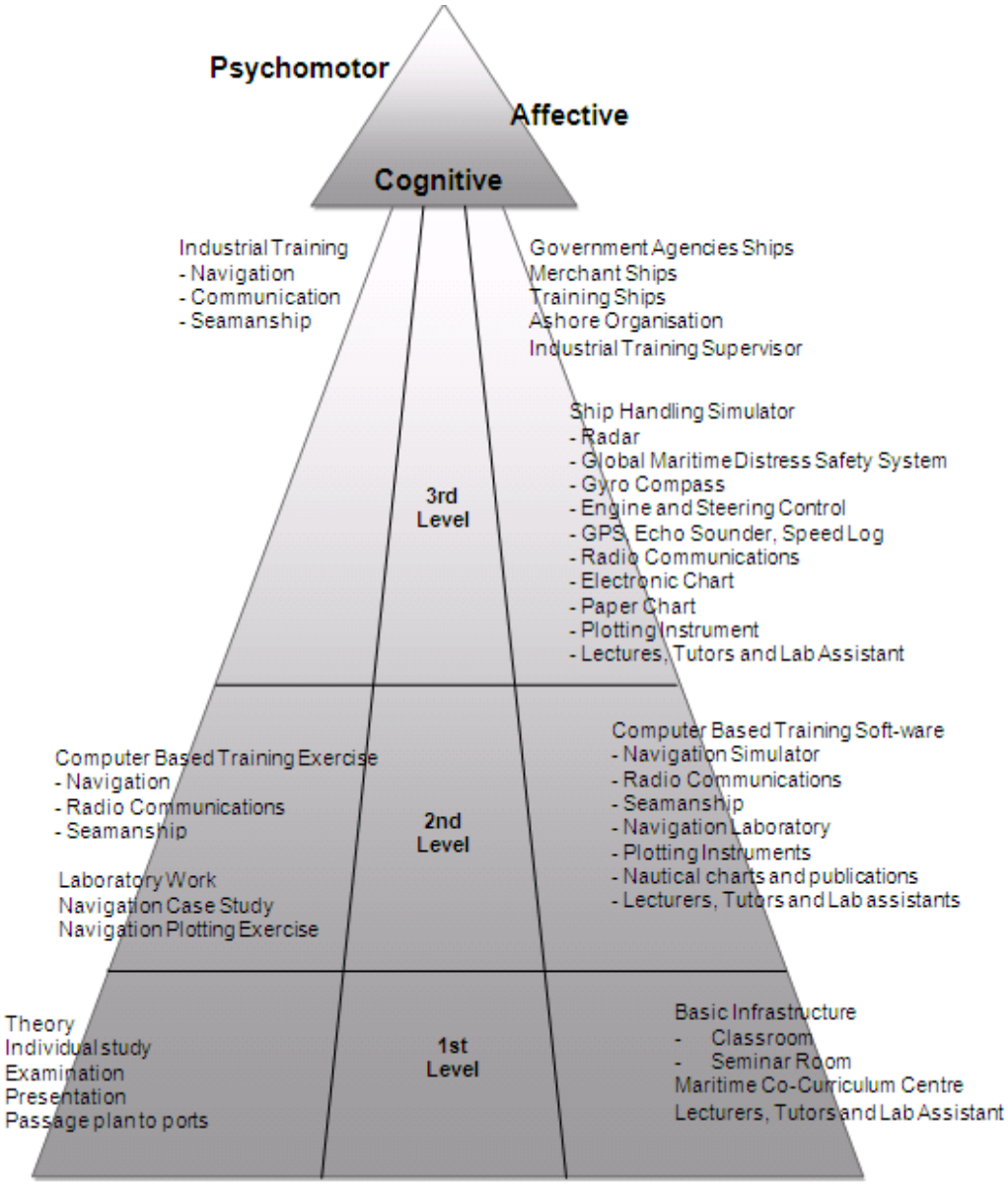

Fig. 1 : Capacity Building of IHL in Shipping and Maritime Operation (MOHE, 2011).

Simulator Equipment to be Acquired by IHL:

A simulator is an essential equipment needed for the teaching and learning of Navigation Science. The simulator will allow students to practise psychomotor and affective domains in performing jobs onboard a ship. A good simulator should be able to create a realistic environment for learning of navigation science, ship handling and maritime communications (Drown and Mercer, 1994). The navigation simulator is designed to create an interactive mock-up bridge of a ship. It has a display for the students to see the view at sea through the bridge window of a ship. All the equipment fitted at the simulator are similar to the equipment onboard a vessel. Students will be exposed to the learning in the simulator before they join the industrial training onboard the ships.

Among the navigation equipments that are fitted in the Ship Navigation Simulator are wheel, engine throttles, electronic chart, navigation radar, global positioning system, echo sounder, ship data panel, gyro compass, ploting table, radio communications and bridge compartment for the trainees. All monitoring panels are fitted in the console for the student usage. **Figure 2** shows the picture of the Ship Navigation Simulator at National Defence University of Malaysia (NDUM).

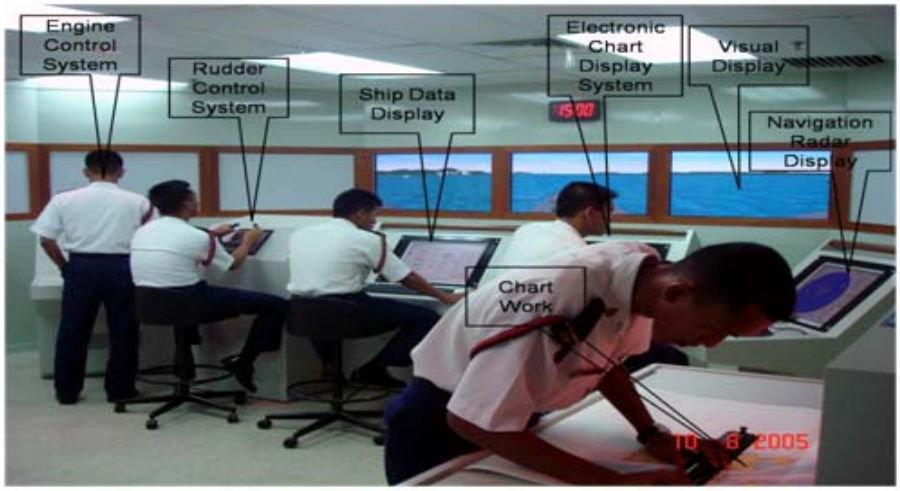

Fig. 2: The picture of Ship Navigation Simulator at NDUM (MOHE, 2011).

Navigation Equipment to be Acquired by IHL:

The preparation of the teaching for the students will depend on the navigation equipment availability. Among the equipments that are required for the teaching and learning in shipping and maritime operation are as follows:

a. Navigation Radar:

The function of navigation radar is to detect objects on the surface of the sea such as vessels, islands, land and any floating objects. The importance of radar is to detect the movement of vessels and for a ship's Captain to avoid a collision. The radar uses radio waves to measure the range of the objects and display them on the computer screen. The use of radio waves, makes it possible for the ship to navigate safely during day and night time. Apart from its ability to detect objects at sea, it can also calculate the speed, course and closest point of approach of a moving object. The new technology of Automatic Radar Plotting Aids (ARPA) has enhanced the capability of navigation radar to enable students to apply their knowledge in operating the equipment.

b. Gyro Compass:

The compass is used to indicate the ship's heading or direction at sea to its crew. The use of compass from the old days has made sailing more accurate. Normally a ship will be equipped with two types of compasses i.e. magnetic and gyro compass. The direction indicated by a magnetic compass will be influenced by the magnetic field of the earth and around the ship. Students are required to apply the magnetic deviation and variation correction when using the magnetic compass. Gyro compass uses electrical power with its compass needle pointing to true North. A gyro compass is more accurate and reliable as compared to a magnetic compass. Students will be taught to use the compass effectively to determine the ship's position accurately.

c. Electronic Chart Display:

The Ship Navigation Simulator is equipped with Electronic Chart Display (ECDIS) as an alternative to paper chart to plot the ship's track, indicate shallow areas and navigation marks at sea. Students must master the use of paper charts before they are allowed to use the ECDIS. The knowledge on paper chart work is important because it provides the foundation in navigation skills. They have to acquire skills on chart work so that they are not overly dependent on ECDIS which would be useless in the event of a electrical failure onboard a ship.

d. Global Positioning System:

GPS determines our position on the earth surface with the inputs from satellites. GPS is also able to provide real time information for communications, military operation and scientific research. The system is global in nature and can provide information on land, sea and air throughout day and night. The students will have the opportunity to use the GPS for the maritime operation at sea.

e. Rudder and Engine Control:

Rudder is the equipment that will control the direction of a ship for changing its course. The engine throttle controls the speed of the ship either ahead or astern. Students will be taught the application of this system in relation to the movement of a vessel on the surface of water.

f. Global Maritime Distress Safety System:

The GMDSS is the international radio safety system mandated by International Maritime Organisation for ships at sea. The GMDSS is based on the linking of Search and Rescue authorities ashore with shipping in the immediate vicinity of a vessel in distress or in need of assistance. The primary purpose of GMDSS is to automate and improve emergency communications for the world's shipping industry. The students will have the opportunity to operate GMDSS for the maritime operation at sea.

The Psychomotor and Affective Training at Ship Navigation Simulator:

The psychomotor and affective training using simulator is very reflective and interactive. The level of training is flexible to meet the requirement of learning outcomes (MQA, 2009). The situation can be changed from basic, intermediate and advanced stages. The lecturers can use their experience and creativity to develop the levels of psychomotor and affective training of the students (Fraenkel *et al*, 2012). The lecturer must develop the psychomotor and affective training module at the Ship Navigation Simulator which contains the following elements:

a. Objective
b. Schedules, Tasks and Frequencies
c. Evaluations and Assessments
d. Learning Outcomes

During the affective training module the students will interact with one another as a team to navigate the ship to a specific destination. The students will take turns to be a leader or member of the team. The interaction will enable them to understand the attitude, behavior and confidence among themselves for team building capacity. The simulator will be able to develop the student leadership because each student will take turns to be a Navigation Officer to ensure ship is navigated safely to a destination. Each group consists of 10 students and are rotated to carry out the following responsibilities:

Table 1: Affective Training at the Navigation Simulator.

No	Responsibility	Position
1.	Navigation Officer	Group Leader
2.	Officer of the Watch	Assistant Group Leader
3.	Helmsman	Member of the team
4.	2 Radar Plotters	Member of the team
5.	Chart work	Member of the team
6.	Engine control	Member of the team
7.	Look out	Member of the team
8.	Radio operator	Member of the team
9.	Tactical communication operator	Member of the team
10.	Total	10 students

The simulator is able to fulfil the psychomotor domain because the student will learn to operate the radar, ECDIS, GPS, GMDSS, wheel, engine throttle and other navigation equipment fitted at the simulator. The students can practise the application of the instruments and relate it to the theory taught in the classroom (Jin Wu *et al*, 2005). This can be considered as pre-industrial training before the students undergo the training onboard government or merchant vessels.

The simulator can be a platform to transfer knowledge and experience by a lecturer through psychomotor training (Fraenkel *et al*, 2012). It will attract young students with the use of information and communication technology to enhance their job. The students can practise the psychomotor domain at the highest level. They are able to receive and respond to orders given by the instructor. The lecturer will evaluate the requirement and organised the team to meet the objective of the exercise. Finally, the students will value the psychomotor training that they had to undergo for the benefit of their job in the shipping and maritime operation.

The affective and psychomotor training module at the Ship Navigation Simulator are as follows:

a. Objective. To provide students with the competency on navigation watch keeping to enable them to undertake the job as Navigation Officer onboard a ship.
b. Weekly Training Module at Ship Navigation Simulator

Week	Summary of Tasks	Frequency of Practice
1	To prepare a pilotage plan for an anchorage	three times
2	To practise the duty of Pilotage Officer for an anchorage off an island.	five times
3	To prepare a pilotage plan for leaving and entering harbor.	two times
4	To practise the duty as Pilotage Officer for leaving and entering harbor.	five times
5	To prepare the visual pilotage plan for leaving and entering harbor.	twice
6	To practise the visual pilotage for leaving and entering harbor.	five times

7	To practise the calculation of course to steer and time taken during the tactical maneuver.	five times
8	Semester Break	
9	To practise the calculation of course to steer and time taken during the replenishment at sea.	five times
10	To practise the calculation of course to steer and time taken during the sector screen.	five times
11	To practise duty as Navigating Office for leaving and entering harbor at the Ship Navigation Simulator.	three times
12	To practise duty as Navigating Office for visual anchorage.	four times
13	To practise duty as Navigating Office for anchorage using radar.	three times
14 and 15	To undergo competency tests as a Navigation Officer at the Ship Navigation Simulator as follows: a. Preparation of a radar and visual pilotage plan for anchorage, entering and leaving habour. b. Conduct of a radar pilotage for entering and leaving habour. c. Conduct of a radar pilotage anchorage plan. d. Conduct of a visual pilotage for entering and leaving harbor.	 once once once once

c. Psychomotor evaluation and assessment criteria are as follows:

i. Ability to plot the parallel index of selected courses during radar pilotage and closest point of approach on all contacts.
ii. Ability to con and steer the ship to its anchorage position.
iii. Ability to navigate the ship on a safe track during entering and leaving harbor.
iv. Ability to manoeuvre the ship as ordered during fleet manoeuvering exercise.
v. Ability to navigate the ships in a formation anchorage.

d. Affective evaluation and assessment criteria are as follows:

i. Leadership skills to perform the job as Officer of the Watch and Navigation Officer.
ii. Ability to organise a ship navigation team.
iii. Communication skills to broadcast clearly within the ship.
iv. Ability in making correct decisions in accordance with the Standard Operating Procedures of navigation safety.
v. Ability in critical thinking of appreciating the situation during entering, leaving and anchorage.
vi. Self-confidence by giving orders accurately.
vii. Ability to work as a ship navigation team.
viii. Attain moral courage and pro-activeness.

Psychomotor and Affective Learning During Industrial Training:

In order to address the issue of mismatch between the graduates and industries requirement, the IHL must develop the psychomotor and affective training programme in line with the needs of the industries (MOHE, 2010). The duration of 6 months industrial training is considered sufficient for the students in shipping and maritime operation. However the students must undergo a structured psychomotor and affective training with a guided task book. Students who wish to work onboard government vessels are required to undergo sea training onboard the vessels. The psychomotor and affective training package shall include:

a. A number of tasks need to be completed by the student onboard the vessels.
b. Apply the knowledge learnt in the classroom onboard the vessels or ashore for a number of tasks.
c. A proper supervisory system to monitor the progress of students by the training officer onboard the vessels.
d. An assessment system to grade the performance of the students both for academic and industrial purposes.
e. An appropriate placement scheme onboard the government and merchant vessels.
f. The certificates of competency that need to be awarded to the students who have successfully completed the training onboard the vessels.
g. An appropriate academic credit hours to be awarded to the students on completion of the psychomotor and affective training onboard the vessel.

Conclusion:

The IHL should review and develop the curriculum of existing programmes to produce graduates that meet the stake-holder requirement for maritime agencies and industries (MOHE, 2011). The learning outcomes in the Navigation Science should be strengthened in the psychomotor and affective domain with emphasis on leadership skills, communication skills, teamwork, problem solving, creativity and critical thinking. A shipping and maritime operation programme shall also incorporate the psychomotor and affective learning during the industrial training onboard government and merchant vessels. The recommended period for the psychomotor and affective training shall not be less than 6 months onboard the merchant and government vessels. IHL must provide the industrial training guide book that incorporates all the taskings, a supervisory system, assessment criteria's and guides on awarding the certificates of competencies. The government should provide adequate

funds to upgrade existing facilities and laboratory equipment for teaching and learning in Navigation Science such as a Ship Navigation Simulators. These facilities are required for the implementation of training modules to produce graduates with high level of psychomotor and affective capabilities.

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