

ASSESSING DRAWING, USING PEN BASED TECHNOLOGY: A CASE OF STUDY AT EAFIT UNIVERSITY

Technology in Practice Strand

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1. ABSTRACT

This article presents the results of a case study realized at EAFIT University. The objective of the experiment was to observe whether the use of digital drawing tablets or pen displays, improves graphic representation in relation with the traditional way of employing paper and pencil as a main tools. The results obtained in the experiment suggest that students with a medium level of drawing knowledge and abilities do not show an improvement in their drawing quality using digital drawing tablets. However the experiment allowed to obtain important findings in order to encourage using "pen based technologies", developing and implementing a new academic model, which incorporates the application of new technologies as new education processes. The finality of such model will be to facilitate the drawing learning, making it more effective and obtaining better results than the actuals.

Keywords: Product design engineering, Drawing by observation, Experiment, Diagnosis, Analogue drawing (paper and pencil), Digital drawing

2. PROBLEM STATEMENT AND CONTEXT

In the major of product design engineering has been detected, inside a bachelor undergraduate investigation [1], a deficiency in the students drawing abilities and in their graphic representation. This shows that they have neglected the drawing as an indispensable tool for the development of their projects. In that moment, this research was the basis for design managers and teachers to understand that there is a huge problem in the models and methods used nowadays in the learning activities and in development of the drawing abilities. This has allowed some students to graduate with drawing deficiencies, having then difficulties in their work when they have to communicate their ideas.

According to Bertoline, the importance of drawing is manifested in his appointment: “The designer who does not know how to draw will obviously be much less creative than the one who knows, without this skill, many designers will be forced to design only what they can draw, instead of drawing everything they can imagine” [2]. Based on the previous statement, this case study was realized, allowing EAFIT University to obtain more evidence, in order to improve the training of product design engineers in their communication and creative skills for the design processes. This research was conducted in order to identify if the digital graphic tablets (currently at the university), make the graphical representation of design engineering students, easier and more accurate, when they need to communicate their ideas, in addition to provide the guidelines for some researches in drawing related processes.

3. METHODOLOGY

According to the view expressed by the author Earl R. Babbie, in his book "The basics of social research ", which emphasizes that an experiment consists of:" (1) take action, and (2) observe the consequences of such action " [3], two different types of assays were performed ("Between Subjects" and "Within Subjects" that are going to be explained further in this document), in order to determine whether by using digital drawing tablets the drawing by observation is improved, compared with the traditional method of paper and pencil.

In both studies, the students had to "copy" a particular model selected in advance. Its graphic representation was based on observation implementing previously acquired knowledge in drawing techniques. The same object was drawn in both studies in order to simplify the quantification and comparison of the quality of each drawing. The object used in the tests was a three-dimensional model in scale, specifically an all-terrain vehicle (ATV) called "Hummer" (See Figure 1), with characteristics such as: having a wide variety of details while keeping a simple design



Figure 1. Vehicle in scale drawn by observation

With the graphical representation of the model, the experimenter was able to explore the visual perception and drawing ability of the students, who were enrolled in two groups of the same drawing course. Each group was part of a different test namely: the first group performed the test "Within Subjects" and the second group performed the test "Between Subjects'.

The students who participated in the tests were aged 18 to 20 years and were enrolled in the second course of drawing belonging to the second semester of the academic program. The sample for each of the tests consisted of twelve (12) participants, chosen by the teacher of the course according to the performance of their students during the academic semester those who had an average level of knowledge and skills in drawing were selected. Before conducting the tests, the participants had already used digital drawing tablets at certain times within the course.

The study was conducted in the "Wacom Lab ". At the beginning of each test, the experimenter read the instructions for 10 minutes, and the class assistant employed 10 additional minutes to explain the usability of the digital tablets and the access to SketchBookPro software, its different icons and applications, and how to use some hardware components, such as the use of the pen, the device menu, and the different buttons. During the tutorial, each participant had the opportunity to interact briefly with the digital tablet, in order to ensure the understanding of the interface and the software basis. Before starting the tests, participants were asked to write the start time and the end time of the activity. (See Figure 2)

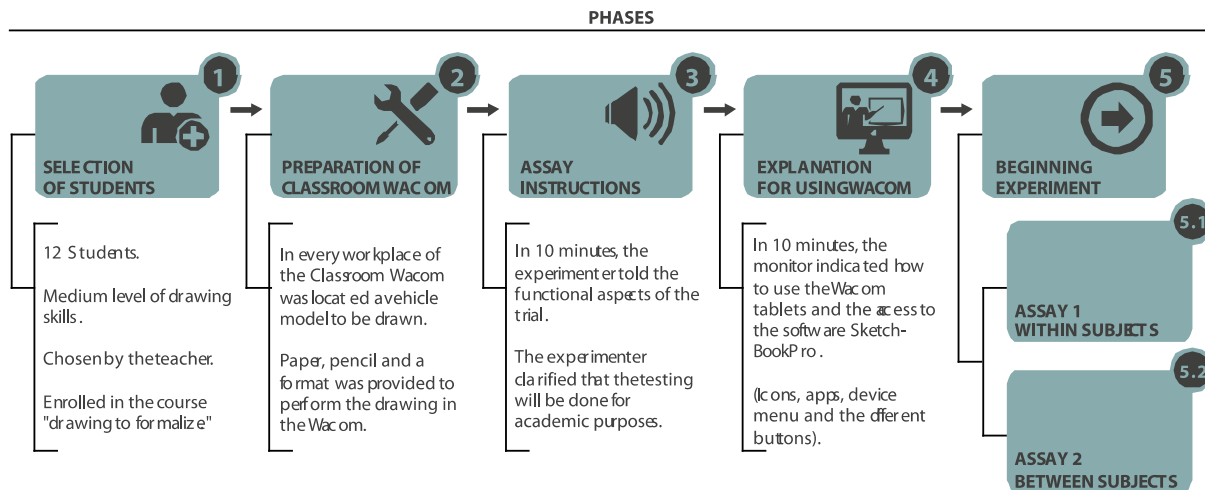


Figure 2. Phases of the experiment - Methodology

3.1 Within Subjects. First Experiment

3.1.1 Characteristics:

Corresponded to an assay in which each participant was exposed to two treatments. (See Figure 3)

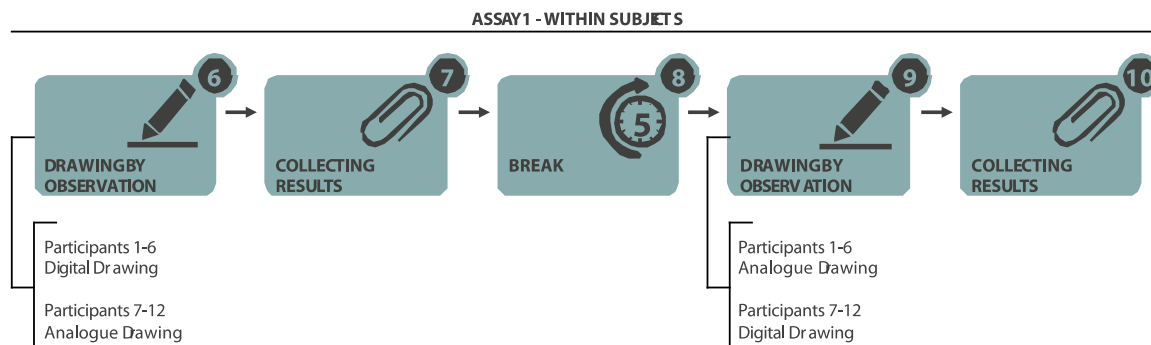


Figure 3. Phases of assay number 1 – Methodology

Each of the participants drew the same object by observation, using the two methods in two different sessions (classic "paper and pencil" and digital drawing using Wacom tablets), using one method first and then the other, with a five (5) minute break. (See Figure 4)

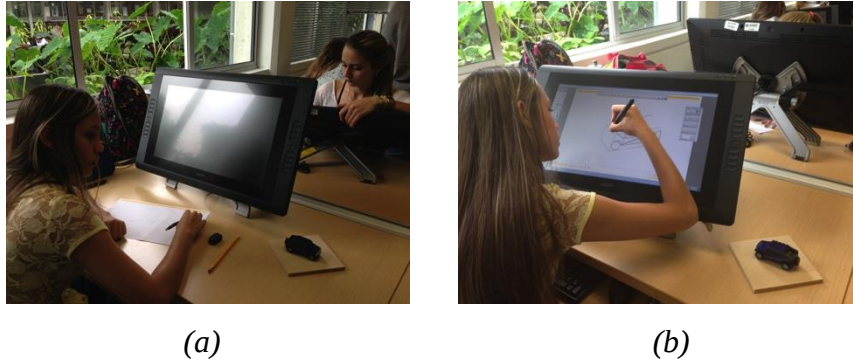


Figure 4. (a) Drawing with paper and pencil, (b) Drawing with Wacom Tablet

With this experiment, some unexpected results were obtained, allowing to examine how individual behavior changes when the circumstances of the experiment changed as well, trying to identify whether the individual skills of each participant are influenced by the method used. This test was performed because it allows more control over all the process and allows to observe possible changes over time in the individual skills of each participant while drawing. The order of the activities performed by the participants in this test (classic pen and paper and digital), could be a disadvantage, generating biased results and allowing participants to misinterpret the second activity. So the decision was to randomly half of the participants performed the analogue drawing before drawing on digital tablets, while the other half started with digital drawing.

At the end of the two sessions, each participant completed a questionnaire composed of five (5) open questions in order to get a deeper insight into their personal preferences and comments about the different methods of drawing, regardless of the test results.

3.2 Between Subjects. Second experiment

3.2.1 Characteristics:

Corresponded to an assay in which the participants divided into two groups and drew the vehicle by observation, in the presence and absence of the technology. (See Figure 5)

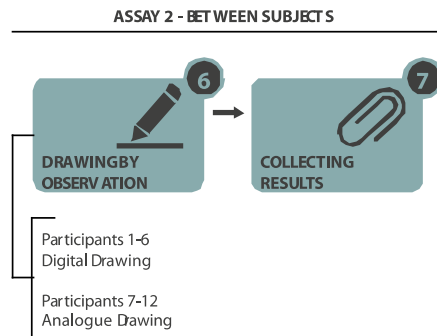


Figure 5. Phases of assay number 2 – Methodology

Simultaneously, half of the group drew the object with paper and pencil, and the other half drew the same object with the digital drawing tablets using a drawing software.

To ensure that the possible differences in the final drawings were a consequence of using two different methods for drawing, it was crucial to ensure that the two groups of participants were as similar as possible.

4. RESULTS AND EVALUATION

The variables that determine the quality of the final drawings in both tests were: line, proportions, precision and perspective. According to the criteria and experience of design engineering drawing teachers, a good drawing must obtain high scores on each of the variables analyzed

The criteria used for evaluation was:

Line: Critical item for representing graphic shapes and ideas. The criteria adopted for the evaluation considers that the line should be thickness constant and continuous, it should not be shaky, discontinuous or with different thickness. (See Figure 6a). The score is from 1 to 3, where:

1 means: POOR: When drawing lines show insecurity and slow response to represent or construct the drawing.

2 means: REGULAR: Lines are continuous and firm but is still perceived lack of security in the drawing construction.

3 means: RIGHT: When lines are firm, long and the joints between curves, straight lines or broken lines are carefully drawn.

Proportions: The representation (by observation) of the dimensions of an object. A high value is given to the ability to correctly perceive the relationship between each part of the item to draw, and how are they related to the whole piece. The precision and attractiveness of an image depends largely on the management of its proportions. (See Figure 6b). The score given to this variable is from 1 to 3, where:

1 means: POOR: The drawing does not present construction lines, pattern or visual measurement unit. The object is disproportionate and spatial relationships between the parts are poorly represented

2 means: REGULAR: The proportions are represented more by observation, instead of using construction lines. There's still a poor spatial relationship between the parts.

3, means: RIGHT: The drawing has been made systemically, there are construction lines, then a pattern of visual measurement is defined to relate the different parts of the model, or shapes and volumes are used to define general geometric forms, before drawing details.

Precision: The ability to represent all the elements or parts of the object, allowing distinguishing the essential details from the secondary ones and recognizing visually: familiar data, logical reasoning and visual memory. (See Figure 6c). The score given to this variable during the evaluation, is from 1 to 3, where:

1 means: POOR: If the drawing studied, only shows some lines or some elements of the represented object, or if it is not complete and the drawing does not show the details the object
 2 means: REGULAR: When the drawing shows the big details (which are very visible) and medium details in some cases, but ignore the smaller and more precise elements that the object of study has.
 3, means: RIGHT: When the drawing is "built" from general details to particular ones, there are all the details to ensure a realistic representation of the model.

Perspective: The way that the representation of objects as they appear in the real world is achieved, in a two-dimensional or flat surface such as paper or screen, with the intention of recreating the depth and relative position of such objects in space. The score given to this variable is from of 1 to 3, where:

1 means: POOR: it doesn't present any "construction" to make the drawing (guide lines, lace, leaks, etc.) and a lack of depth in proportions and in the result becomes evident.
 2 means: REGULAR: There is evidence of previous knowledge applied in the drawing; appear indications of construction to ensure the effect of depth and proportion (lines, lace, etc.), But the desired effect is not achieved, disregarding the fundamental aspects as the "parallel" or "convergence" of construction or projection lines.
 3, means: RIGHT: When the drawing does not show any of the errors outlined above, there is evidence that in the drawing had considered the construction to achieve a level of representation with the point of view of the observer, or they made their own interpretation of the object drawn to achieve the effect of volume, proportion and depth.

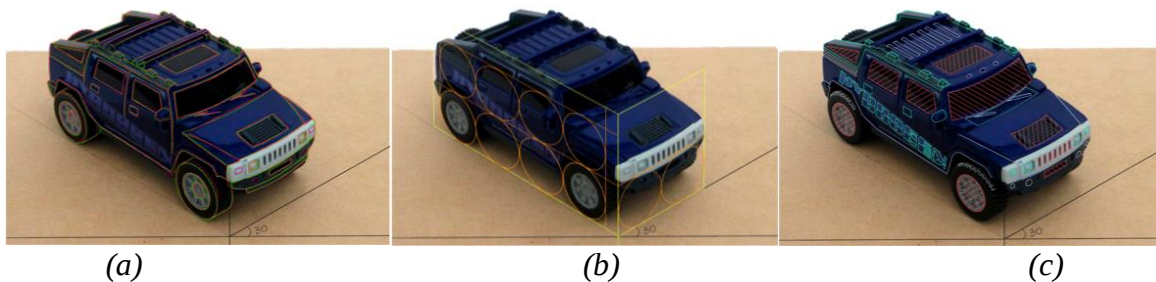


Figure 6. (a) Line, (b) Proportions, (c) Precision

4.1 Assay analysis results “Within Subjects”

4.1.1 Quantitative analysis

To analyze the results, the experimenter proceeded to graph the scores obtained by each of the evaluated variables (line, proportions, precision and perspective). The bar chart allows illustrating each of the participants who performed both tests one after the other and the total score of each drawing done with one technology or the other.

The Figure 7 shows the graph for the "Within Subjects" trial, in the x-axis of the graph the different students related as Wj are located, where W means "Within Subjects" participant and

the letter "j" corresponds to each participant, and in the y-axis, the total score of each drawing is demarcated.

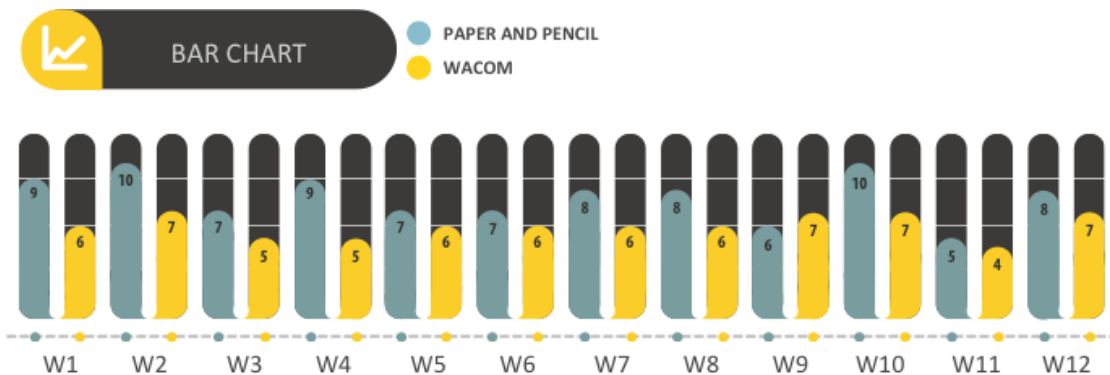


Figure 7. Quantitative assessment "Within Subjects"

This graph shows that with the use of "digital drawing tablets technology", a lower score total is obtained, (72) compared with the use of "paper and pencil" (94). This indicates that regardless of the method with which the assay begins, the quality of the drawing obtained with the Wacom tablets is inferior. Additionally, it is possible to show that when the assay starts with the method "paper and pencil" and ends with the use of "Wacom technology" the drawing quality drops from 48 points to 35, indicating that a learning process is not evident when moving from one method to the other.

4.1.2 Qualitative analysis

The analysis of the results obtained from the evaluation of the qualitative surveys done to each participant (See Figure 8), shows that 92% of the students feel more comfortable using "paper and pencil" as a method of drawing, with 8% of students who said they were more comfortable with the use of digital drawing technology. However, students are aware that digital drawing technology as a drawing tool for product design engineering is just as important as "paper and pencil" and frequently more with 58%, which allows us to infer that, although is not observed in the assays an improvement in the drawings with the use of digital drawing technology, there is a general feeling among students that this technology is very important to represent design ideas. This situation can be explained as a lack of familiarity with new technology, an understandable situation, considering that human being has used the "paper and pencil" since childhood as the natural way to represent their ideas through drawing.

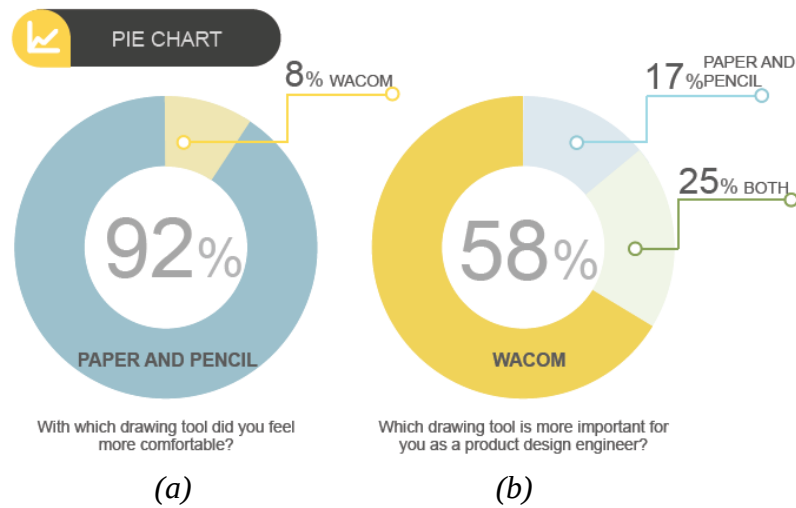


Figure 8. Qualitative assessment "Within Subjects" (a) Question 1 (b) Question 2

4.2 Analysis of assay results "Between Subjects"

4.2.1 Quantitative analysis

Figure 9 shows the graphic for the test "Between Subjects", the x-axis in this graph represents the different variables, one after the other and in the y-axis the corresponding total score is located. To each variable (line, proportions, precision and perspective) was assigned the sum of the scores obtained by the group that used the "paper and pencil" and "digital Wacom Tablet", and is also available for each variable, two bars of different colors that identify the used drawing method.

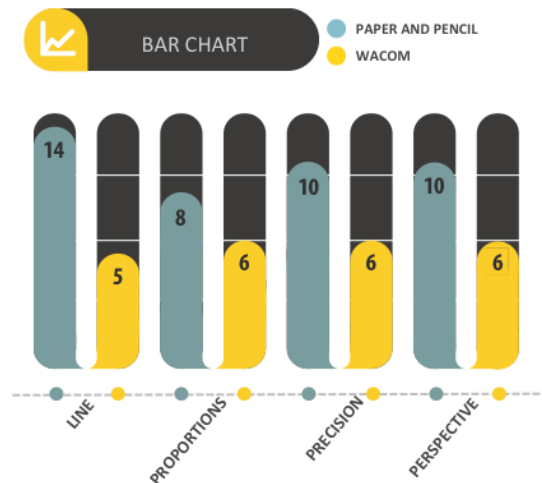


Figure 9. Quantitative evaluation "Between Subjects"

It is possible to observe in this graphic, that with the use of "Digital drawing technology" a lower total score in all variables is achieved, (23) compared with the use of "paper and pencil" (42). This indicates that the quality of the drawing is better when the "paper and pencil" is employed compared to the use of "digital Wacom tablet".

With this assay the results of the above experiments are confirmed, allowing corroborating that the knowledge acquired in the current methods of teaching drawing and the use of "Wacom technology" does not improve the quality of the final.

Additionally, the graphic shows that the variable "line", gets a much higher score, when the drawing is done with "paper and pencil", compared with the results of the lines obtained when using the digital tablet. They were generally perceived as trembling, without continuity and imperfect.

5. CONCLUSIONS

- Regarding to the case of study conducted, it was possible to observe and quantify that the use of digital drawing technology is not showing a significant improvement in observation drawing, compared to the traditional paper and pencil drawing, with the methods that are actually been used for teaching this course in product design engineering.
- The experience or training with digital drawing tablets may affect the results of this experiment. Further experiments should assure that the participants can handle the tablets
- The level of knowledge in drawing does not affect the final results either in digital or traditional drawing.
- The fact that in the assay "Within Subjects" a learning process is not evident when the final drawings were evaluated and after doing it in both methods, can mean that is necessary not just one first iteration to draw the model, and obtain drawings with better quality must require more perseverance and dedication, which is finally the result of several iterations.
- It can be concluded from the "Between Subjects" assay, that as the "paper and pencil" is the daily method using by people to draw and represent their ideas, the circumstantial use of digital drawing technology allows generating difficulties and discomfort when students use digital tablets.
- In general, students of product design engineering believe that the use of the digital drawing tablets is an important tool, because they give to the graphical representation of ideas professionalism, realism and perfection, however it was observed in the research, a huge unfamiliarity with this technology.
- Results obtained in the research are valid for product design engineering students with an average knowledge and drawing skills. It is unknown its validity in advanced students which possess higher skills using the digital drawing tablets.
- It is recommended to conduct similar experiments in order to identify whether the use of the digital drawing tablet, allow to develop new product concepts, solve design problems and reinforce students' creativity.

- The development of new methods of teaching drawing using digital drawing technologies is suggested, as it allows students to interact naturally with these technologies when it is required.

6. REFERENCES

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