



CMS 21: INTEGRATING GAME-BASED LEARNING IN BASIC AUTOMOTIVE

Jermil R. Angeles^{1*}, Joel I. Alvarez²

¹ Nueva Ecija University of Science and Technology, College of Education

² Nueva Ecija University of Science and Technology, College of Education

*Corresponding Author

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ABSTRACT

This study sought to determine the effectiveness of Car Mechanic Simulator 21 (CMS 21) in learning concepts in Automotive. This study described the performance of two groups of students in different skills in Automotive before and after a series of instructions using the two learning interventions (module and CMS 21) using pre-test and post-test design. This study was conducted at Nueva Ecija University of Science and Technology, and Bachelor of Science in Industrial Education (20) students served as subjects. The study used the experimental design of research. Using t-tests, results revealed that i) there is statistical evidence to reject the null hypothesis "There is no significant difference in the performances of subjects under the controlled group in the pre-test and post-test, and ii) there is statistical evidence to reject the null hypothesis There is no significant difference in the performances of subjects under the experimental group in the pre-test and post-test. Lastly, after applying statistical treatments, there is statistical evidence to reject the null hypothesis There is a significant difference in the performances of the students between the two groups after their respective interventions. Thus, the use and implementation of CMS 21 is recommended.

KEYWORDS: Basic Automotive; Car Mechanic Simulator 21; Distance Learning; Game-based learning, Modular learning

1. INTRODUCTION

The coronavirus disease (COVID-19) pandemic and related lockdown and physical distancing measures caused unprecedented disruption in the delivery of education and training and catalyzed innovation in distance learning. According to the International Labor Organization (2021), due to these lockdown measures, the adoption of distance learning solutions by TVET programs has facilitated the acquisition of practical skills and the organization of work-based learning, both of which are essential components for the success of TVET programs, specifically in learning the basics of Automotive.

On the contrary, based on the statistical results of the examinations conducted by the researcher among his students, it was shown that learning the basics of Automotive is one of the least learned competencies of the students during the first semester of their second year under the program Bachelor of Science in Industrial Education and Bachelor of Technology and Livelihood Education. With this, it resulted in students' difficulty involving learning the basic concept in Automotive.

In an effort, to engage learners in learning the basic concept in Automotive, only few teachers used game-based learning. The idea of using games to engage learners in the process of active learning is not new. As cited by Cicchino (2015), Game-Based Learning environment enables learners to make meaningful choices within problem (McCall, 2011) and often present learner with ill-structured problems, well-structured rules with ill-structured paths to resolution, students typically work in small groups and construct knowledge through the activation of prior understanding, as well as by engaging in collaborative discourse.

Game-Based Learning interventions were effective in promoting higher levels of critical thinking including the development of independent beliefs prior to engaging in collaborative discourse and providing opportunities for guided reflection (Cicchino, 2015). Thus, this paper focused on determining the effectiveness of Car Mechanic Simulator 21 (CMS 21) in learning concepts in Automotive.

Statement of the Problem

1. How may the performance of the subjects before the respective integration be described considering the students in:
 - 1.1 Controlled group; and



- 1.2 Experimental group?
2. Is there a significant difference between the performance of the subjects in the two groups before the intervention?
3. How may the performance of the subjects after the respective integration be described considering the students in:
 - 3.1 Controlled group; and
 - 3.2 Experimental group?
4. Is there a significant difference in the performance between pre–test and post–test results of the subjects in:
 - 4.1 Controlled group; and
 - 4.2 Experimental group?
5. Is there a significant difference between the performance of the subjects in the two groups after the intervention?

2. METHODOLOGY

2.1 Research Design

This study utilized the quasi-experimental research design. According to L. Thomas (2022), quasi-experimental research, as opposed to true experimental design, is the systematic study of establishing a cause-and-effect relationship between an independent and dependent variable in which subjects are assigned to groups based on non-random criteria. This study aims to assess the effectiveness of integrated game-based learning for teaching Basic Automotive in the form of an already downloadable software application known as Car Mechanic Simulator 21 or CMS 21. With this given problem, in the mind of the researcher, this research design is the most appropriate to be employed in this study.

2.2 Participants

Twenty selected 3rd year BSIE students served as the subjects of this study. These students were grouped based on the results of the pre-test conducted before the implementation of the two interventions. After determining the groupings, ten (10) 3rd year BSIE students were assigned to controlled group with modular learning as learning material. Moreover, ten (10) 3rd year BSIE students were assigned to the experimental group who used the CMS 21 as a learning material.

2.3 Instrument

This study utilized instruments that are of great help towards the attainment of the objectives of this research. This study made use of i) Summative Assessment for Basic Automotive, ii) Car Mechanic Simulator 21, and iii) Module in Basic Automotive to attain the goals of the study.

i. Summative Assessment for Basic Automotive (SABA)

Description. Summative Assessment for Basic Automotive (SABA) is a teacher-made test which contains items involving basic concepts and skills including basic car parts and functions which under the subject “Basic Automotive”. It is a multiple choice type of test that contains 50 items with four (4) choices each. A Table of Specification of SABA was prepared for this purpose.

Validation. The draft form of SABA was checked by an expert in the field of Basic Automotive and was pilot-tested to a group of College students who have taken the course under study and were not members of the sample. After the pilot-testing and analyzing the internal consistency, the 60 item test later became 50 with an alpha index of 0.813. One point was allotted to every correct answer given by the student.

ii. Car Mechanic Simulator 21 (CMS 21)

Description. Car Mechanic Simulator 21(CMS 21) is a mobile game which simulates how to operate a car. It also engages its users with different knowledge and skills about automotive such as basic parts, simple cleaning procedures and troubleshooting. This mobile application is available at Google Playstore for free.

iii. Module in Basic Automotive

Description. Module in Basic Automotive is a teacher-made learning module that will serve as the guide and mode of instruction. The topics in the learning module are based on the syllabus of instruction for Basic Automotive, a major subject offered for Bachelor of Technology and Livelihood Education and Bachelor of Science in Industrial Education. Considering the process of validation of modules in the College of Education, this instrument underwent the following procedure: i) checking of grammar and technicalities of writing by an English Expert through the aid of Plagscan and Grammarly, ii) content validity by experts in the field of Automotive, and iii) final checking by the College Dean.

2.4 Procedure of the Study

The researcher conducted this study into three phases, namely: Pre-test, Instruction, and Post-test.

Pre-test. In the first phase, the validated teacher-made pre-test was administered to the two groups of participants to test their prior knowledge on Basic Automotive. The results of the pre-test were also used in determining the groupings of the participants.



Instruction. During this phase, two modes of learning were implemented in the two separate groups. In the controlled group, a modular mode of learning was implemented where students used modules that facilitated learning by themselves. Meanwhile, the experimental group utilized game-based learning using the CMS 21 application. This application was implemented to the participants to learn the basic concepts and skills in Automotive.

Post-test. In this stage, the validated teacher-made post-test was utilized by the two groups of participants to test their learned knowledge and skills on Basic Automotive. The results of the post-test were compared to the results of the pre-test, and further tests of differences were conducted to determine the more effective learning approach.

2.5 Data Analysis

In this study, the data that were obtained in each phase were described and analyzed using the following framework or statistical treatment:

1. To describe the performance of the students in the two groups before and after the implementation of learning module and CMS 21 in the controlled and experimental group respectively, mean score and standard deviation were used. Also, the scores were interpreted as follows: 41 – 50 (Excellent), 31 – 40 (Very Satisfactory), 21 – 30 (Satisfactory), 11 – 20 (Needs Improvement) and 0 – 10 (Poor).
2. To determine significant differences within and between groups, paired sample t-test and two sample t – test respectively were used.

3. RESULTS AND DISCUSSION

3.1 Performance of Subjects before the Implementation of Learning Modalities

3.1.1 Performance of Subjects under the Controlled Group before Implementing Modular Learning

Table 1 Pre - Test Results of Subjects under Controlled Group

Subjects	Scores	Verbal Interpretation
C1	13	Needs Improvement
C2	15	Needs Improvement
C3	16	Needs Improvement
C4	20	Needs Improvement
C5	22	Satisfactory
C6	25	Satisfactory
C7	26	Satisfactory
C8	27	Satisfactory
C9	27	Satisfactory
C10	32	Very Satisfactory
Mean Score	22.3	Satisfactory

Table 1 shows the performance of the subjects in the controlled group before implementing the modules for Basic Automotive. As shown in the table, it was revealed that 40% or 4 out of 10 subjects in the controlled group obtained scores from 11 - 20 with verbal interpretation of *needs improvement*. Moreover, 5 out 10 or 50% of the subjects in the group performed satisfactory with scores from 21 to 30. Lastly, only one or 10% of the subjects obtained a score of 32 verbally interpreted as very satisfactory. In general, the group obtained a mean score of 22.3 verbally interpreted as satisfactory.

Based on these results presented, it can be deduced that most of the subjects in the controlled group performed satisfactory in the pre-test involving selected concepts in basic automotive. Impliedly, this result suggests that there is still a room for intervention and improvement among the subjects in the controlled group since most of the subjects performed satisfactorily.



3.1.2 Performance of Subjects under the Experimental Group before using CMS 21

Table 2 Pre - Test Results of Subjects under Experimental Group

Subjects	Scores	Verbal Interpretation
E1	14	Needs Improvement
E2	14	Needs Improvement
E3	17	Needs Improvement
E4	19	Needs Improvement
E5	21	Satisfactory
E6	26	Satisfactory
E7	25	Satisfactory
E8	26	Satisfactory
E9	28	Satisfactory
E10	32	Very Satisfactory
Mean Score	22.2	Satisfactory

Table 2 displays the subject's performance in the experimental group prior to the game-based CMS 21 intervention. According to the table, 40% of the experimental group's 10 subjects, or 4 out of 10, obtained scores between 11 and 20, with verbal interpretation of *needs improvement*. Additionally, 5 out of 10 participants, or 50% of the subjects, scored satisfactorily with scores between 21 and 30. And only one subject, or 10% of the group, obtained a score of 32, which is considered to be very satisfactory verbally. The group had a mean score of 22.2 overall, which was verbally assessed as satisfactory.

Based on the results, it can be concluded that the majority of the experimental group's subjects did satisfactorily on a pre-test that included fundamental automotive principles. Given that some of the subjects continue to perform below expectations, this result implies that there is still room for intervention and improvement among the individuals.

3.2 Test of Difference between the Performances of the subjects in the Two Groups before the respective learning modalities

Table 3 T Test results between Performances of the subjects in the two groups before the implementation of the respective learning modalities

	Scores	Scores
Mean	22.3	22.2
Variance	38.23333	37.73333
Observations	10	10
Hypothesized Mean Difference	0	
df	18	
t Stat	0.036282	
P(T<=t) one-tail	0.485729	
t Critical one-tail	1.734064	
P(T<=t) two-tail	0.971457	
t Critical two-tail	2.100922	



3.3 Performance of Subjects After the Implementation of Learning Modalities

3.3.1 Performance of Subjects under the Controlled Group After Implementing Modular Learning

Table 4 Post-Test Results of Subjects under Controlled Group

Subjects	Scores	Verbal Interpretation
C1	22	Satisfactory
C2	26	Satisfactory
C3	24	Satisfactory
C4	30	Very Satisfactory
C5	32	Very Satisfactory
C6	33	Very Satisfactory
C7	33	Very Satisfactory
C8	32	Very Satisfactory
C9	30	Very Satisfactory
C10	35	Very Satisfactory
Mean Score	29.7	Satisfactory

Table 4 displays the subject's performance in the controlled group after using modules in Automotive as learning intervention. According to the table, 30% of the controlled group's 10 subjects, or 3 out of 10, obtained scores between 21 and 30, with verbal interpretation of *satisfactory*. Additionally, 7 out of 10 participants, or 70% of the subjects, scored *very satisfactory* with scores between 31 and 40. After using module as a learning intervention, the group obtained a mean score of 29.70, which was verbally assessed as *satisfactory*.

Based on the results, it can be concluded that since the scores of all of the subjects under the controlled group have a drastic positive change compared to the pre - test results of the group, it can be deduced that the performance of the subjects under this group improved after using the intervention specified for the group.

3.3.2 Performance of Subjects under the Experimental Group After using CMS 21

Table 5 Post - Test Results of Subjects under Experimental Group

Subjects	Scores	Verbal Interpretation
E1	25	Satisfactory
E2	27	Satisfactory
E3	30	Satisfactory
E4	32	Very Satisfactory
E5	35	Very Satisfactory
E6	35	Very Satisfactory
E7	38	Very Satisfactory
E8	39	Very Satisfactory
E9	42	Excellent
E10	40	Very Satisfactory
Mean Score	34.3	Very Satisfactory

Table 5 displays the subject's performance in the experimental group after using CMS 21 as a learning intervention. According to the table, 30% of the experimental group, or 3 out of 10, obtained scores between 21 and 30 verbally interpreted as *satisfactory*. Additionally, 6 out of 10 participants, or 60% of the subjects, scored *very satisfactory* with scores between 31 and 40. Lastly, one of the subjects in the group obtained a score of 42, verbally interpreted as *excellent*. After using CMS 21 as a learning intervention, the group obtained a mean score of 34.30, which was verbally assessed as *very satisfactory*.

Based on the results, it can be concluded that since the scores of all the subjects under the experimental group have a drastic positive change compared to the pre-test results of the group, it can be deduced that the performance of the subjects under this group improved after using the intervention specified for the group.

Moreover, when compared to the change in the controlled group, it can be clearly shown that the experimental group performed better compared to the controlled group. Also, when the highest and lowest scorer in the experimental group were interviewed, they stated that they found the use of CMS 21 in learning Basic Automotive more creative and enjoyable on their part as



students. Also, the use of such intervention helped them to be more active in learning concepts in Automotive. This result greatly supports the study conducted by Alvarez (2021) where it was revealed that the use of game-based interventions was found to be more effective compared to the traditional ways of presenting intervention.

3.4 Test of Difference between the performance of subjects in each group before and after using the respective interventions

3.4.1 Test of Difference between the performance of subjects in the controlled Group before and after using modular learning modality

Table 6 T - Test results between the Pre - Test and Post - Test of Subjects under Controlled Group

t-Test: Paired Two Sample for Means		
	Pre-Test	Post-Test
Mean	22.3	29.7
Variance	38.23333	18.45556
Observations	10	10
Pearson Correlation	0.911444	
Hypothesized Mean Difference	0	
df	9	
t Stat	-8.13891	
P(T<=t) one-tail	<0.01	
t Critical one-tail	1.833113	
P(T<=t) two-tail	<0.01	
t Critical two-tail	2.262157	

Table 6 shows the result of the t-test conducted and it was revealed that there is a statistically significant difference in the individuals' test results before and after a series of interventions using the module in Automotive, with a mean difference of 7.40, were in favor of the post-test results. The computed sig is less than the sig critical value, which is 0.05. Therefore, at the 95% level of significance, there is sufficient statistical evidence to reject the null hypothesis that there is no significant difference between the students' performance in fundamental automotive concepts before and after the module's implementation. Therefore, it can be said that there is a considerable difference in the students' basic automotive performance before and after using the Automotive module as a learning intervention.

3.4.2 Test of Difference between the performance of subjects in the Experimental Group before and after using CMS 21

Table 7 T - Test results between the Pre - Test and Post - Test of Subjects under Experimental Group

t-Test: Paired Two Sample for Means		
	Pre-Test	Post-Test
Mean	22.2	34.3
Variance	37.73333	32.45556
Observations	10	10
Pearson Correlation	0.941084	
Hypothesized Mean Difference	0	
df	9	
t Stat	-18.4048	
P(T<=t) one-tail	<0.01	
t Critical one-tail	1.833113	
P(T<=t) two-tail	<0.01	
t Critical two-tail	2.262157	

Table 7 shows the result of the t-test conducted and it was revealed that there is a statistically significant difference in the subjects' test results before and after a series of interventions using CMS 21, with a mean difference of 12.10, in favor of the post-test results. The computed sig is less than the sig critical value, which is 0.05. Therefore, at the 95% level of significance, there is sufficient statistical evidence to reject the null hypothesis that there is no significant difference between the students' performance in



basic automotive concepts before and after using CMS 21 as game - based intervention. Therefore, it can be said that there is a considerable difference in the students' basic automotive performance before and after using the CMS 21 as a learning intervention.

Comparing the results of the two paired sample t-test, it can be deduced that with a mean difference of 0.10, the controlled group performed better compared to the experimental group considering the pre - test results. However, after the implementation of the respective interventions, it was found out that with a mean difference of 5.60, the experimental group performed better compared to the controlled group considering the scores in the post - test.

Lastly, based on the results of the paired sample t-test presented, it can be deduced that both interventions were statistically found to be effective in amplifying the performance of the students in learning basic automotive concepts.

3.5 Test of significant difference between the performance of the subjects in the two groups after the intervention

Table 8 T - Test results between the Post - Tests of Subjects in the Two Groups

t-Test: Two-Sample Assuming Unequal Variances		
	Controlled	Experimental
Mean	29.7	34.3
Variance	18.4555556	32.4555556
Observations	10	10
Hypothesized Mean Difference	0	
df	17	
t Stat	-2.0386916	
P(T<=t) one-tail	0.0286723	
t Critical one-tail	1.73960673	
P(T<=t) two-tail	0.05734459	
t Critical two-tail	2.10981558	

Table 8 displays the results of the t test and the statistically significant difference in scores between the experimental and control groups following a course of corresponding interventions. The computed sig, which is 0.028, is below the sig critical value, which is 0.05. Therefore, there is sufficient statistical evidence to reject the null hypothesis that, at the 95% level of significance, there is no significant difference between the test scores of the students in the two groups after the respective interventions. Therefore, it can be concluded that after the treatments, there is a significant difference between the test results of the children in the two groups.

After further analysis of the mean scores of the two groups, it was revealed that the experimental group performed better compared to the controlled group with a mean difference of 4.60 in favor of the experimental group. The t test conducted further supports that this computed difference is significant and thus implied that using CMS 21 as an intervention in learning basic concepts in automotive compared to using of module in Automotive.

4. CONCLUSIONS

Based on the findings of this study, the following conclusions were drawn.

1. The controlled group performs better in the experimental group before the implementation of the respective interventions. However, after implementing the corresponding interventions, it was found out that the increase in the performance of the experimental group is greater than the controlled group.
2. The two interventions were statistically found to be both effective. However, after the interventions, the use of CMS 21 in learning concepts in Basic Automotive was found to be more effective compared to the use of modules in Automotive.
3. The use of game - based learning through CMS 21 were statistically revealed to be effective.

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