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COMPUTER-AIDED DESIGN AND STUDENTS' PERFORMANCE IN TECHNICAL DRAWING

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ABSTRACT

The core of this study was to assess the level of performance of Computer-Aided Design as perceived by the respondents in terms of pretest, posttest and daily activities results. Moreover, it aimed to ascertain the level of acceptability of Computer-Aided Design as a method in teaching technical drawing. This was conducted at Mayor Anunciacion R. Tuazon National School of Fisheries, Calunasan, Calape, Bohol during the Third Quarter, School Year 2016-2017. The study employed the experimental static-group pretest-posttest and descriptive design. This design involved two groups, the experimental and control group which received separate treatments. The descriptive design was used to determine the acceptability level in terms of convenience of use, promotion of learning, operation and quality of output. The respondents of the study were the Grade 8 students of MARTNSF Calunasan, Calape, Bohol. The results were then tabulated, interpreted and analyzed. The results revealed that the performance of students in the pre-test, post-test and daily activities in both methods offered students with accelerated rating. The results also revealed that there was no significant difference in the performances of students using the conventional and computer-aided drawing as shown in the pretest, posttest and daily activities. This means that computer-aided design has a parallel result to the conventional. There has been a significant difference between the conventional and computer-aided drawing when it comes to the acceptability level. It was found out that the computer-aided design got a higher rating of 3.065 compared to the conventional method which is 2.877. This finding confirmed that computer-aided design is positively accepted by the respondents. It is concluded that computer-

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aided design can be an effective tool for instruction, thus beneficial and useful for both teachers and students. The researcher highly recommends the use of Computer-Aided Design as an instructional method to supplement the conventional one as envisioned in the K-12 curriculum by the Department of Education.

Chapter 1

PROBLEM AND ITS SCOPE

INTRODUCTION

Rationale

Man's creative imagination paves the way of the essentials of drawing. According to Jean-Auguste-Dominique Ingres, "To draw does not mean simply to reproduce contours; drawing does not consist merely of line: drawing is also an expression, the inner form, the plane, the modelling" (Kimmelman, 2008).

As an art, drawing includes all sort of creative expressions. Furthermore, it provides great educational significance. It gives the students opportunity to express themselves, be creative, relieve stress and just enjoy.

As technology advances, man also advances to a more comfortable and wonderful life. In the interest of coping with the new era of technological advancement, the researcher comes to an idea of bringing computer-aided instruction into technical drawing to ease the burden of manual drawing. Furthermore, the researcher is optimistic to determine how efficient and effective Computer-Aided Design in teaching the subject.

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People in industries recognize the importance of technical drawings. It is a universal language that everyone can understand. Drawing techniques may vary in style. However, a standard method of drawing is observed in making industry-grade illustrations for construction, manufacture, and architectural purposes. This is called Computer-Aided Drawing (Hendrickson, 2009).

Computer-aided design (CAD) is a software application for 2D and 3D designs developed and marketed by Autodesk. It is the use of computer systems to assist in the creation, modification, analysis, or optimization of a design. It describes the process of creating a technical drawing with the use of computer software (Rouse, 2011).

As a public vocational school, it must cope with these new trends of technological advancement. The lack of learning facilities to suffice the needs of the growing population of the school is one of the greatest problems the teacher encounters. The school has no specific drawing/drafting room. The teacher finds it difficult to conduct classes with no drawing room and no fabricated drawing tables intended for manual hand drawing. Students had a hard time creating their drawing activities in their armchairs and benches. Furthermore, conventional drawing is time consuming and sometimes results to inaccurate output. Otherwise, computer aided drawing leads to easy, speedy and accurate outputs.

In this modern age, the researcher believes that CAD software addresses the needs of improving manual hand drawings that is accurate, speedy and easy drafting according to industry standards.

Driven by the objectives of the K-12 program that is to prepare students to be skilful and globally competitive, the researcher, as a drawing teacher, desires to enhance the delivery of quality instruction of drawing teachers through the use of Computer-Aided Drawing. The researcher is aware of the advantages of using CAD software in teaching Technical Drawing

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especially in honing the creative and manipulative drawing skills of the students. It is believed that there is a need to conduct a study on the effectiveness of Computer-Aided Design to the students' performance in Technical Drawing.

Literature Background

Technical Drawing as one of the mandated subjects for Technical-Vocational Schools in the country is an applied subject (DO 69, s.2009). It is applied in the sense that students employ both theoretical practice and actual hands-on exercises. They are trained to develop competencies through actual practice that suits to industry standards.

This study is anchored on John Dewey's theory of instrumentalism which states that in order to be considered correct a theory must be successfully applied (Alexander, 2012). Technical Drawing is a "learning by doing" discipline which can be learned well if actually performed. With the aid of the computer-aided drawing, the students can create computerized drawings quickly with precision and accuracy.

Moreover, Froebel's theory of Self-Activity supports this study. The theory states that humans are essentially productive and creative and sought to encourage the creation of educational environments that involved practical work and the direct use of materials. Through engaging with the world, understanding unfolds (Ellington, 2006). Students absorb the lessons clearly when they are engaged in actual experiences and practicalities in life. In short, students must be exposed to hands-on activities.

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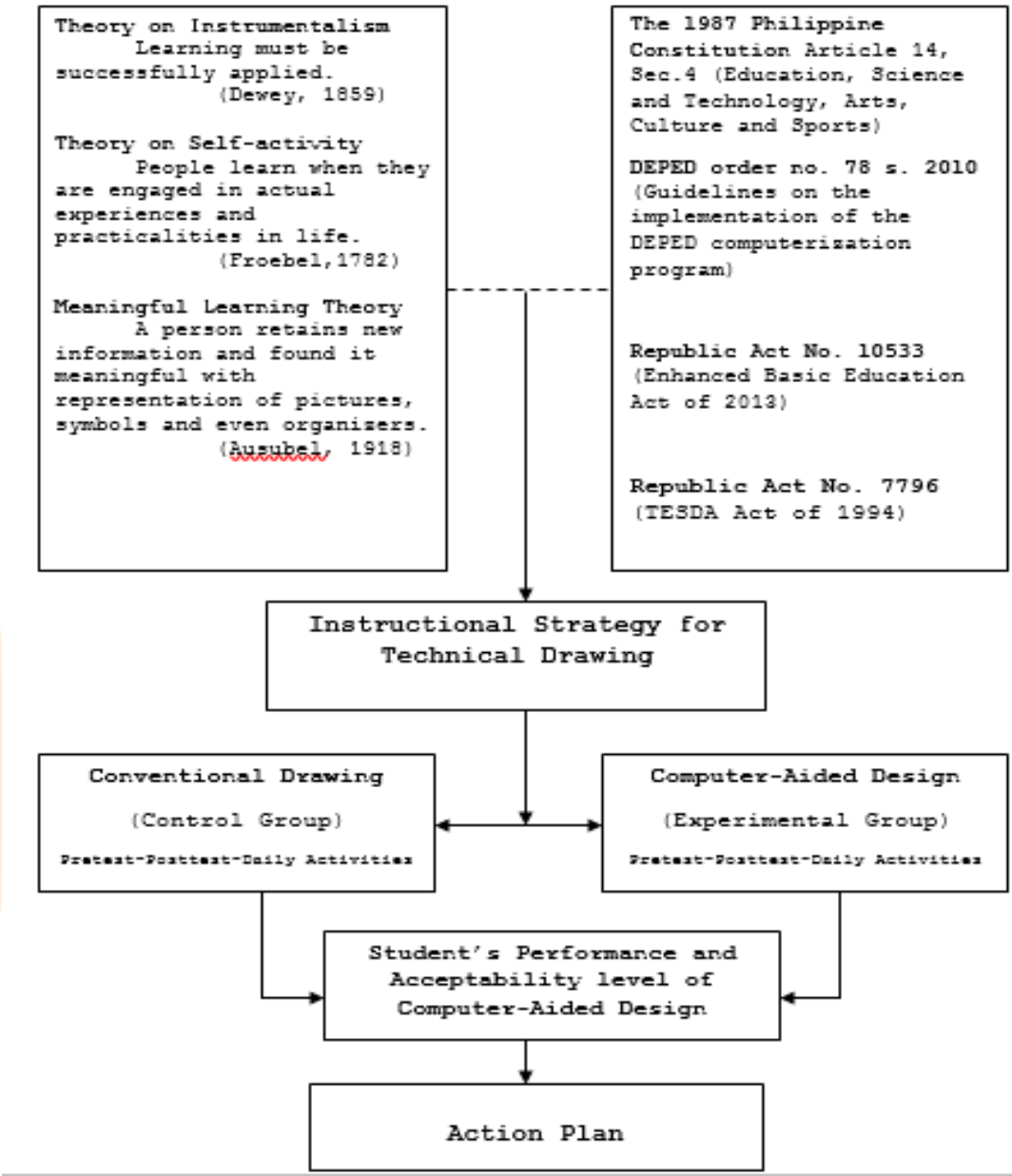

Figure 1. Theoretical and Conceptual Framework

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Students are trained to develop competencies through actual practice of clearly defined skills and knowledge to industry standard of performance under specified conditions. Effective learning requires training in both theory and practice in doing and in thinking about doing (Nigparanon, 2016). Hence, technical skills in the field of technical drawing can be developed more rapidly if actually performed through the Computer-Aided Design, a more advance technological instruction rather than the conventional method of drawing.

In the Blooms Taxonomy of Education, Benjamin S. Bloom (1956) identifies the three domains of educational objectives. Cognitive domain is the mental skills or knowledge. Affective domain is the growth in feelings and emotional areas or attitude and the psychomotor domain is the manual or physical skills of a person (Clark, 2015). Technical drawing is not just skills development but also learning in concept development. One has to learn first its basic concepts before engaging into skills development.

David Ausubel (1960) in his Meaningful Learning Theory further explained that learning placed considerable interest on what the student already knows as being the primary determiner of whether and what he/she learns next. This theory emphasizes that a person retains new information and found it meaningful with representation of pictures, symbols and even organizers (Rhalmi , 2011).

The Multiple Intelligences Theory (Howard Gardner) also supports this study. One of these is Gardner's visual-spatial intelligence as do architects and sailors. They like to draw, do jigsaw puzzles and read maps. They can be taught through drawings, verbal and physical imagery (Armstrong, 2010). Computer-Aided Design can be a tool to develop the drawing skills of students especially those who are inclined to visual-spatial intelligence.

In the studies on computer-based instruction and student's achievement, results showed that computers had an effective and important role in developing students' abilities and

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competences in contrast to traditional method. Students are moving toward computer instruction and they gain deeper learning compared to their counterparts taking traditional lecture/textbook-based methods (Righi, 2012).

Moreover, this research is interrelated to the studies which intend to find out the impact of using PowerPoint presentation on students' achievement. The studies found out that in general multi-media and technology had positive impact on student's achievement which proves that using multimedia in education is an effective means of reaching a better learning. Student's achievement represents performance outcomes of students in instructional environments, specifically in school hence, considered to be a multifaceted construct that comprises different domains of learning (Gambari & Yusuf, 2015).

This study is anchored on this legal basis, the 1987 Constitution of the Republic of the Philippines, Article XIV, Section 1, entitled Education, Science and Technology, Arts, Culture, and Sports, which states that:

> **The State shall protect and promote the right of all citizens to quality education at all levels and shall take appropriate steps to make such education accessible to all.**

This implies that the Constitution aims to produce functionally literate individuals capable of learning and making accurate decisions. To realize this, schools must constantly upgrade their areas of instruction including instructional materials used by the teacher. The study is a vital means to deliver quality education, specifically in the field of Technical Drawing.

Provisions 1 and 2 of DepEd Order No. 78 series 2010, also states that:

> **1. With the legal mandate of promoting the right of all citizens to take appropriate steps in making education accessible to all, Department of**

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> **Education is geared towards the transformation of education through the DepEd Computerization Program (DCP).**
>
> **2. DCP aims to provide public schools with appropriate technologies that would enhance the teaching-learning process and meet the challenges of the 21st century. This program shall respond to the computer backlog of public schools by providing them hardware and software and training on simple trouble shooting.**

It is further supported in Section 2 of Republic Act No. 10533 (Enhanced Basic Education Act of 2013) which states that:

> **The State shall create a functional basic education system that will develop productive and responsible citizens equipped with the essential competencies, skills and values for both life-long learning and employment. In order to achieve this, the State shall :(a) Give every student an opportunity to receive quality education that is globally competitive based on a pedagogically sound curriculum that is at par with international standards.**

The researcher believes that Computer-Aided Design as an instructional medium in teaching Technical Drawing is the greatest solution to cope with the new era of computerization and technological advancement.

The Provision 31 of Philippine Education for All 2015 (EFA) also supports this study which states that:

> **A vital part of the restructured curriculum is the promotion of the use of Information and Communication Technology (ICT) in every learning area. DepEd, through its Computerization Program, provided computers and**

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peripherals to recipient public high schools nationwide. Other government agencies like the Department of Trade and Industry (DTI), local governments, and private firms such as Intel likewise contributed to the advancement of computer education in public elementary and high schools through donations of computers.

In support of the EFA 2015, there is a need for teachers to advance quality instruction to the students. This will be done through constant exposure to computerization and technology.

Technology offers positive academic benefits for all students. Technological innovation is moulding the learners to be creative and progressive. As with any curriculum innovation, the positive benefits of technology for student learning are influenced by different factors, including teaching training, administrative support and state and local curriculum standards and assessment procedure (Pangiligan, 2013).

The use of advanced instructional materials in teaching has been proven to be an effective tool in conceptualizing ideas through demonstrating actual process. Learning in school should be a miniature with a real work situation with the aid of instructional technology whose application and function models the real world of work (Taguba, 2010). Through the use of the Computer-Aided Design, students would gain knowledge and skills in ICT-Technical drafting manipulation.

This study is also aligned with the goals of Republic Act No. 7796 known as Technical Education and Skills Development Act or TESDA Act of 1994 which is to focus on technical education and skills development on meeting the changing demands for quality middle-level manpower and to attain international competitiveness.

Furthermore, the study falls in line with Batas Pambansa Bilang 232 known as the "Education Act of 1982" which states that:

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> **The State shall promote the right of every individual to relevant quality education, regardless of sex, age, creed, socio-economic status, physical and mental conditions, racial or ethnic origin, political or other affiliation. The State shall therefore promote and maintain equality of access to education as well as the enjoyment of the benefits of education by all its citizens.**

The above mentioned Act clearly promotes development of curricular designs and instructional materials, preparation and evaluation of programs to upgrade the relevant quality education to every person either in formal or non-formal schooling. Thus, the study is very suited to the objectives of this Act because of the upgrading styles of using computer-aided design in teaching technical drawing rather than using the conventional one.

THE PROBLEM

Statement of the Problem

The main purpose of this study was to assess the effectiveness of Computer-Aided Design on student's performance in a Technical Drawing 8 class of Mayor Anunciacion R. Tuazon National School of Fisheries in Calape, Bohol for the School Year 2016-2017.

Specifically, the study sought to find answers to the following queries:

1. What is the performance of the students in the conventional method and computer-aided design in the:

    1.1. pre-test;

    1.2. post-test; and

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1.3. daily activities?

2. Is there a significant difference in the performance of the students in the conventional method and computer-aided design in the:

2.1. pre-test;

2.2. post-test; and

2.3. daily activities?

3. What is the acceptability level of computer-aided design as perceived by the Grade 8 students and teacher user?

3.1. convenience of use;

3.2. promotion of learning;

3.3. operation; and

3.4. quality of output?

4. Based on the findings, what action plan can be proposed?

Statement of Null Hypothesis

There is no significant difference in the performance of the students during the pre-test, post test and daily activities using the conventional method and computer aided design.

Significance of the study

The core of this study is to measure the effectiveness of teaching and performance of students using Computer- Aided Design in Technical Drawing 8 students of Mayor Anunciacion R

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Tuazon National School of Fisheries, Calunasan, Calape, Bohol. In addition, the following will benefit the study as well:

Students. The study may help improve performance of students not only in Technical Drawing but also in other subjects hence; computerized instruction is a vital instructional tool taught in the academe and thus exposing them to the new trends of the teaching learning process.

Parents. The parents would realize that through computer-aided integration in the classroom it could make their sons/daughters more competent and well-versed junior/senior high school completers fully equipped with the 21st century's technical-vocational skills.

Teachers. They would brightly see the importance of integrating computer aided instruction and giving them useful instructional tools in their subjects taught and for them to keep posted with modern technology.

School Administrators. This study may help them become more cognizant for their role of supporting and assisting in the implementation of providing enough funding and training for teachers in computer-aided instruction and giving the proper facilities to improve the students' performance for global competitiveness.

Community. As the growing community of technologies it is important that the young generation will be given a chance to learn and understand the worth of exposing them to computer aided instruction.

Future Researchers. The results of this study may serve as reference for future researches.

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RESEARCH METHODOLOGY

Design

The researcher used the static-group pre test-post test design in studying the impact of computer-aided design (independent variable) on student's performance (dependent variable). This design involved two groups: the experimental and control groups. Both groups received separate treatments.

The control underwent the conventional drawing and the experimental group underwent the computer-aided design. The variables were controlled, which means that both groups are equivalent in terms of academic levels (high, medium and low achievers) since they are in heterogeneous grouping; gender levels (male and female); teacher and teaching location. Both groups, the control and experimental underwent pre tests, series of tests on daily activities and finally the post tests.

The researcher utilized the use of questionnaire to assess the acceptability level of computer-aided design to students and teacher-user in terms of convenience of use, promotion of learning, operation and quality of output.

Procedures in giving the lessons:

Conventional drawing	Computer-Aided Design
1. Prepare all the needed drawing instruments.	1. Open an existing AutoCAD drawing interface given by the teacher.

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2. Draw a title block according to the architectural drafting Standards 3. Draw the illustrative figures given by the teacher with proper dimensioning and scaling. 4. Indicate dimension lines, dimensions, and drawing titles according to architectural drafting. 5. Erase unnecessary lines.	2. Draw a title block according to the architectural drafting Standards 3. Draw the illustrative figures given by the teacher following the specified dimensions using the CAD commands. 4. Indicate dimension lines, dimensions, and drawing titles according to architectural drafting. 5. Save your work.

Environment and Participants

The locale of this study is the Mayor Anunciacion R. Tuazon National School of Fisheries, formerly the Calape National School of Fisheries. The school is located in Barangay Calunasan, Calape, Bohol, 3 kilometers away from the town proper. The school was founded by Mayor Anunciacion Rodriguez-Tuazon in February 1980. The school has 26 teachers headed by the

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principal, Mr. Jacinto R. Ballares. It has a population of 525 students with complete junior high school from grade 7 to grade 10 and senior high school grade 11 of the K to 12 curriculums.

The researcher selected the Grade 8 students of Mayor Anunciacion R. Tuazon National School of Fisheries in Calape, Bohol who are officially enrolled for the school year 2016-2017, as respondents with a total population of 80 students. These comprise of 2 sections (Grade 8-Tuna and Grade 8-Mackerel) which were heterogeneously grouped. Each section is equal in terms of academic levels (high, medium and low achievers) and gender levels (male and female).

The researcher applied the match pair designs wherein the participants were matched into pairs with most similarity to each other. Both groups, the control and experimental underwent grade pairing in technical drawing subject. There were 40 respondents in the control group and they have an average grade of 80.34. There were also 40 respondents in the experimental group and with an average grade of 80.32. They were chosen to be the respondents of the study because they were taking technical drawing as a mandatory subject for technical-vocational schools.

Instruments

The instruments used for this study were the researcher's self-made pre-test and post-test and the five (5) daily drawing activities.

The researcher presented the lessons in two-dimensional view using the AutoCAD. The CAD software was installed in the different units of computers in the school's computer laboratory. A self-made test was used in collecting the data for the study which had three parts. Part 1 elicits

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student's profile such as name, grade, class and gender. Part 2 consists a 20-item multiple choice test with 4 options. Part 3 is a 20-point skill test. Next was the series of plate making on the given 5 drawing activities. On the other hand, the researcher utilized another questionnaire to assess the level of acceptability of the computer-aided drawing. The questionnaire was submitted to the adviser and English critic for corrections. After the correction was made, it was reconstructed.

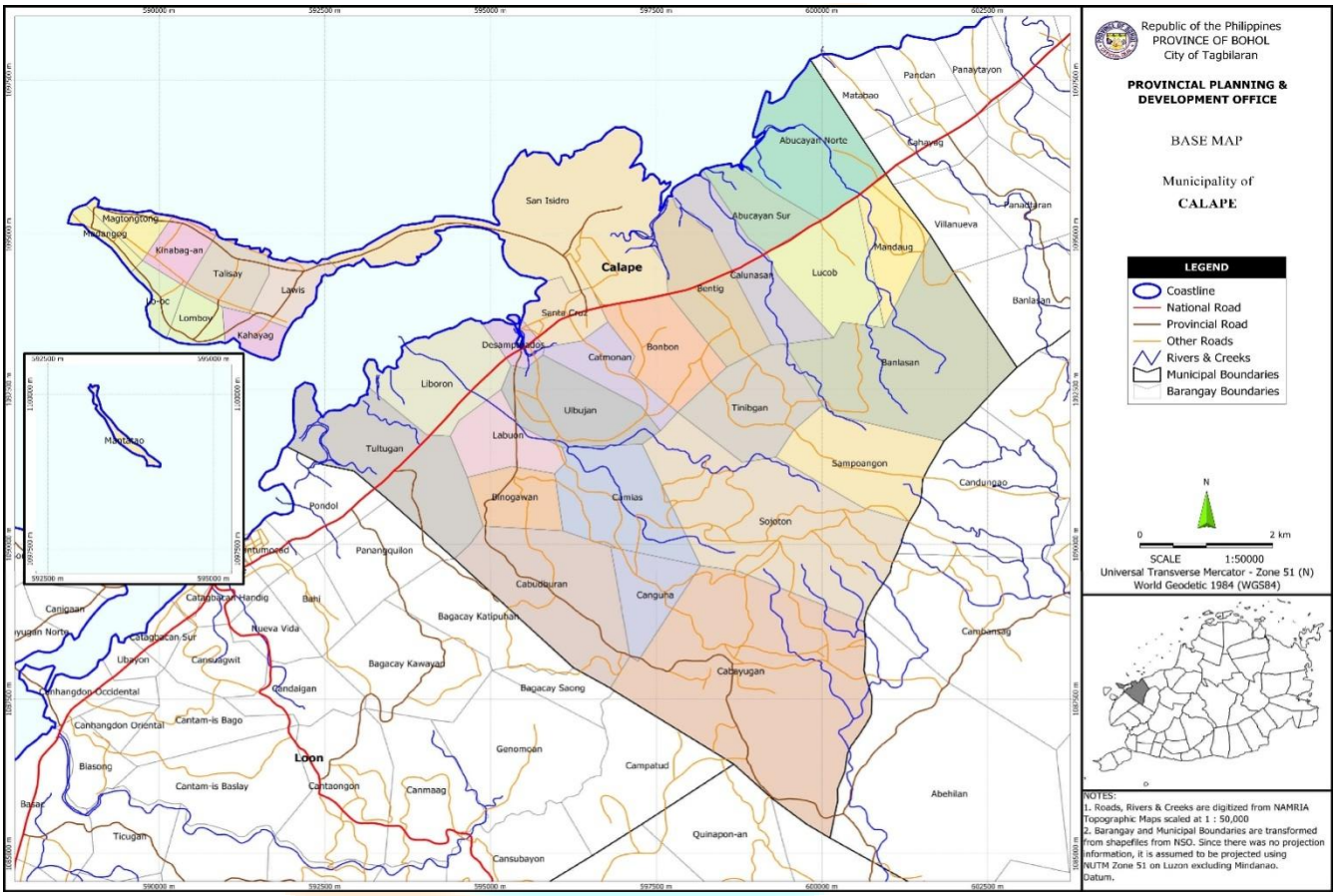

Figure 2. Map of Calape, Bohol

Dry run of the questionnaire was done to the Grade 9 students who were not participants of the study. It was done to find out whether the contents were clear, readable and

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comprehensible. The questionnaire was revised and tried out the second time for assurance of its reliability and validity.

Data Gathering Procedure

1. Asking Permission

The researcher asked permission and approval from the school principal before the administration of the study.

2. Tests Administration

The Grade 8 students in Technical drawing answered the pre test before undergoing to both computer-aided and conventional method of drawing. After which, the researcher retrieved their answers for checking. The next session, the researcher facilitated the conventional method in the control group. It was then followed with the administration of a series of follow-up tests in every lesson presented. Finally, the post test was administered. After which, the researcher collected their answers for checking. The same procedure was done for the other experimental group of selected students for the administration of the Computer- Aided drawing.

3. Experimentation Proper

The researcher checked the results of the pre-test of the student-participants. Each group (control and experimental) was exposed to its respective methods of instruction. It was followed by assessing the acceptability level of both methods by the entire student-participants using the self-made questionnaire.

4. Analyzing and interpreting the test results

The researcher gathered, tallied and tabulated the results using the appropriate statistical treatment to arrive at proper analysis and interpretation.

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5. Conclusion and Recommendation

Based on the data gathered, the researcher formulated the conclusions and recommendations.

6. Action Plan

An action plan was designed for the acceptability and utilization of the results of the study.

Statistical Treatment

The data collected; tabulated and analyzed were the bases for conclusions and recommendations. To get the acceptability level of Computer-Aided Design, the data were treated by average weighted mean.

Results were interpreted using the following scale:

Scale		Accomplishment	Description
4	=	3.28-4.00	Very High
3	=	2.52-3.27	High
2	=	1.76-2.51	Average
1	=	1.00-1.75	Low

To determine the difference on students' performance in the control (conventional method) and experimental (computer-aided design) set up, T-test was used:

$$t = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\frac{{SD_1}^2}{N_1} + \frac{{SD_2}^2}{N_2}}}$$

Where:

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t = t-test

$\bar{X}_1$ = average weighted mean of the first variable

$\bar{X}_2$ = average weighted mean of the second variable

$SD_1{}^2$ = variance of the first variable

$SD_2{}^2$ = variance of the second variable

N_1 = number of respondents taking pre test

N_2 = number of respondents taking post test

DEFINITION OF TERMS

The following terms are defined to facilitate better understanding:

Computer-Aided Design. This refers to the process of using a computer with CAD software to design and produce drawings and models.

Conventional Method. This refers to creating drawing outputs using manual hand drawing with the aid of paper-pencil materials and drawing tools and instruments.

Freehand Drawing. This refers to a style of drawing made without the use of guiding or measuring instruments and tools.

Mechanical Drawing. This refers to creating drawings by using special drawing instruments and tools in a very precise and accurate way.

Promotion of Learning. This refers to the mastery of competencies taught in technical drawing subject.

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Questionnaire. An instrument containing a set of questions to gather information to measure the acceptability level of the Computer-Aided Design in terms of convenience of use, promotion of learning, operation and quality of output.

Student's Performance. This refers to the performance outcomes on specified competencies achieved by the students in the subject specifying post-test and daily activities.

Technical drawing. This refers to the act and discipline of composing drawings or plans rendered to scale as employed in mechanical drawing and is a mandated subject for technical-vocational schools in the country.

Chapter 2

PRESENTATION, ANALYSIS AND INTERPRETATION OF DATA

This chapter covers the presentation, analysis and interpretation of data gathered. It presents the performances of students exposed to the conventional and Computer-Aided Design method in the pre-test, post-test and daily activities.

This portion also deals with the performance of the Computer-Aided Design (CAD) and the conventional method of drawing in terms of convenience of use, promotion of learning, operation and quality of output as perceived by Grade 8 students of Mayor Anunciacion R. Tuazon National School of Fisheries, Calunasan, Calape, Bohol. Moreover, the acceptability of the Computer-Aided Design (CAD) is also shown in this chapter as assessed by the respondents.

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Table 1 illustrates the performance of the students in the pre-test and post-test upon the exposure to conventional and computer-aided method of drawing. The conventional reveals that 35 out of 40 or 87.5% of the respondents were labelled "poor". Meanwhile, 5 out of 40 or 12.5% of the respondents were described as "fair". No respondents were able to get "good" and "very good". This denotes that the students are not acquainted yet with the lessons.

Table 1

Performance Profile of students in the pre-test and post-test based on their exposure to conventional and computer-aided design

N=80

CONVENTIONAL					COMPUTER-AIDED DESIGN				
	PRETEST		POSTTEST		PRETEST		POSTTEST		Description
Range of Scores	f	%	f	%	f	%	f	%	
31-40	0	0%	29	72.5%	0	0%	30	75%	Very Good
21-30	0	0%	8	20%	0	0%	7	17.5%	Good
11-20	5	12.5%	3	7.5%	6	15%	3	7.5%	Fair
0-10	35	87.5%	0	0%	34	85%	0	0%	Poor
Total	40	100%	40	100%	40	100%	40	100%	

In contrast, after giving a comprehensive discussion on the lessons through the conventional method, the post-test comparatively showed higher results to pre-test. Twenty nine (29) out of 40 or 72.5% rated "very good". Eight (8) out of 40 or 8% of respondents were described "good". Three (3) or 7.5% rated "fair". The result confirms that there is a noticeable

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change and improvement of the students' performances after giving thorough discussions on the lessons.

Table 1 also demonstrates the performance of another group of students based on their pre-test and post-test result upon exposure on the computer-aided design. The performance of students through computer-aided design reveals that 34 out of 40 or 87.5% got "poor" and 6 out of 40 or 12.5% got "fair" on their performance of the pre-test. This means that almost all of the students have not yet familiarized the lessons as revealed in the test.

On the other hand, after giving the lessons through computer-aided method of drawing, their scores have improved a lot, 30 out of 40 respondents or 75% labelled as "very good". Seven (7) or 17.5% labelled as "good". Three (3) out of 40 or 7.5% rated as "fair". This means that computer-aided design as a method of instruction offers them great help in advancing and developing their knowledge in technical drawing. This finding is associated with the Meaningful Learning Theory wherein students learn through meaningful representation of pictures, symbols and organizers (Rhalmi, 2011). These features are positively found in the computer-aided design most especially in visualizing objects and shapes in a drawing design.

Table 2

Performance Profile of students in daily activities based on their exposure to conventional and computer-aided design
N=80

CONVENTIONAL METHOD			COMPUTER-AIDED DESIGN		
	Daily Activities		Daily Activities		
Range of Scores	f	%	Range of Scores	f	%
92-98	2	5%	86-97	13	32.5%
85-91	1	2.5%	74-85	10	25%
78-84	3	7.5%	62-73	5	12.5%
71-77	7	17.5%	50-61	3	7.5%

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64-70	12	30%	38-49	6	15%
57-63	7	17.5%	26-37	3	7.5%
50-56	8	20%			
Total	40	100%	Total	40	100%

Table 2 shows the performances of the students in daily activities upon the exposure to conventional and computer-aided method of drawing. The conventional reveals that 12 out of 40 or 30% of the respondents got the range of scores in between 64-70. There are 8 out of 40 or 20% of the respondents were in the range scores of 50-56. Meanwhile, 17.5% of the respondents got the range of scores in between 71-77 and 57-63. Range scores of 85-91 and 92-98 got the lowest percentage ratings of 5% and 2.5%. The weighted mean in daily activities for conventional is 67.2.

The table also shows the performances in daily activities using the computer-aided design. It reveals that 13 out of 40 or 32.5% of the respondents got the range scores of 86-97. There are 10 out of 40 or 25% of the respondents got the range scores of 74-85. Five (5) out of 40 or 12.5% of the respondents are in the range scores of 62-73. Meanwhile, 7.5% of the respondents got the range scores of 50-61 and 26-37. There are 6 out of 40 or 15% of the respondents got the range scores of 38-49. The weighted mean in daily activities for computer-aided design is 71.1 respectively.

The results revealed that there is a slight increase in the weighted mean scores of students in daily activities using the computer-aided design as a method in teaching technical drawing. This is connected with the Experiential Learning Theory which suggests that trying and doing contributes much to the development of student's skills and ideas. Students showed that they learn best when they have active involvement in the process of learning (Kolb, 2014).

Table 3 shows the results on the difference between the performances of students exposed to conventional and computer-aided design. The pre-test revealed that there is no significant difference in the student's performances exposed to the two methods as shown by the

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computed t-value of 1.55 which is lesser than tabular t-value of 1.99 at df78 and 0.05 level of significance. Thus, null hypothesis accepted. This means that the students' performance did not differ as to the methods employed either conventional or Computer-Aided Design.

Table 3

Difference between the Performances of the Students using Conventional and Computer-Aided Design

N=80

Difference Between	Variables	T computed value	T tabular value	Description	Interpretation
		At 0.05 level of significance, df 78			
Conventional and Computer-Aided Design	Pretest	1.55	1.99	Insignificant	Accept null hypothesis
	Posttest	-0.20	1.99	Insignificant	Accept null hypothesis
	Daily activities	1.06	1.99	Insignificant	Accept null hypothesis

The post test showed insignificant difference in the student's performances exposed to both methods as shown by the computed t-value of -0.20 which is lesser than the tabular t-value of 1.99 at df78. Hence, null hypothesis accepted. The researcher has the same observation that the performance of students did not differ significantly employing the two methods.

Daily activities also revealed insignificant difference in the student's performances exposed to both methods as shown by the computed t-value of 1.06 which is lesser than the tabular t-

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value of 1.99 at df 78. As a result, null hypothesis accepted. This means that performance of the students in daily drawing activities did not differ significantly as to the methods used.

In other words, there is no significant difference in the performances of students exposed to both methods in the pre-test, post-test and daily activities. Therefore, the null hypothesis is accepted. The said analysis is supported by John Dewey's Instrumentalism Theory wherein it is a "learning by doing" discipline (Alexander, 2012). Students learned either using conventional or computer-aided design if they performed the activities.

This finding implies that both methods are effective instructional means that can be applied in teaching technical drawing. It also suggests that computer-aided design is an alternative or supplementary strategy in teaching especially in the modern arena of education these days.

Table 4

Acceptability level of Computer-Aided Design and Conventional Method

N=80

CRITERIA	CONVENTIONAL		COMPUTER-AIDED DESIGN	
1. Convenience of use	**WM**	**Description**	**WM**	**Description**
1.1. Draw designs efficiently	2.925	High	2.725	High
1.2. Lay-out drawings and designs easily	2.825	High	2.650	High
1.3.Simple to copy and reproduce	3.075	High	3.175	High
AWM	2.942	High	2.850	High
2. Promotion of Learning				

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2.1. Draw objects correctly with proper application of type, size and thickness of lines	2.825	High	3.025	High
2.2. Perform proper dimensioning and set to correct scale and unit.	2.925	High	3.350	High
2.3. Create correct size title block and label all necessary text information.	3.225	High	3.175	High
AWM	2.992	High	3.183	High
3. Operation				
3.1. Create speedy drawings	2.40	High	2.70	High
3.2. Create accurate drawings	2.575	High	2.85	High
3.3. Correct errors quickly	3.05	High	3.30	High
AWM	2.675	High	2.95	High
4. Quality of output				
4.1. Improve the quality of the design	2.625	High	3.30	High
4.2. Create two-dimensional drawings(2D)	3.125	High	3.25	High
4.3. Visualize objects and shapes	2.950	High	3.275	High
AWM	2.90	High	3.278	High
General Average Weighted Mean	2.877	High	3.065	High

Table 4 shows the acceptability level of the computer-aided design and the conventional method in terms of convenience of use, promotion of learning, operation and quality of output.

The conventional method in terms of convenience of use had an average rating of 2.942 and interpreted as "high". This means that the said method is suitable for instruction and requires less effort to use as perceived by the respondents.

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Promotion of learning got the average rating of 2.992 and interpreted as "high". This implies that the method has the capability to facilitate the teaching-learning process wherein it resulted to learning.

In terms of operation, the participants gave a "high" rating as reflected in the average weighted mean of 2.675.

This shows that the respondents assessed the conventional method to be easy in terms of operation.

Furthermore, when it comes to the quality of output, the conventional method got a weighted mean of 2.90 which is interpreted. This illustrates that using conventional method of drawing confirms to the quality of the drawing design.

Finally, the general average weighted mean of the conventional method is 2.877 with the qualitative description as "high". It proves that the conventional method is still an effective method use for instruction as experienced for a longer of time.

Additionally, the acceptability level of conventional method depicts how this method attest to quality education provided that the instructional materials (IM's) are readily available, the room is conducive for learning, and the teachers are well-focused to instruction.

Table 4 also illustrates the acceptability level of the performance of computer-aided design. In terms of convenience of use, the method is rated as "high" with a weighted mean of 2.85. This means that computerized instruction is easy and convenient to use.

In terms of promotion of learning, the computer-aided drawing is labelled "high" with a weighted mean of 3.183. This means that computerized method of instruction promotes faster learning. Multi-media and technology are effective means of reaching better learning. There is a significant increase in student's achievement that received computer-based instruction (Aaza & Serin, 2013).

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When it comes to operation, the method obtained a weighted mean of 2.95 which is described as "high". This demonstrates that computer-aided drawing is an appropriate method of instruction because it requires less effort to operate in making drawing outputs.

Moreover, the quality of output scored 3.275 which is interpreted as "high". This means that high quality of output is achieved using the AutoCAD method.

Finally, the general weighted average mean of computer-aided drawing is 3.065, described as "high". It reveals that the computer-aided design is a helpful tool for instruction. Students are moving toward computer instruction and they gain deeper learning compared to their counterparts taking traditional based methods (Righi, 2012).

In addition, the acceptability level of computer-aided drawing suggests that it can be used as an excellent alternative or supplementary method for conventional method of drawing. Students positively accept the use of computer-aided drawing as an instructional strategy in teaching Technical Drawing.

Chapter 3

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

This chapter discusses the summary of the study, its findings and conclusions on the analysis and interpretation of data. Recommendations are provided as bases for the proposed action plan.

Summary

The core of the study was to assess the effectiveness of Computer-Aided Design on student's performance in a Technical Drawing 8 class of Mayor Anunciacion R. Tuazon National School of Fisheries during the School Year 2016-2017.

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Furthermore, the study sought to determine the acceptability level of Computer-Aided Design in terms of convenience of use, promotion of learning, operation and quality of output.

The study also sought to determine the difference between the performances of the students in the conventional and Computer-Aided Design method in the pre-test, post test and daily activities.

The study used the experimental method of research particularly the static-group pre-test post-test design. It was supplemented with questionnaires to assess the level of performance and acceptability of Computer-Aided Design.

The respondents were the grade 8 students of Mayor Anunciacion R. Tuazon National School of Fisheries with a total population of 80. These comprises of two groups which are matched into pairs and underwent grade pairing. The same respondents perceived the acceptability level of Computer-Aided Design.

Findings

The following are the findings based on the result of the data obtained:

1. As a result of the performance of students in the pre-test, post-test and daily activities, it was found out that both methods (conventional and computer-aided design) offer the students with accelerated rating. Majority of the respondents got high scores in the post-test and daily activities which rated "very good". This means that both methods improve students' performance thus, beneficial and useful to students.

2. There was no significant difference in the performances of the students in the conventional and computer-aided design method as shown in the pre-test, post-test and daily activities. It was attested by their corresponding computed t-value which is lesser than the tabular t-value with df78 at 0.05 level of significance. Thus, the null hypothesis was accepted.

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3. The acceptability level of the performance of Computer-Aided Drawing resulted to an average weighted mean of 3.065 and interpreted as "high". On the other hand, conventional method acceptability level also showed an average weighted mean of 2.877 and interpreted as "high". This finding confirmed that computer-aided design is positively accepted to be used as a method in teaching as perceived by the respondents.

Conclusions

Based on the findings, the researcher concluded that Computer-Aided Design is an effective method for instruction thus beneficial and practical to both students and teachers. Moreover, this method can offer a parallel performance to conventional one. Hence, it also improves students' performance and provides significant insights to teachers especially in the modern world of technical drawing.

Recommendations

Based on the findings, the following recommendations are given:

1. Computer-Aided Design is suggested to be employed as an instructional method used by drawing teachers in teaching technical drawing.

2. Public schools must be equipped with necessary ICT facilities to leverage the potentials of CAD and improve student's performance given that CAD offers parallel performance with the conventional method.

3. Drawing teachers should be trained and encouraged to use Computer-Aided Design in teaching technical drawing and other technology subjects at secondary schools.

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4. It is recommended that skills activities be done and rated in the classroom to get the actual performance of the students.

5. Further studies should be carried out to improve the study.

Action Plan for the Computer-Aided Design

Rationale

The K-12 curriculum aims to develop 21st century skilled learners. One way to achieve this is upgrading the instructional methods used by the teacher. In the context of education, up-to-date instructional medium caters great impact to the teaching-learning processes. Hence, teachers are no longer the dispensers of knowledge but rather proactive facilitators who promote collaborative knowledge-building and guide students to learn in a variety of environments.

This study on Computer-Aided Design has been proven to have a positive impact on the students' performance. It also attests positive output in the performance of students and acceptability of CAD in terms of convenience of use, promotion of learning, operation and quality of output. It helps the learners hone their drawing skills through computerized planning and designs. It is a vital instructional method that is beneficial to both the students and teachers.

For this reason, the researcher firmly considered the need for the implementation of this computer-aided design as an instructional method in teaching technical drawing. The researcher also developed an AutoCAD Basics (2D) learning module wherein topics are introduced progressively in every lesson for gradual understanding.

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Objectives:

The implementation of this instructional method concerns the following aims:

1. Provide drawing teachers with a modernized method in teaching that is Computer-Aided Design (CAD).
2. Enhance the delivery of instruction in the field of technical drawing.
3. Improve student's performance in technical drawing.
4. Build up students' self-confidence and self-reliance as future CAD operators and graphic designers.

Mechanics of the Implementation

After the approval of this study by the members of the examining tribunal, the researcher will present Computer-Aided Design through the newly developed AutoCAD basics (2D) learning module to the Schools District Supervisor and the School Principal for further assessment, inspection and approval for implementation.

Schedule for the Implementation

The implementation of the proposed plan will start by the next School Year 2017-2018 and continue to the succeeding years.

Evaluative Measures

The School Principal together with the researcher shall oversee the implementation of the proposed plan and evaluate its effectiveness on student's performance on the subject.

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A PROPOSED ACTION PLAN FOR THE IMPLEMENTATION OF COMPUTER-AIDED DESIGN SCHOOL YEAR 2017-2018

AREAS OF CONCERN	OBJECTIVES	CONTENT	STRATEGIES	PERSONS INVOLVED	TIME FRAME	BUDGET	SUCCESS INDICATOR
Constructing Geometrical Figures	To draw regular polygons and solids	*Geometric Figures (Line, Angle Polygon, Circle, Solid)	*Demonstration of appropriate procedures in drawing regular polygons and solids	*Researcher *Students	June-July 2017	none	.Geometric figures are accurately constructed (conventional)
Basic CAD Command keys	To introduce the basic command keys of AutoCAD	*Line Drawing *Arcs & Circle Drawings	* Introduction of the basic line and circle commands	*Researcher *Students	August-September 2017	none	Line, Arcs and Circles exercises are correctly performed in the CAD
Trade Mathematics and Measurement	To carry out measurement and calculations	*Dimensioning *Systems of measurement * conversion	*Applying proper dimensioning to drawing	*Researcher *Students	October 2017	none	Proper dimensioning is applied
Drawing signs, symbols and data	Analyze signs, symbols and data	*Alphabet of lines	*Proper application on the lines to drawing	*Researcher *Students	November 2017	none	Correct application of lines in drawing is achieved
CAD object drawings	To create different 2-dimensional objects through CAD	*2D objects drawing	*Perform object drawing in two-dimensional view	*Researcher *Students	December-January 2018	none	Two-dimensional objects are properly drawn

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							using CAD commands
CAD basic editing commands	To introduce the editing commands in the CAD	*basic editing commands	* Execute editing/modifying commands	*Researcher *Students	February-March 2018	none	Can properly edit/modify drawing outputs
Printing CAD output	To introduce the how on CAD printing	*Output printing	*Printing of CAD outputs with correct lay-out and scale	*Researcher *Students	March 2018	2,000.00	Can print correctly CAD outputs

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