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Original Paper

A comparative study on the training method that mixed face-to-face/ non-face-to-face education for apprentice engineers in the training ship

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Abstract: A ship's apprentice for engine part shall carry out boarding training (practice education) onboard the merchant ship of a shipping company or on a training ship. To improve the maritime abilities of student apprentices for engine part in a situation where the boarding training period has been shortened by 50 % compared to the previous training period, this study aimed to verify the difference in understanding and acquiring familiarity of maritime abilities between students with online classes who received the theoretical education of equipment mounted on ships and the indirect practice education of its operation videos before receiving the boarding training on a training ship, and those who received the education after the boarding training. The survey was conducted twice for students of the engine part at Korea Maritime University who participated in the boarding training. To validate the difference in understanding between the two groups, a mean difference verification was performed, and statistical analysis was conducted at a significance level of ≤ 0.05. After the education, the two groups did not have a significant difference in their understanding of the education, but the control group who experienced theory and indirect practice education through videos before receiving the boarding training showed a higher overall understanding than the experimental group who received the boarding training first.

Keywords: Training ship, Boarding training period, Practice education, Survey

1. Introduction

The COVID-19 virus, known to have originated in Wuhan, China in November 2019, has spread worldwide, causing an unprecedented pandemic in 2022. We can no longer return to the past before the COVID-19 outbreak **[1]**. This has changed the lives of people around the world, regardless of country, region, or culture, and has limited human activities, including human relations, quality of life, and movement **[2]**. The pandemic caused by this virus, which has affected every aspect of society, both large and small, has had a significant impact even on college education. Changes are happening in all areas, from the students, professors, and instructors who are the subjects of education, to all individuals and institutions that are directly or indirectly connected to the educational system and related industries. These changes also brought about several variations to the education offered in the Maritime University, which trains marine engineers. To become a third-class engineer, engineers must possess at least 12 months of factory technical training and approved boarding experience in accordance with the STCW international agreement [STCW A-III/1], and at least six months of boarding experience, including boarding training in accordance with the Domestic Ship Personnel Act [Ship Personnel Act Article 9, Paragraph 4, Item 2]. For this reason, Maritime University students receive commissioned training from a shipping company in their junior year or boarding training on a school training ship for more than six months. Under COVID-19 circumstances, shifts for commissioned training are not seamless, but it is proceeding as before by boarding the ship according to the crew's shift and

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leaving the ship after the training period. However, in practice education on school training ships, the number of people on board is limited to less than 50 % of the maximum in accordance with the quarantine regulations for a training ship. To follow social distancing guidelines, the students used a two-person room rather than the previous four-person bedroom. As the number of students who can be trained on a training ship to obtain a certificate of competency decreases, a demand for training education method that meets the domestic and foreign regulations is emerging **[3][4]**. In accordance with the quarantine regulations of a training ship, Korea Maritime University prioritized boarding training for sailing students who required 12 months of boarding training, excluding commissioned apprentices. In addition, the engine-related training students who could meet the domestic and foreign regulations within six months of boarding were divided into two groups, and students who were boarding for a year were adjusted to receive three months of training per semester.

As we confirmed that the understanding and familiarity of maritime abilities increase **[5]** by the training period through the result of analyzing the practical education effect according to the training period on a training ship in the previous study, various educational methods were used to maintain students' understanding and familiarity with the maritime abilities in a situation where the practice period was shortened by 50% compared to the previous practice period **[6][7]**. It is necessary to consider qualitative growth to master equipment operation and experience during practice training in the ship, by setting the appropriate number of training personnel and improving the practice environment **[8]**. Among various class types, such as video, real-time, and mixed classes, real-time classes showed the highest student satisfaction **[9]**. The Korea Maritime University used an online video medium as an indirect training method for a period other than the three-month boarding training per semester to equip engine-related students with maritime abilities. This indirect training education is conducted through the methods of providing video classes that utilize real-time classes, PPT and recorded videos of training lectures.

Considering the previous studies on training education using videos, it was confirmed that when case-based education using videos was provided **[10]**, the improvement of professional competence was superior to that of the existing theoretical education. In addition, conducting video education before practical training is strongly suggested **[11]** because it increases the efficiency of knowledge transfer. Self-education using video has been confirmed to reduce uncertainty and improve educational satisfaction **[12]**. Self-education using video was confirmed to have higher educational satisfaction than existing document education **[13]**, and the effect of repetitive learning using video was verified to be excellent **[14]**. We also confirmed that the practical education method using video is more effective in improving work performance ability than existing scenario-based training education methods **[15]**.

The purpose of this study is to derive the maximum effect from the non-face-to-face class time by providing the theoretical education of equipment mounted on ships and the indirect practice education of its operation videos to students studying from home. We aimed to verify the difference in understanding and familiarity of maritime abilities between students who received the theoretical education of equipment mounted on ships and the indirect practice education of its operation videos before receiving the boarding training on a training ship and those who received the education after the boarding training.

2. Research Methods

2.1 Research subjects

This study is a control group study to compare the effects of two education methods on the performance of equipment maintenance work: conducting practice education after watching video lectures on equipment that third-class engineers are in charge of, and watching video lectures after the practice education. The survey was conducted with engine-related student apprentices on the training ship of the Korea Maritime University. They were divided into two groups: 40 subjects in the experimental group who watched video lectures after conducting practice education, and 41 subjects in the control group who conducted practice education after watching the video lectures. Finally, the effects of each educational method were studied based on the results of 36 subjects in the experimental group and 38 subjects in the control group, excluding questionnaires that had the same value or that were not returned.

The video was created by describing the basic theory of each ship's equipment and the manual of the equipment mounted on a training ship in the PPT, using the same equipment used by student apprentices when training in groups was used in the video. We selected a total of five equipment as training subjects, namely boiler, refrigerator, air conditioner, water generator, and electric device, which are the equipment that the third-class engineers oversee, and the specifications of this equipment are shown in **Table 1**.

The experimental group received simple theoretical lectures, equipment operation for eight weeks, and video lectures for five weeks. The control group watched video lectures for five weeks, one week for each piece of equipment, attended simple theoretical lectures on board, and proceeded with equipment operation and maintenance. The videos, references, and training content were provided equally to the experimental and control groups.

Table 1: Specifications of the device

Subject	Specifications	Maker
Aux. boiler	MA03r0202, 3000 kg/h	KangRim
Refrigeration plant	4P.2/CRNC270127, R407C	HI AIR KOREA
Air conditioning plant training	HKA-13/12, R407C	HI AIR KOREA
Fresh water generator	AQUA-blue-C80-HW	ALFA LAVAL
Electric device	KT-17411/PZO40#3C	KTE/ Hyosung motor

The pre-questionnaire was completed before the beginning of the semester and the post-questionnaire was completed after the end of the final exam when the classes for the experimental and control groups were concluded. The post-questionnaire was administered using the same questionnaire as in the pre-questionnaire.

2.2 Research tools

The questionnaire used in this study was designed by researchers who had 10 years of sailing experience as merchant ship engineers or who had more than 10 years of educational experience on a training ship. They selected 25 items from the learning goals of the NCS competency unit referring to the task of the third-class engineer on a merchant ship, education on a training ship, and the environment. The equipment that the third-class engineers supervised was divided into five (E1–E5): auxiliary boilers, refrigerators, air conditioners, fresh water generators, and electric devices. The questionnaire was designed with five items, listed in **Table 2**, with the theoretical and practical items for each piece of equipment.

Table 2: Composition of survey items

Subject	Learning Objectives	Code
Aux. boiler	1) Boiler burner and working principle 2) Understanding burner trips device and alarms 3) Boiler emergency operation 4) Boiler water test and adjustment 5) Boiler water blow down	E1
Refrigeration plant	1) Refrigeration device principle 2) Characteristics and roles of each device of the refrigeration system 3) Refrigeration plant operation 4) Refrigerant replenishment and shift method 5) Lubricating oil replacement	E2
Air conditioning plant	1) Understanding the air conditioning system 2) Understanding the unloading system 3) Air conditioning plant operation 4) Temperature control method 5) How to care for filters in air conditioners	E3
Fresh water generator	1) The principle of the fresh water generator 2) Characteristics and roles of each device of the fresh water generator 3) Starting and stopping the fresh water generator 4) Distillation water and salinity adjustment 5) Test and adjustment of safety devices	E4
Electric device	1) Check the battery according to the instruction manual 2) Charge the battery according to the instruction manual 3) Check the motor instrument panel and whether it works normally 4) Check the motor protection device 5) Analysis of causes of motor failure	E5

The auxiliary boiler (E1) part consists of theoretical items to check the understanding of the form of the boiler burner, operating principles, burner trip, alarm system, and practical items for manual boiler operation, water test, and water management operation of the blowdown. The refrigerator (E2) part was designed with theoretical items that can explain the principle of refrigeration, the refrigeration system, the name and roles of each part, and practical items for driving and stopping the refrigerator, replenishing the refrigerant, driving in shifts, and replenishing and replacing lubricants. The air conditioner (E3) part was designed as a description part of the air conditioning system and the air conditioner's no-load system, as well as the practical part for driving and stopping the air conditioner, controlling the temperature inside the ship, and replacing the filter of the air conditioning system. The fresh water generator (E4) part consists of theoretical items for the principle of the water generator and the names and roles of each part, and practical items for driving and stopping the water generator, adjusting the amount of fresh water and salinity, and checking and adjusting safety devices. The electric device (E5) part is included to confirm the ability to test a storage battery or recharge a DC power management unit according to the instruction manual, and the ability to determine the normal operation of an induction motor using AC power, check the protection device, and analyze the cause of failure.

The survey was designed on a 5-point Likert scale, with a “strongly disagree” rating of 1, “disagree” of 2, “normal” of 3, “agree” of 4, and “strongly agree” rating 5.

To verify the consistency of the survey items, reliability analysis was performed. Reliability is mainly determined by calculating the Cronbach’s alpha coefficient (Cronbach's α), which is generally considered reliable if it is greater than 0.7. Cronbach's α for the 25 survey items was 0.869, which is higher than 0.7, hence it was judged that the variables used in this study were considered reliable. Therefore, the analysis proceeded without removing the 25 items. The results of the reliability analysis for each sub-item unit are presented in **Table 3**.

Table 3: Composition of the questionnaire

Code	Competence	N of questions	Cronbach's α
E1	Aux. boiler	5	0.803
E2	Refrigeration plant	5	0.731
E3	Air conditioning plant	5	0.707
E4	Fresh water generator	5	0.808
E5	Electric device	5	0.700
Overall		25	0.896

The water generator (E4) showed the highest value at 0.808, and the electric device (E5) showed lowest with a significant value of 0.700.

2.3 Data analysis

The data collected through the survey were analyzed using SPSS 19.0, and statistical verification of the results was performed at a significance level of ≤ 0.05.

Homogeneity between the two groups was verified by analyzing the pre-education questionnaire data. The difference between the two groups was examined by analyzing post-education questionnaire data, and the difference between the two groups before and after class was confirmed.

3. Research Results

3.1 Homogeneity verification before education

Prior to the implementation of this curriculum, a chi-square test was performed on the survey response results by subjects to test homogeneity between the experimental and control groups during the education on ship familiarization and safety.

Table 4: Homogeneity test of the subject between control and experimental group before education

Code		Likert scale					χ^2	p
		1(N)	2(N)	3(N)	4(N)	5(N)		
E1	C.G.	87	97	2	4	0	4.646	0.200
	E.G.	100	72	3	5	0		
E2	C.G.	40	127	19	4	0	0.101	0.992
	E.G.	40	129	17	4	0		
E3	C.G.	35	125	27	3	0	1.781	0.619
	E.G.	25	129	23	3	0		
E4	C.G.	63	114	10	3		2.697	0.441
	E.G.	68	95	11	6			
E5	C.G.	145	39	4	2	0	1.101	0.777
	E.G.	141	31	6	2	0		

C.G. : Control group, E.G. : Experimental group

The results of the homogeneity test by subject for the experimental and control groups are shown in **Table 4**. Homogeneity verification was confirmed as there was no significant difference between the two groups in terms of the education levels of the auxiliary boilers (χ^2=4.646, p=0.200), refrigeration plant (χ^2=0.101, p=0.992), air conditioner (χ^2=1.718, p=0.619), fresh-water generator (χ^2=2.697, p=0.441), and electric device (χ^2=1.101, p=0.777).

3.2 Effect of practice in the experimental and control groups after the end of the education

To compare the educational effect, the mean difference between the two groups was verified for each sub-item at the end of the semester, while targeting the experimental group who watched the video after practice and the control group who watched the video before practice. The experimental and control groups were compared and verified before and after education, respectively.

3.2.1 Verification of mean difference between the two groups after completing the education

An independent sample *t*-test was performed to verify the mean difference between the experimental and control groups; the results are shown in **Table 5**.

Table 5: Independent sample *t*-test of the subject between control and experimental groups after education

Code		E.G.(N, %)		C.G.(N, %)		*t*	*p*
		M	S.D.	M	S.D.		
E1	B1	3.500	0.5575	3.583	0.6918	0.572	0.569
	B2	3.368	0.5413	3.667	0.7171	2.011	0.048
	B3	2.711	0.4596	2.806	0.5767	0.786	0.434
	B4	2.684	0.5253	2.778	0.6375	0.691	0.492
	B5	2.632	0.4889	2.778	0.5909	1.162	0.249
E2	R1	3.632	0.7136	3.694	0.6242	0.402	0.689
	R2	3.658	0.6271	3.694	0.5248	0.271	0.787
	R3	2.816	0.5123	2.861	0.4245	0.413	0.681
	R4	2.711	0.5151	2.778	0.4847	0.578	0.565
	R5	2.763	0.5420	2.833	0.4472	0.606	0.547
E3	A1	3.789	0.7766	3.889	0.4646	0.672	0.504
	A2	3.789	0.7766	3.861	0.4871	0.478	0.634
	A3	2.579	0.5517	2.889	0.3187	2.978	0.004
	A4	2.737	0.5543	2.806	0.4672	0.575	0.567
	A5	2.579	0.5517	2.889	0.3984	2.781	0.007
E4	F1	3.737	0.7235	3.778	0.6375	0.258	0.797
	F2	3.605	0.7548	3.722	0.6146	0.729	0.469
	F3	2.763	0.6339	2.806	0.4672	0.326	0.745
	F4	2.737	0.6445	2.806	0.4672	0.523	0.603
	F5	2.763	0.5897	2.806	0.4672	0.342	0.734
E5	O1	3.500	0.5067	3.639	0.6393	1.039	0.302
	O2	3.658	0.4808	3.694	0.6242	0.283	0.778
	O3	2.895	0.4526	2.917	0.3684	0.228	0.820
	O4	2.684	0.5253	2.806	0.4014	1.112	0.270
	O5	2.763	0.4896	2.889	0.3984	1.215	0.229

C.G. : Control group, E.G. : Experimental group
M=Mean, S.D. = Standard deviation

Significant differences (t=2.011, p<0.05) were found in the boiler burner trip device and alarm system items of the auxiliary boiler (E1); the control group (M=3.667) scored higher than the experimental group (M=3.368). There was no significant difference between the theoretical part of the boiler burner principle and the practical part of the boiler emergency operation, water testing, and water management.

The refrigerator (E2) also showed no significant difference in the theoretical part of understanding the refrigerator principle and the characteristics of each device, as well as in the practical parts of operations, refrigerant transfer and replenishment, and lubricant exchange.

The air conditioner (E3) showed a significant difference in driving of the air conditioner (t = 2.978, p<0.05), and the control group (M=2.889) had higher values than the experimental group (M=2.579). There was also a significant difference (t =2.781, p<0.05) in the air filter replacement of the air handling unit, and the control group (M=2.889) was higher than the experimental group (M=2.579).

There was no significant difference in the items of understanding the air conditioning system, the no-load system, and the temperature control method-related items. There was little difference in the understanding between the two groups in terms of general theoretical items.

In the freshwater generator (E4), there was no significant difference in any of the items of the two theoretical parts and three practical parts.

For the electric device (E5), there was no significant difference between the DC distribution-related and motor-related items.

That is, unlike Aux. boiler and air conditioner, there was no significant difference in the mean of the two groups' lecture results in the refrigerator, freshwater generator, and electric device.

3.2.2 Mean comparison before and after the completion of education

To confirm the understanding of the control and experimental groups before and after the education, a paired sample *t*-test was conducted. **Table 6** shows the results for the experimental group, and **Table 7** lists the results for the control group.

Table 6: Paired sample *t*-test before and after education in the experimental group

Code		BE		AE		Mean (BE-AE)	*t*-value
		M	S.D.	M	S.D.		
E1	B1	1.921	0.6731	3.500	0.5575	-1.5789	-15.154^{***}
	B2	1.974	0.6362	3.368	0.5413	-1.3947	-12.655^{***}
	B3	1.368	0.4889	2.711	0.4596	-1.3421	-13.192^{***}
	B4	1.342	0.4808	2.684	0.5253	-1.3421	-15.492^{***}
	B5	1.368	0.4889	2.632	0.4889	-1.2632	-11.365^{***}
	R1	2.289	0.5651	3.632	0.7136	-1.3421	-11.684^{***}

E2	R2	2.289	0.6538	3.658	0.6271	-1.3684	-11.821***
	R3	1.711	0.4596	2.816	0.5123	-1.1053	-17.546***
	R4	1.632	0.5413	2.711	0.5151	-1.0789	-12.332***
	R5	1.737	0.5543	2.763	0.5420	-1.0263	-10.684***
E3	A1	2.447	0.6017	3.789	0.7766	-1.3421	-8.561***
	A2	2.342	0.5340	3.789	0.7766	-1.4474	-10.369***
	A3	1.711	0.5151	2.579	0.5517	-0.8684	-8.598***
	A4	1.684	0.5253	2.737	0.5543	-1.0526	-10.589***
	A5	1.763	0.4896	2.579	0.5517	-0.8158	-8.261***
E4	F1	2.211	0.4741	3.737	0.7235	-1.5263	-12.969***
	F2	2.211	0.5280	3.605	0.7548	-1.3947	-12.655***
	F3	1.474	0.5060	2.763	0.6339	-1.2895	-10.352***
	F4	1.368	0.4889	2.737	0.6445	-1.3684	-12.503***
	F5	1.500	0.5067	2.763	0.5897	-1.2632	-11.365***
E5	O1	1.553	0.7240	3.500	0.5067	-1.9474	-16.371***
	O2	1.474	0.7255	3.658	0.4808	-2.1842	-17.577***
	O3	1.026	0.1622	2.895	0.4526	-1.8684	-24.257***
	O4	1.289	0.4596	2.684	0.5253	-1.3947	-11.973***
	O5	1.053	0.2263	2.763	0.4896	-1.7105	-20.472***

***p<0.001
B.E : Before Education, A.E : After Education
M=Mean, S.D. = Standard deviation

The experimental group showed a significant value (p<0.001) in all 25 items on the five pieces of equipment, and the largest difference between before and after education (mean: 2.1842) was found in the electrical device (E5) item of charging a battery according to the instruction manual. Since the process of checking the four buttons according to the manual can be performed easily compared to the other items, it is thought that the difference before and after education is clearly revealed. Among the practical items of the air conditioner, the difference is relatively small in terms of the air conditioning operation (mean: 0.8684) and filter exchange (mean: 0.8158). It was confirmed that the educational effect on the driving method requiring various preparations and the filter exchange operation requiring a lot of preparation is lower than that of the simple operation.

The item with the lowest mean before education is checking the normal state of the induction motor (O3), and the item with the highest is understanding the air conditioning system (A1). This is thought to be low because experience is needed in addition to theoretical lectures to analyze the cause of motor failure, and land and boarding training is insufficient to have familiarity with the device. The item with the lowest mean after education was the item of changing the air conditioning filter (A5), which required various preparations, and the item with the highest was the theoretical education item of understanding the air conditioning system (A1).

Table 7: Paired sample *t*-test before and after education in the control group

Code		BE		AE		Mean (BE-AE)	*t*-value
		M	S.D.	M	S.D.		
E1	B1	1.806	0.7863	3.583	0.6918	-1.7778	-16.733***
	B2	1.833	0.8452	3.667	0.7171	-1.8333	-19.621***
	B3	1.333	0.4781	2.806	0.5767	-1.4722	-15.777***
	B4	1.306	0.4672	2.778	0.6375	-1.4722	-13.506***
	B5	1.306	0.4672	2.778	0.5909	-1.4722	-13.506***
E2	R1	2.194	0.6684	3.694	0.6242	-1.5000	-14.767***
	R2	2.250	0.6492	3.694	0.5248	-1.4444	-12.476***
	R3	1.778	0.4847	2.861	0.4245	-1.0833	-14.801***
	R4	1.611	0.5492	2.778	0.4847	-1.1667	-15.652***
	R5	1.750	0.5542	2.833	0.4472	-1.0833	-11.729***
E3	A1	2.417	0.6036	3.889	0.4646	-1.4722	-15.777***
	A2	2.389	0.5492	3.861	0.4871	-1.4722	-17.447***
	A3	1.722	0.4543	2.889	0.3187	-1.1667	-13.804***
	A4	1.778	0.4216	2.806	0.4672	-1.0278	-11.014***
	A5	1.806	0.4014	2.889	0.3984	-1.0833	-13.000***
E4	F1	2.250	0.7319	3.778	0.6375	-1.5278	-16.372***
	F2	2.194	0.7491	3.722	0.6146	-1.5278	-13.164***
	F3	1.444	0.5040	2.806	0.4672	-1.3611	-15.050***
	F4	1.389	0.4944	2.806	0.4672	-1.4167	-15.337***
	F5	1.472	0.5063	2.806	0.4672	-1.3333	-14.967***
E5	O1	1.444	0.7725	3.639	0.6393	-2.1944	-21.092***
	O2	1.444	0.7725	3.694	0.6242	-2.2500	-20.796***
	O3	1.083	0.2803	2.917	0.3684	-1.8333	-24.597***
	O4	1.278	0.4543	2.806	0.4014	-1.5278	-16.372***
	O5	1.111	0.3187	2.889	0.3984	-1.7778	-22.007***

***p<0.001
B.E : Before Education, A.E : After Education
M=Mean, S.D. = Standard deviation

As shown in **Table 7**, all 25 items of the five pieces of equipment showed significant values. (p<0.001)

In particular, the largest difference between before and after education was found in the items of checking (mean: 2.1944) and charging (mean: 2.2500) the battery according to the instruction manual of the electrical device, which is a mixture of the theory and practice of the electrical device (E5). Since this is done by checking the manual and working step by step, it is considered that the differences before and after education were significant due to the help of the textbook. The difference between before and after education in the practical items of the air conditioner was relatively small. Compared to the practical items of other equipment, the differences in the air conditioning operation (mean: 1.1667), air conditioning temperature control (mean: 1.0278), and filter replacement (mean: 1.0833) are relatively small. Because of the nature of the air conditioner practice process, which requires a variety of preparations, it is possible that a short training time is not effective.

Before the education, the item analyzing the cause of motor failure (O5) was the lowest, and the item analyzing understanding the air conditioning system (A1) was the highest. This result is the same as that in the experimental group. After the education, the items for managing water in the boiler (B4, B5), which is difficult to implement in indirect practical training or land training, and the item of transporting the refrigerant (R4) were the lowest, and the theoretical items for understanding the air conditioning system (A1) were the highest. A relatively low level of understanding was shown in the equipment maintenance and management items, but in the theoretical part, an average above a certain level appeared through prior education.

As a result of comparing **Tables 6** and **7**, the average before and after the education of the control group was higher than that of the experimental group for all 25 items. The theoretical items for the five pieces of equipment showed a higher average than the practical items equally, and it was the same before and after the education. It is judged that the targets learned the theoretical part in advance in the sophomore year, but the average before the education was very low owing to the lack of direct experience in the operation-related part of the equipment mounted on a ship.

4. Conclusion

The purpose of this study is to derive the maximum effect within the non-face-to-face class time by providing the theoretical education of equipment mounted on a ship and the indirect practice education of its operation videos to students studying from home to improve the maritime abilities of the student apprentices for engine parts in a situation where the boarding training period has been shortened by 50 % compared to the previous training period. We aimed to verify the difference in understanding and familiarity of maritime abilities between students who received the theoretical education of equipment mounted on a ship and the indirect practice education of its operation videos before receiving the boarding training on a training ship, and those who received the education after the boarding training. The survey was conducted twice, and the results of the analysis are as follows.

As a result of an independent sample t-test performed on the understanding of each piece of equipment after the education, no significant difference was found in most of the items. However, the boiler burner trip device, alarm system, air conditioner operation, and air conditioner filter replacement showed significant differences.

To determine the difference between before and after education in the experimental and control groups, a paired sample t-test was performed, and it was confirmed that there was a significant difference in all 25 items of the experimental and control groups. In addition, the mean before and after education of the control group was higher than that of the experimental group for all 25 items.

The three practical items, which were maintained and managed in the same way as the five pieces of equipment, showed a lower average value than the two theoretical items that were pretrained in the sophomore year.

Similar to previous studies, it was found that taking video classes before practice had a high educational effect. Because the number of students participating in the study was limited to engine-related students, it is difficult to generalize the results to all maritime students. It is expected that the research will be more effective if it is conducted on the general public, marine college students, and high school students in the future.

Author Contributions

Conceptualization, J. -J. Hur and J. -S. Kim; Methodology, H. -M. Jeon; Validation, K. -K. Yoon; Formal Analysis, J. -H. Noh and J. -J. Hur; Investigation, E. -S. Jeong, S. -G. Oh, and J. -U. Lee; Writing—Original Draft Preparation, J. -H. Noh and H. -M. Jeon; Writing—Review and Editing, J. -J. Hur and J. -S. Kim; Supervision, J. -J. Hur.

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