Vol 3, No 1, Januari 2022, 14-20

# IMPLEMENTATION OF SIMULATOR LEARNING MEDIA ON CONTAINER SHIPLOADING HANDLING PLANNING FOR VOCATIONAL EDUCATION CADETS

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## ABSTRACT

The era of Education 4.0 is education characterized by the use of digital technology in the learning process. The teaching and learning process that is integrated with appropriate technology will support the success of education in this era. Vocational education is a tertiary institution that supports the mastery of applied skills in certain fields. Shipping is one of these vocational fields. Shipping is closely related to the port and the loading and unloading process in it. Generally, this loading and unloading process takes quite a long time and causes congestion. The reason is that it is difficult to find an instant way to arrange items that are easy to pick up in the order they arrive. The purpose of this study is to develop a web-based simulator to determine the right stowage plan for the arrangement of containers on a transport ship and implement it in learning in shipping vocational education (Polteknik Pelayaran Surabaya and Politeknik Pelayaran Malahayati). With the RnD type, this research produces a simulator design that can display ship mileage, ship data, container data, container arrangement on ships, as well as ship stability and displacement calculations. It is hoped that with this simulator, the loading and unloading process at the port will be faster and congestion can be reduced. When implemented in Cargo Handling and Stowage Include Cargo Space and Reporting classes and ship construction and stability, the simulator media had a positive effect on cadets (87% through the results of the response questionnaire and 86.5% on competency tests).

Keywords: Vocational Education, Simulator, Stowage Plan

## 1. Introduction

The industrial revolution 4.0 resulted in changes in various fields, including education. Education 4.0 is education characterized by the use of digital technology in the learning process (Ciolacu et al, 2017; Godin et al, 2022; Himmetoglu et al, 2020; Motta et al, 2020). The teaching and learning process that is integrated with appropriate technology will increase the success of achieving educational goals (Abrami et al, 2012; Alismail & McGuire, 2015; Kelley & Knowles, 2016). The use of technology as a learning medium will make the teaching and learning process effective and efficient. This is because the process of delivering information (messages or content, material) is easier (Chun et al, 2016; Jethro et al, 2012; Lin & Chen, 2017). With learning media, it is hoped that it can help improve student understanding because the presentation of data/information is more interesting or reliable, interpretation of data is easier, and information is obtained more quickly.

Vocational education is higher education that supports the mastery of certain applied skills, including diploma education programs which are equivalent to academic education programs (Hanushek et al, 2017; Wardina et al, 2019; Winangun, 2017). Vocational education has a very important role in improving the quality of the workforce in the global era. The existence of vocational education can create workready resources because this education prioritizes practical knowledge that can be directly applied in the world of work (Baiti & Munadi, 2014; Basuki, 2022; Mahfud, 2012). The shipping polytechnic is a vocational education institution in the maritime field.

One of the problems being faced by the shipping sector is the process of loading and unloading goods at the port which takes a long time. This is because it is difficult to find an instant way of arranging items that are easy to pick up in the order they arrive. The Stowage Plan is a description of the information regarding the cargo arrangement plan on the ship

where the image shows a side view (plan) and a top view (profile) of the locations of the cargo, the amount of cargo, and the weight of the cargo in the hold according to the shipping sign (Consignment Mark) for each port of destination. If you can make a stowage plan correctly and quickly, you will avoid Long Hatches or delays in loading and unloading goods due to the cargo that should be unloaded at one port being overlapped by the cargo for the next port.

Thus, the purpose of this research is to create a web-based simulator software to determine the right stowage plan for the arrangement of containers on a transport ship and apply it to learning in shipping vocational education (Politeknik Pelayaran Surabaya and Politeknik Pelayaran Malahayati).

## 2. Method

There are three stages in making this simulator. The first stage is the search for ship data and container data. In this study, the containers used are ordinary containers measuring 20 ft with a maximum weight of 24 tons. The second step is storing data that has been inputted as a database in my SQL. The third stage is programming the simulator in PHP my Admin. At this stage, the researcher enters the formula for calculating ship stability. The stability of the ship can be determined using the following equation (Perhubungan, 2020; Samson & Sidum, 2014; Samson et al, 2013):

a) The height of the metacentric point above the keel ($KM$)

$$KM = KB + BM$$

$KM$ = *The vertical distance from the keel of the ship to point M*

$KB$ = *The sum of the distances from the keel to the floating point*

$BM$ = *The distance of the floating point to the metacentric*

b) Height of the Floating Point of the Keel ($KB$) KB values can be found in the following ways:

*For ship type plat bottom*, $KB = 0{,}50d$

*For ship type V bottom*, $KB = 0{,}67d$

*For ship type U bottom*, $KB = 0{,}53d$

With $d$ = *ship draft*

c) Distance from floating point to metacentric ($BM$)

$$BM = 10\,\frac{b^{Y}}{d}$$

With:

$b$ = ship width (m)

$d$ = ship draft (m)

d) Height of Centroid of Keel ($KG$)

$$Total\ of\ KG = \frac{\sum M}{\sum W}$$

With:

$\sum M$ = *Number of Moments ton*

$\sum W$ = *the sum of the multiplication of the center of gravity and the object's weight* ($ton$)

After the simulator has been successfully developed, validation is carried out (simulator media experts and simulator user practitioners). The instrument used in this validation is an assessment questionnaire. Suggestions and assessments from this validator are important before conducting trials on shipping polytechnic cadets. At the simulator trial stage, cadets were asked to understand the manual book for using the simulator and then conduct several experiments in determining the route and calculating the required fuel.

During the practicum activities, the cadets' skills in operating the simulator were observed. To see the effect of the simulator media, a cadet response questionnaire and an assessment of skills were given during the practicum. The cadets in this study were the cadets of the Politeknik Pelayaran Surabaya, the D3 Nautica study program, for the Pola Pembibitan class (24 cadets) and the Politeknik Pelayaran Malahayati cadets for the D3 Nautica study program, for the Pola Pembibitan class (24 cadets). The data collection process is carried out in March 2022 in the even semester of the Cargo Handling and Stowage Include Cargo Space and Reporting classes and ship construction and stability class.

## 3. Findings and Discussion

### Development of Simulator

Our discussion begins with the identification of the type of vessel. The type of ship used is a container ship, which is a ship used for container

transportation between islands in Indonesia. The following is the ship data used in this study:

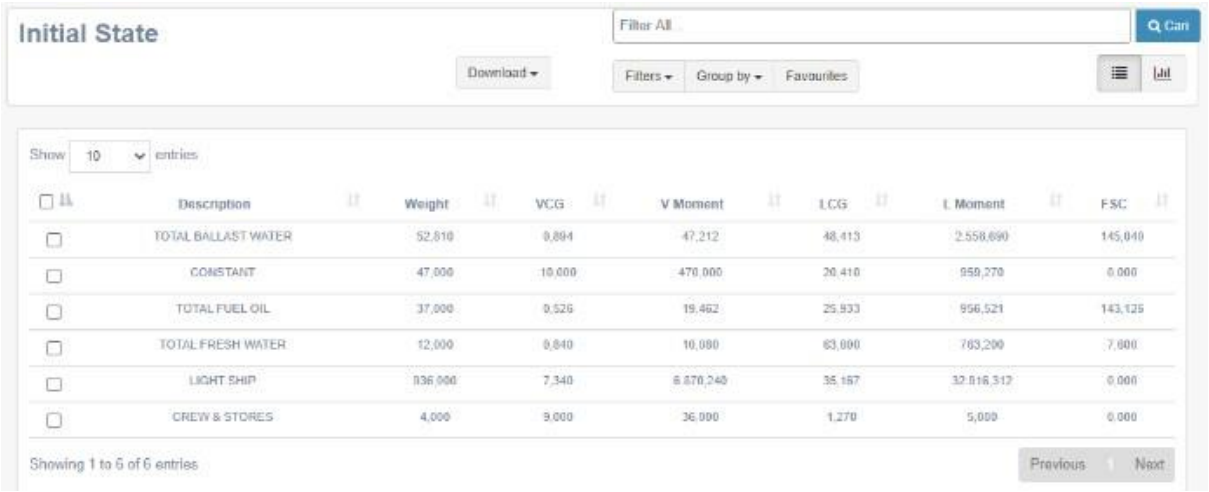


**Figure 1**. Ship data

Figure 1 shows the display of ship data input, the inputted data includes total ballast water, constant, total fuel oil, total freshwater, light ship, crew and stores.

The containers used are ordinary containers measuring 20 ft with a maximum weight of 24 tonnes (according to the standards allowed by port operators in Indonesia). The following is the container data used in this study:

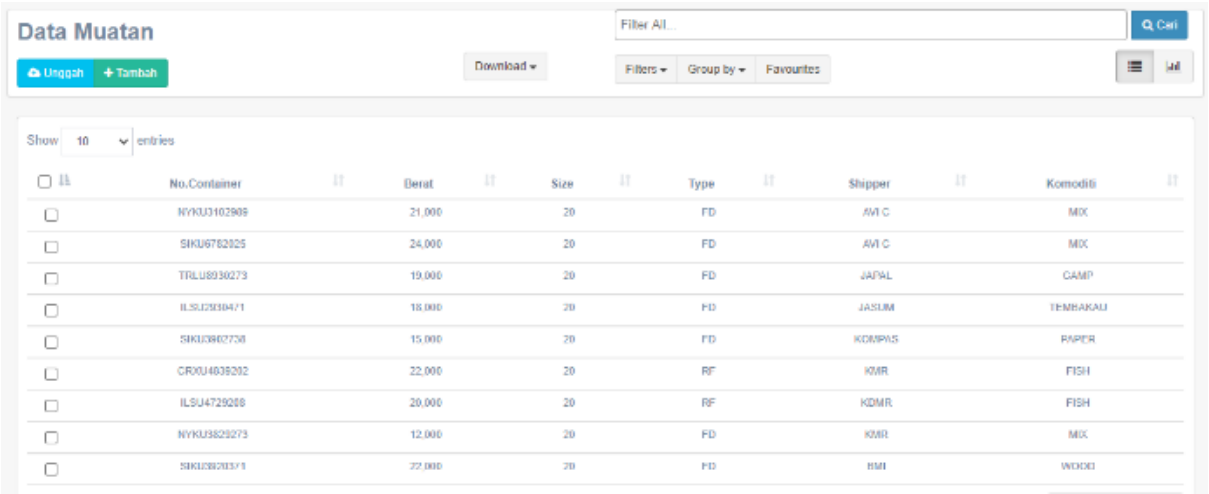


**Figure 2**. Container data

Figure 2 shows a display of the container data input. The data inputted includes the container number, weight, size, type, shipper, and commodity. Based on ship data and container data, it can be seen that the displacement is 1088.8.

The software used in the development of this simulator is PHP My Admin as a prototype/display and the database uses My SQL. The simulator design is made/designed in such a way as to make it easier for users to operate it. The following is a display of the simulator that has been designed in this study:

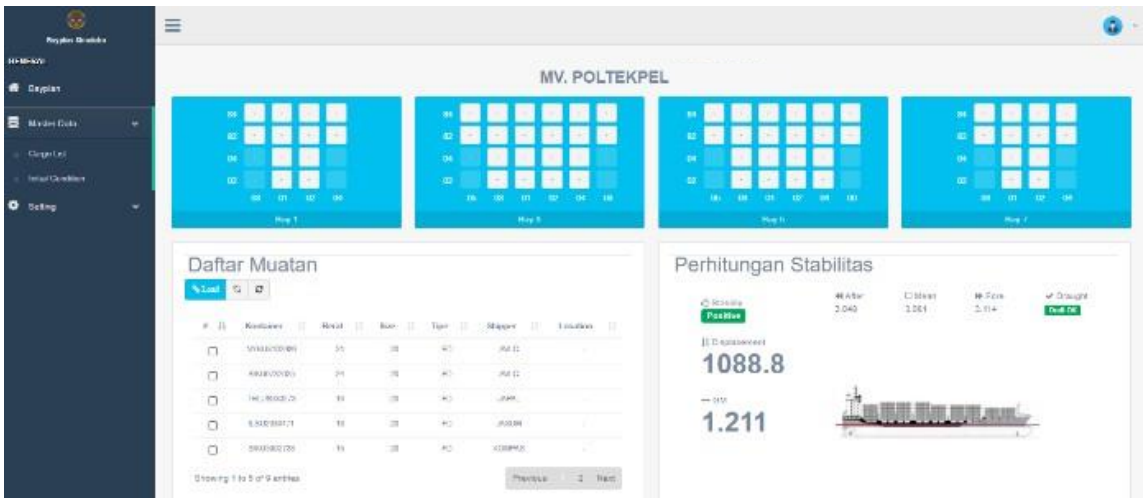


**Figure 3**. Display of the simulator

After the data input process is done, we can test the simulator three times. The first trial was carried out on November 2nd , 2020 to find out the calculation of the stability of the ship if 1st Bay is fully filled, 3rd Bay is filled with 4, and the other Bay is empty. The following results are obtained:


**Figure 4**. 1st trial (1st bay is fully filled)


**Figure 5**: Calculations of stability at 1st trial

From the calculation of the stability of the ship in Figure 5, it can be seen that the displacement value is 1415.8, the GM value is 1.124, the after value is 4.404, the fore value is 3.079 and the mean value is 3.741. Because the after value is greater than the fore value, the ship is in a look-up position.

The second trial was carried out on November 8th , 2020 to find out the calculation of the stability of the ship if 7th Bay is fully filled, 5th Bay is filled with 4, and the other Bay is empty. The following results are obtained:


**Figure 6**. 2nd trial (7th bay is fully filled)


**Figure 7**: Calculations of stability at 2nd trial

From the calculation of the stability of the ship in Figure 7, it can be seen that the displacement value is 1415.8, the GM value is 1.158, the after value is 2.717, the fore value is 3.122 and the mean value is 2.919. Because the after value is greater than the fore value, the ship is in a look-down position.

The third trial was carried out on November 13th , 2020 to find out the calculation of the stability of the ship if 1st Bay is filled with 2, 3rd Bay is filled with 4, 5th Bay is filled with 4, and 7th Bay is filled with 5. The following results are obtained:


**Figure 8**: 3rd trial (all of Bay are filled)


**Figure 9**: Calculations of stability at 3rd trial

From the calculation of the stability of the ship in Figure 9, it can be seen that the displacement value is 1415.8, the GM value is 2.084, the after value is 3.336, the fore value is 3.106 and the mean value is 3.221. Because the fore and after values are almost the same and still in the mean, the ship is in balance.

**Application of Simulator**

Before the simulator is implemented, validation is carried out by simulator media experts and simulator user practitioners. The following aspects need to be assessed regarding simulator development: Content, Writing, Color, Accessibility, Media Integration, User-Friendly Rules, Usage Techniques, and Overall Functions. From the validation results, it can be concluded that the simulator is suitable for use with several suggestions for improvement.

The application of the simulator was carried out in March 2022 at the Politeknik Pelayaran Surabaya (24 cadets) and Politeknik Pelayaran Malahayati (24 cadets) in the Nautica D3 study program in the Pola Pembibitan class during applied Cargo Handling and Stowage Include Cargo Space and Reporting classes and ship construction and stability learning. The achievement of the learning objectives of applied Cargo Handling and Stowage Include Cargo Space and Reporting classes and ship construction and stability this time are; (1) Operate ON/OFF the simulator system properly, (2) Understand the simulator system and the function of each button, (3) Create a Stowage Plan. (4) Calculate the stability of the ship based on the stowage plan that has been made.

After completing the practicum module, the cadets make a report which is then followed by an assistance session to the lecturer/instructor/lecturer assistant (for evaluation and assessment). From the evaluation results, 87% of cadets gave a positive response to this simulator. While the results of the assessment showed that 86.5% of the cadets passed the competency test to make a stowage plan correctly. This is a positive influence for learning applied Cargo Handling and Stowage Include Cargo Space and Reporting classes and ship construction

and stability in the classroom. This fact is in line with research conducted by Rahman et al (2021), Santoso et al (2018), Saraswati & Novallyan (2017), and Sylviani & Permana (2020).

## 4. Conclusion

Based on the explanation of the results and discussion, it appears that the Simulator can display ship mileage, ship data, container data, arrangement of containers on ships, and calculation of ship stability and displacement. From the above formulation, it can be seen that this simulator can help to speed up the loading and unloading process on ships so that congestion that often occurs at the port can be reduced. In its application, this simulator has a positive influence on applied Cargo Handling and Stowage Include Cargo Space and Reporting classes and ship construction and stability learning because it is proven by 87% positive responses of cadets and 86.5% of competency test completeness.

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