
ANALYSIS OF DIFFERENT TEST RESULTS ACHIEVEMENT SAFETY AVIATION STUDENTS VOCATIONAL EDUCATION IN INDONESIA USING ATC SIMULATOR LABORATORY AND AFIS MANUAL

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Abstract

In the practice of air traffic services, Air Traffic Service students using 2 laboratories directly in carrying out practicums, namely AFIS Manual Laboratory and Laboratory ATC simulator, of course, there are different quality achievements obtained by students in undergoing air traffic service practicum. In the practice of air traffic service there are 4 (four) exercises or important problems that greatly affect student achievement known as "abnormal situation exercise", among others: (1) Traffic Info exercise, (2) Communication Failure exercise, (3) Urgency exercise, and (4) emergency exercise. Which students must complete 4 (four) exercises well before undergoing the final exam. By using 2 different laboratories, of course, there are differences in air traffic control performance in "abnormal situation exercise". This study used a different independent sample test to 96 airport ATS students who were carrying out education at aviation schools in Indonesia and divided the classes into 2 different class groups and took scores from the group of students who carried out air traffic service using the ATC Simulator laboratory and AFIS manual laboratory by taking scores on traffic info exercise, Communication failure exercise, urgency exercise, emergency exercise, and taking the average learning value of air traffic control to look for differences in student achievement in air traffic service using 2 different laboratories. The results of this study found that there were differences in student achievement in carrying out air traffic service using 2 different laboratories and the results stated that the learning results of students who used atc simulator laboratories had higher scores than students who used AFIS Manual Laboratory.

Keywords : *ATC Simulator, AFIS Manual, Achievement students Air Traffic Service*

I. INTRODUCTION

Aviation Vocational school learning air traffic services (ATS)[1] educated and trained to have mastery of basic knowledge and skills of air traffic service techniques, language skills specified in air traffic, mastery of air traffic operational procedures and basic knowledge of other aviation, capable and skilled in the field of air traffic services as well as knowing how to learn effectively, efficiently, and sustainably. To support the learning process, of course, it must be supported by practical tools that also develop over time, as a consequence of technological development. The ATS learning process has a 30% theory learning comparison and 70% practice learning[2]. Competency air traffic service skills are carried out in AFIS Manual and ATC Simulator laboratories. Before conducting simulations first students are equipped with basic theoretical knowledge about ATS, aerodrome[3], flight progress strip, aircraft type and performance[4], co-ordination dan phraseology[5].

II. LITERATURE REVIEW

The learner method of air traffic service is practically carried out in the AFIS Manual Laboratory by creating a manual simulation by using the technical board as an Aerodrome Layout in the process of learning directly on an actual object. This manual simulation using miniature aircraft without the appropriate scale and driven by students, thus the estimated duration of takeoff, landing or while in the air must be estimated manually by the student. So that the timeliness used is sometimes not in accordance with real circumstances, moreover sometimes the controller cannot see the aerodrome layout because it is hindered by the student body that simulates the movement of the plane, weather conditions can not be regulated as the actual situation.



Figure 1. Practicum Learning ATS in AFIS Manual Laboratory

Air Traffic Control learning is also conducted in the ATC Simulator laboratory. Laboratory ATC simulator is a system flight traffic control laboratory using *computerize* flexible can be used to simulate various traffic operations such as talent testers for people unfamiliar with certain environments, training *and* upgrading professional operational staff, training Emergency on the flight[6], testing and training of new divisions (airspace, route structure, air traffic flow and procedures)[7], and aeronautical practice[8]. The ATC Simulator system architecture consists of PC work positions and each position can be easily reconfigured to another through software at the beginning of each initial simulation exercise, so that any position can be used for training preparation, station administrator and controller or as a pseudo pilot. ATC Simulator supports the following positions without additional software agreements: Controller Position, Pseudo Pilot Position, Administrator Position, Airspace and Scenario Development Position[9].

And in Laboratory ATC simulator here can create airport layouts virtualized in the simulator in accordance with the wishes and needs of practicum so that students can feel in actual conditions such as on the ground. With simulation students can increase motivation and attention to topics, improve students in cognitive learning, covering factual information, concepts, principles and decision-making skills[10]. The time of use of ATC Simulator Laboratory and AFIS Manual Laboratory has no difference in operation or implementation, approximately ± 30 minutes /students or 1x the course of exercise each student and supported by a sufficient number of labor personnel and lecturers then the ATC Simulator Laboratory should be utilized. as a laboratory that can contribute greatly in increasing air traffic control capabilities vocational aviation education[11].



Figure 2 Practicum Learning in ATC simulator

In the practice of air traffic control, ATS students using 2 laboratories directly in carrying out practicums, namely AFIS Manual Laboratory and Laboratory ATC simulator. of course, there are different quality achievements obtained by students in undergoing ATS practicum. In the practice of air traffic control there are 4 (four) exercises or important problems that greatly affect student achievement known as "abnormal situation exercise", among others: (1) Traffic Info exercise, (2) Communication Failure exercise, (3) Urgency exercise, and (4) emergency exercise. Which students must complete 4 (four) exercises well before undergoing the final exam. By using 2 different laboratories, of course, there are differences in flight traffic guidance performance in "abnormal situation exercise"[6].

Based on the discussion above, new ideas emerged for the analysis of different tests of the achievements of aviation vocational education students in air traffic service learning using ATC simulator and AFIS Manual. In this study that will be used as a case test material is student achievement in: (1) Traffic Info exercise, (2) Communication Failure exercise, (3) Urgency exercise, and (4) emergency exercise, (5) average value of Air traffic Service.

III. RESEARCH METHODOLOGY

Data to be conducted Independent sample test where the goal is analysis with this method aims to compare two averages of two unrelated groups[12]. In this study, different tests were conducted to 96 vocational students in Indonesia who came from ATS airport personnel who were carrying out a refresher course at Surabaya Aviation Polytechnic and divided 2 different class groups and took grades from groups of students who carried out air traffic service using the ATC Simulator laboratory and AFIS manual by taking scores on Traffic Info Exercise, Communication failure exercise, urgency exercise, emergency exercise, and taking the average learning value of air traffic control. By analyzing several problem formulations, among others:

1. Is there a difference in student achievement in the Traffic Information exercise in air traffic service subjects using the ATC Simulator Laboratory and AFIS Manual?
2. Is there a difference in student achievement in the Communication Failure exercise in air traffic service subjects using the ATC Simulator Laboratory and AFIS Manual?
3. Is there a difference in student achievement in exercise urgency procedure in air traffic service subjects using The ATC Simulator Laboratory and AFIS Manual?
4. Is there a difference in student achievement in the Emergency procedure exercise in air traffic service subjects using the ATC Simulator Laboratory and AFIS Manual?
5. Is there a difference in the average achievement of students in air traffic service subjects using the ATC Simulator Laboratory and AFIS Manual?

IV. RESULT AND DISCUSSION

1. Data Normality Test

“average swilk trafficinfo comfail urgency emg”
“swilk trafficinfo comfail urgency emg ratarata”

Shapiro-Wilk W test for normal data

Variable	Obs	W	V	z	Prob>z
trafficinfo	96	0.92090	6.312	4.078	0.00002
comfail	96	0.87270	10.159	5.131	0.00000
urgency	96	0.90542	7.547	4.474	0.00000
emg	96	0.87461	10.006	5.098	0.00000
ratarata	96	0.96463	2.823	2.297	0.01081

From the above data it can be concluded that the "Prob>z value" of all variables is less than alpha=0.05.

Thus H0 which states that normal distributed data is REJECTED.

Thus, all variables do not follow the normal distribution. Because the data is not normally distributed, a different test is performed with the Mann-Whitney/Wilcoxon rank-sum test.

2. DIFFERENT TEST MANN-WHITNEY (WILCOXON RANK SUM TEST)

a) Traffic Information

“ranksum trafficinfo, by(group)”

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

group	obs	rank sum	expected
AFIS Manual	48	1572.5	2328
ATC Simulato	48	3083.5	2328
combined	96	4656	4656

unadjusted variance	18624.00
adjustment for ties	-342.32
adjusted variance	18281.68

Ho: $\text{traffi-o}(\text{group}==\text{AFIS Manual}) = \text{traffi-o}(\text{group}==\text{Atc simulator})$
 $z = -5.588$
 Prob > |z| = 0.0000

From the above data can be concluded that in fact, the value of "Traffic Info" by using the Laboratory ATC simulator is greater than the AFIS Manual. Statistically, the value of Prob|z| = 0.000 and less than alpha = 0.05, thus, this difference is significant.

b) Communication Failure

“Rangsum comfail,by(group)”

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

group	obs	rank sum	expected
AFIS Manual	48	1630	2328
ATC Simulato	48	3026	2328
combined	96	4656	4656

unadjusted variance	18624.00
adjustment for ties	-403.58
adjusted variance	18220.42

Ho: $\text{comfail}(\text{group}==\text{AFIS Manual}) = \text{comfail}(\text{group}==\text{Atc simulator})$
 $z = -5.171$
 Prob > |z| = 0.0000

From the above data can be concluded that in fact, the value of "Communication Failure" using the Laboratory ATC Simulator is greater than the AFIS Manual. Statistically, the value of Prob|z| = 0.000 and less than alpha = 0.05 Thus, this difference is significant.

c) Urgency Procedures

“Rangsum urgency,by(group)”

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

group	obs	rank sum	expected
AFIS Manual	48	1545	2328
ATC Simulato	48	3111	2328
combined	96	4656	4656

unadjusted variance	18624.00
adjustment for ties	-434.53
adjusted variance	18189.47

Ho: $\text{urgency}(\text{group}==\text{AFIS Manual}) = \text{urgency}(\text{group}==\text{Atc simulator})$
 $z = -5.806$
 Prob > |z| = 0.0000

From the data above it can be concluded that in fact, the value of "Urgency Procedure" with ATC Simulator is greater than the AFIS Manual. Statistically, the value of $Prob|z| = 0.000$ and less than $\alpha = 0.05$. Thus, this difference is significant.

d) Emergency procedures

"Rangsum emg,by(group)"

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

group	obs	rank sum	expected
AFIS Manual	48	1491	2328
ATC Simulato	48	3165	2328
combined	96	4656	4656

unadjusted variance 18624.00
 adjustment for ties -339.16

 adjusted variance 18284.84

Ho: $emg(group==AFIS Manual) = emg(group==Atc simulator)$
 $z = -6.190$
 $Prob > |z| = 0.0000$

From the above data can be concluded that in fact, the value of "Emergency Procedure" using the Laboratory ATC Simulator is greater than the AFIS Manual. Statistically, the value of $Prob|z| = 0.000$ and less than $\alpha = 0.05$. Thus, this difference is significant.

e) Average

"Average summary,by (group)"

Two-sample Wilcoxon rank-sum (Mann-Whitney) test

group	obs	rank sum	expected
AFIS Manual	48	1321.5	2328
ATC Simulato	48	3334.5	2328
combined	96	4656	4656

unadjusted variance 18624.00
 adjustment for ties -35.75

 adjusted variance 18588.25

Ho: $ratarata(group==AFIS Manual) = ratarata(group==Atc simulator)$
 $z = -7.382$
 $Prob > |z| = 0.0000$

From the above data it can be concluded that in fact, the "Average" value of AFIS courses using the Laboratory ATC Simulator is greater than the AFIS Manual. Statistically, the value of $Prob|z| = 0.000$ and less than $\alpha = 0.05$. Thus, this difference is significant.

3. TWO SAMPLE MAIN TEST (T_TEST)

In this study also conducted a T-test where if the normality test is ruled out.

a) Traffic Info

"ttest trafficinfo, by(group)"
 Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]
AFIS Man	48	73.16667	.4729691	3.276826	72.21518 74.11816
ATC Simu	48	77.3125	.575933	3.990181	76.15387 78.47113
combined	96	75.23958	.42734	4.18706	74.39121 76.08796
diff		-4.145833	.7452507		-5.625546 -2.666121

diff = $mean(AFIS Man) - mean(ATC Simu)$ t = -5.5630
 Ho: diff = 0 degrees of freedom = 94
 Ha: diff < 0 Ha: $diff \neq 0$ Ha: diff > 0
 $Pr(T < t) = 0.0000$ $Pr(|T| > |t|) = 0.0000$ $Pr(T > t) = 1.0000$

From the data above it can be concluded that in fact, the value of "Traffic Info" with ATC Simulator is greater than the AFIS Manual. Statistically, the value of $Prob(T < t) = 0.000$ and less than $\alpha = 0.05$. Thus, this difference is significant.

b) Communication Failure

"ttest comfail, by(group)"
 Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]
AFIS Man	48	73.3125	.4062415	2.814524	72.49525 74.12975
ATC Simu	48	76.52083	.5317821	3.684294	75.45103 77.59064
combined	96	74.91667	.3713024	3.638006	74.17954 75.6538
diff		-3.208333	.6691968		-4.537039 -1.879627

diff = $mean(AFIS Man) - mean(ATC Simu)$ t = -4.7943
 Ho: diff = 0 degrees of freedom = 94
 Ha: diff < 0 Ha: $diff \neq 0$ Ha: diff > 0
 $Pr(T < t) = 0.0000$ $Pr(|T| > |t|) = 0.0000$ $Pr(T > t) = 1.0000$

From the data above it can be concluded that in fact, the value of "Communication Failure" with ATC Simulator is greater than the AFIS Manual. Statistically, the value of $Prob(T < t) = 0.000$ and less than $\alpha = 0.05$. Thus, this difference is significant.

c) Urgency Procedures

"ttest urgency, by(group)"
 Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]
AFIS Man	48	73.04167	.3718346	2.576145	72.29363 73.7897
ATC Simu	48	75.97917	.3966723	2.748226	75.18116 76.77717
combined	96	74.51042	.3095677	3.033132	73.89585 75.12499
diff		-2.9375	.5437002		-4.017029 -1.857971

diff = $mean(AFIS Man) - mean(ATC Simu)$ t = -5.4028
 Ho: diff = 0 degrees of freedom = 94
 Ha: diff < 0 Ha: $diff \neq 0$ Ha: diff > 0
 $Pr(T < t) = 0.0000$ $Pr(|T| > |t|) = 0.0000$ $Pr(T > t) = 1.0000$

From the data above it can be concluded that in fact, the value of "Urgency Procedure" with ATC

Simulator is greater than the AFIS Manual. Statistically, the value of Prob(T<t)= 0.000 and less than alpha=0.05. Thus, this difference is significant.

d) Emergency Procedures

"ttest emg , by(group)"
Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]
AFIS Man	48	72.77083	.4213281	2.919047	71.92323 73.61844
ATC Simu	48	77.29167	.6385644	4.424104	76.00704 78.57629
combined	96	75.03125	.4456055	4.366025	74.14661 75.91589
diff		-4.520833	.7650372		-6.039833 -3.001834

diff = $\text{mean}(\text{AFIS Man}) - \text{mean}(\text{ATC Simu})$ t = -5.9093
Ho: diff = 0 degrees of freedom = 94

Ha: diff < 0 Ha: $\text{diff} \neq 0$ Ha: diff > 0
Pr(T < t) = 0.0000 Pr(|T| > |t|) = 0.0000 Pr(T > t) = 1.0000

From the above data can be concluded that in fact, the value of "Emergency Procedure" with ATC Simulator is greater than the AFIS Manual. Statistically, the value of Prob(T<t)= 0.000 and less than alpha=0.05. Thus, this difference is significant.

e) Average

"ttest ratarata, by(group)"
Two-sample t test with equal variances

Group	Obs	Mean	Std. Err.	Std. Dev.	[95% Conf. Interval]
AFIS Man	48	73.07292	.253626	1.757172	72.56269 73.58315
ATC Simu	48	76.77604	.2985113	2.068147	76.17551 77.37657
combined	96	74.92448	.272107	2.666093	74.38428 75.46468
diff		-3.703125	.391708		-4.48087 -2.92538

diff = $\text{mean}(\text{AFIS Man}) - \text{mean}(\text{ATC Simu})$ t = -9.4538
Ho: diff = 0 degrees of freedom = 94

Ha: diff < 0 Ha: $\text{diff} \neq 0$ Ha: diff > 0
Pr(T < t) = 0.0000 Pr(|T| > |t|) = 0.0000 Pr(T > t) = 1.0000

From the data above it can be concluded that in fact, the value of "Average" with ATC Simulator is greater than the AFIS Manual. Statistically, the value of Prob(T<t)= 0.000 and less than alpha=0.05. Thus, this difference is significant.

V. CONCLUSION

From the analysis of the calculation results above, it can be concluded that:

1. Based on the Two-sample Wilcoxon rank-sum (Mann-Whitney) test and t-test, there was a significant difference in student achievement in air traffic service subjects using laboratory ATC simulator with AFIS Manual for variable "Traffic Info exercise". This is because students' knowledge of the provision of traffic info is more riel and can

predict the potential for plane accidents using Laboratory ATC simulator compared to AFIS Manual Laboratory.

2. Based on the Two-sample Wilcoxon rank-sum (Mann-Whitney) test and t-test, there was a significant difference in student achievement in air traffic service subjects using the ATC Laboratory simulator with the AFIS Manual for variable "Communication Failure". This is because students' knowledge about handling aircraft that experience communication failure problems is more riel and can provide instructions or services that are in accordance with the actual conditions at the airport by using Laboratory ATC simulator compared to AFIS Manual Laboratory.

3. Based on the Two-sample Wilcoxon rank-sum (Mann-Whitney) test and t-test, there was a significant difference in student achievement in air traffic service subjects using the ATC Laboratory simulator with the AFIS Manual for the variable "Urgency". This is because students' knowledge about handling aircraft that experience urgency problems is more riel and can give instructions or services and coordinate with related units that are in accordance with the actual conditions at the airport by using atc simulator laboratories rather than AFIS Manual Laboratories.

4. Based on the Two-sample Wilcoxon rank-sum (Mann-Whitney) test and the t-test, there is a significant difference in student achievement in air traffic service subjects using the ATC Laboratory simulator with the AFIS Manual for variable "Emergency". This is because students' knowledge of handling aircraft that experience emergency problems is more riel and can provide instructions or services and coordinate with related units that are in accordance with the actual conditions at the airport by using atc simulator laboratories rather than AFIS Manual Laboratories.

5. Based on the Two-sample Wilcoxon rank-sum (Mann-Whitney) test and the t-test, there is a significant difference in student achievement in air traffic service subjects using laboratory ATC simulator with AFIS Manual for variable "grade average". This proves that student achievement is better using ATC Simulator Laboratory facilities than manual AFIS Laboratory because ATC Simulator Laboratories can simulate more riel AFIS learning and approach actual conditions at the airport and supported by near-reality features such as weather conditions, aircraft speed, aircraft size, aircraft movements, etc.

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