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AN ANALYSIS OF REPRESENTATION DRAWING AS A DESIGN TOOL

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Abstract: The different forms of communication make possible the understanding between people, and the verbal and non-verbal languages are the vehicle that provide these interactions, in a flow that makes sense in their contexts. In this article we will deal with the teaching-learning process, in the development of the ability to draw and visualize the shapes of known artifacts, and or those imagined, but capable of being represented. Drawing is a powerful form of communication and becomes efficient as the noises disappear, that is, drawing is easy to understand and self explanatory, in its shape, materials and textures. "To make good perspectives you have to know how to draw". This knowledge is not a manual skill, but a cerebral operation of the way we see things. The exercise of the mental process through drawing and constant refinement increases the capacity for three-dimensional perception. This study permeates forms of two-dimensional representation of artifacts, the efficiency and effectiveness of methods and their techniques, such as: cube method, master line, perspective with vanishing point, frame, ballpoint pen, among others). The analysis of these techniques was carried out from their application in the field, with the participation of sixteen volunteer design undergraduate students. The purpose of the study is to confirm whether the practice of exercises using these techniques improves the students' quality of communication through drawing and its importance in the design process.

Keywords: Manual drawing, methods and techniques, teaching and learning.

INTRODUCTION

The different forms of communication make understanding between people possible. Verbal and non-verbal languages are the vehicle that provide these interactions, in a flow that makes sense in their contexts. This article will deal with the teaching-learning process, in the development of the ability to draw and visualize the shapes of known artifacts, and or those imagined, but capable of being represented.

Drawing is a powerful form of communication and becomes efficient as noise disappears, that is, drawing is easy to understand and highly explanatory, in its form, materials and textures.

"To make good perspectives you have to know how to draw. This knowledge is not a manual skill, but a brain operation of the way we see things. The exercise of the mental process through drawing and constant refinement increases three-dimensional perception. For Powell (1986), this domain of three-dimensionality allows the designer to visualize and draw objects as if they were transparent".

Design is a mental process and when trying to visualize the image of the object to be drawn, it is possible to choose the way to represent it, if you try to see this image in its details and from different points of view. Often a good start is to draw its main views and, from there, if you have a dimensional idea of the object, its functional and aesthetic details, this process facilitates the choice of how we want to see the object represented, focusing on what is most important or what plastically is pleasing to the eye.

For those not in the habit of drawing, the process can be slow and tedious. Learning to sketch can be compared to learning to ride a bicycle, there comes a time when you just need to let go and experience the freedom, speed and confidence that drawing can offer, Henry (2012).

Representation skill comes with practice, practice, practice, practice, and when you think you know how to draw, practice a little more, you soon discover that with each drawing you learn a little more.

This study permeates two-dimensional forms of representation of artifacts, the efficiency and effectiveness of methods and

techniques. The analysis of these methods and techniques was carried out based on their application in the field, with the participation of sixteen volunteer design students.

THEORETICAL REFERENCE

Cognition is present in all individuals who interact in society, and it is not exclusive to those who seek solutions to solve design or work environment problems and their interfaces. The act of thinking comprises a sensory dimension of inputs and outputs, perceptible to human capacity.

Eissen and Steur (2015), in the book Sketching: drawing techniques for product designers, in the introduction ask: do designers still draw by hand? In the computer age, doesn't it make much more sense to use the computer? They claim that many may think that drawing is a dying skill, but this is far from the truth. The authors carried out a survey of major design studios around the world and found that almost all of them use freehand drawing (sketches, sketches) and brainstorming sessions at the beginning of the design process. They also highlight the combination of hand drawing with digital media at different stages of product development.

Over several years within the Undergraduate Design course, in faculty discussions, and in drawing disciplines more specifically, the theme concerns the difficulty of students in drawing well. This opportunity led us to reflect on the subject, and look for possible solutions to improve the student's communication skills through drawing.

The efficiency of the methods and their techniques can be measured in terms of the effort required from the volunteers to accomplish the task, in this case, to carry out an artifact design.

The effectiveness of the methods and techniques can be measured by how much was released to reach the objective when carrying out or fulfilling the task (drawing). The smaller the effort made, the greater their efficiency and effectiveness. In this case, some aspects must be considered, such as: time, design quality, actions and possible errors.

Authors such as: Powell (1986); Julián et al (2005); Montenegro (2010); Henry (2012) and Essen et al (2015) present in their publications, methods and techniques for manual drawing, very similar to those used in this research, and corroborate the way they can be used in academia and professional life.

The manual representation drawing is an important basis for the product development process, it helps in the internal communication of the project team and in the presentation of project proposals. The drawing of sketches or sketches is the starting point of the process and is widely used in the generation of alternative solutions, in this stage the production of ideas is relatively large and allows to combine, rearrange, add or refine the drawings according to the concept. and goals to be achieved.

For Scott Robertson and Thomas Bertling (2013), these techniques must be impregnated in muscle memory so that concentration is spent on building the design, not on how to create the lines for construction. However, developing muscle memory takes practice and patience.

The authors corroborate that for you to develop this "muscle memory", from your mental connection with body movements, mainly the arm, to intuiting the image of what you want to draw, it is necessary to practice a set of techniques and gradual processes, in towards reflective practical development, which stimulate the potentialities and skills for representation design.

For (Henry, 2012); (Robertson and Bertling, 2013); (Powell, 1986); (Eissen and Steur, 2015); (Montenegro, 2010), and drawing teachers, and also, researchers have developed and continue to develop constructive principles

and sequential structures, based on grids, main line, axonometric perspectives, perspectives with vanishing point, cube method and other resources in order to facilitate understanding and visualizationspace for drawing practice.

The prepared didactic material was structured based on simple methods and techniques to facilitate the teaching-learning process. Each one has its particularities and, throughout the process, students identify with some techniques that best fit their style of drawing.

CUBE METHOD - DRAWING IN PERSPECTIVE

The Cube Method, or the Box Method, as it is known, is an auxiliary technique widely used for the visualization and construction of objects. The drawing to be obtained with this technique must follow a constructive logic, observing the dimensions of the object, choosing and drawing the main views inside the box, reflecting lines, defining some useful references in the morphology of the object, prioritizing the view that shows more details of the object. in perspective. It is important to start observing the size of the objects around us, their use relationships, the internal and external environment.

It is worth noting that in many cases it is not necessary to draw all views of the object. Remembering the height, width and depth relationships. They are useful references to build the box, then just transfer the views observing the parallelisms for the folding of the lines.

METHOD – PERSPECTIVE WITH VANISHING POINTS

This type of perspective is widely used for its practicality and versatility, when drawing we must keep in mind the indication of the size of the object, position of the horizon line, distance from the observer, and whether the object will be seen from above, from the front or from below. The distance of the vanishing points on the right and left side must not be too close to the base in order not to distort the object to be drawn too much, the vertical axis line can be centralized, more to the left or more to the right, depending on the view and the details you want to emphasize.

METHOD – AXONOMETRIC PERSPECTIVES

In the axonometric family, we have the isometric perspective that has the 30 degree angles at the base of the box, the dimetric perspective has an angle of 45 degrees and another of 7 degrees respectively, and finally the trimetric perspective that has the angles of 45 degrees respectively.

The morphological characteristics of the object can help us choose the type of perspective we want to show the object, emphasizing all views, or the front view, or even the top view. Each box in the drawings has a different inclination, and these inclinations cause natural distortions in the object. Parallels must be maintained.

Many times we are looking at the blank paper and the drawing does not come out, you only learn to draw by drawing, and breaking these ghosts and obstacles that we create. The mental image that I want to put on paper must lead my hand towards the realization of the drawing. Initially, if the drawing is not good, observe what is wrong with it and modify it, until it does not present any kind of visual noise.

For Powell (1986), the angle of convergence of the parallels and the distance between the observer and the object, in this case, looking from above and the superior view suggests a small object.

METHOD – MASTER LINE

This technique is very effective

forconstruction of more organic shapes, the master line can be used as the central line of the drawing's skeleton, as if it were transparent, and the ellipses starting from the center of this line define the contour points of the object. Another possibility is to add to the mainline a base that defines the floor plan of the object and a central section to define its height. It can be said that it is the deconstruction of the cube method, points of reference and formal transitions are created to help visualize the contours and limits of the object, to cause the effect of three-dimensionality.

METHOD – LIGHT AND SHADOW

This resource defines the parts of the object that receive light, areas with greater incidence of light, and other areas that will be shaded to increase the three-dimensional effect of the object.It is important to define the light projections on the object to check the areas that must be shaded.

Henry (2012), comments that fidelity is, basically, to sharpen and deceive the eyes of thein the same way that a realistic painting does. But the designer needs to be able to create the correct sketch of the object's geometry in order to build fidelity based on the application of light, color, shadow and depth.

The level of realism in the representation of the object depends on the purpose and moment in the project, the methods and techniques discussed in this article, it deals with the constructive processes and their effectiveness while teaching and learning.

METHOD – AXONOMETRIC GRID WITH VANISHING POINT

The reticulated gridis built from an isometric perspective, and can be very useful for drawing different types of objects, or more than one object distributed in space, observing its location. For students, it helps in the first exercises to steady the hand from the reference lines, maintain the parallelism and convergence of the lines.

The book PERSPEKTIV – ZEICHNEW by Gunter Anselm and Jacques Rivalan (1978), explains the constructive process of grids with vanishing point from the isometric perspective.

APPLICATION AND ANALYSIS OF METHODS AND TECHNIQUES

The application, evaluation and analysis carried out in this article aimed to verify the efficiency and effectiveness of the set of Methods and Techniques developed specifically for the practice of drawing. From its application, each type of Method and techniques used by the sixteen students of the 2nd and 3rd phases of Industrial Design at UDESC were analyzed and observed.

The analysis of the results on the application of the set of proposed methods and techniques, aimed to extract from the volunteers, positive and negative aspects, and also, to highlight some difficulties observed in the application in the field.

The concept adopted for preparing the questionnaire and the procedure for analyzing the collected data was based on the objectives of this research.

The presentation of the evaluation results in relation to the contents of each question in the questionnaire and their correlations were commented on in the responses of the design student volunteers.

ASSESSMENT FORM

In our day-to-day decisions we are directly or indirectly relying on observed data. In scientific research, we also need to collect data that can provide information capable of answering our questions, (BARBETTA, 2003).

Despite the limitations encountered for validating or rejecting the set of methods and their techniques, in view of a relatively small sample size for analysis, a target population

5

was sought, directly related to the design process and who had completed two semesters of representation design, using this material (students of the industrial design course). Data were collected from the application of a questionnaire centered on the objectives of this research, aiming at verifying the criteria based on the structure of the set of methods and their respective techniques.

In order to evaluate the methods and techniques, 17 direct questions were elaborated with four alternative answers: divided into three parts, the first answering yes or no, the second answering to what degree it improves or not the ability to draw manually, and the third open part the students could write their impressions about the contents addressed.

- Does not improve drawing ability:

- Improves the ability to draw in a few ways:

- Improves the ability to draw in many ways:

- It totally improves the ability to draw.

Questionnaire prepared based on the objectives of the Research:

1. Does the set of methods and techniques cover the field of knowledge for the practice of artifact design?

Yes   not

2. Is its structure, considering the order of the exercises in relation to the degree of complexity, adequate to seek an improvement in the process of developing skills for manual drawing?

Yes   not

3. Are the level of detail of the set of methods and their techniques adequate for the development of manual drawing skills and their quality?

Yes   not

4. In your experience in the Disciplines of Representation Design I and II, which methods and techniques do you find most efficient?

Cube Method

Perspective with Vanishing Points

axonometric perspectives

Master Line

Light and shadow

Axonometric grid with vanishing point

5. Did the change in the drawing made in graphite in relation to the use of a ballpoint pen present any benefit?

6. Yes   not

Cube Method

- Does not improve drawing ability:

- Improves the ability to draw in a few ways:

- Improves the ability to draw in many ways:

- Fully improves drawing ability:

Perspective with Vanishing Points

- Does not improve drawing ability:

- Improves the ability to draw in a few ways:

- Improves the ability to draw in many ways:

- Fully improves drawing ability:

axonometric perspectives

- Does not improve drawing ability:

- Improves the ability to draw in a few ways:

- Improves the ability to draw in many ways:

- Fully improves drawing ability:

Master Line

- Does not improve drawing ability:

- Improves the ability to draw in a few ways:

- Improves the ability to draw in many ways:

- Fully improves drawing ability:

Light and shadow

- Does not improve drawing ability:

- Improves the ability to draw in a few ways:

- Improves the ability to draw in many ways:

- Fully improves drawing ability:

Axonometric grid with vanishing point

- Does not improve drawing ability:

- Improves the ability to draw in a few ways:

- Improves the ability to draw in many ways:

- Fully improves drawing ability:

Please describe any comments you would like to make.

We appreciate your participation.

Does the set of methods and techniques cover the field of knowledge for the practice of artifact design?

In response to this question, the sixteen students answered yes.

Is its structure, considering the order of the exercises in relation to the degree of complexity, adequate to seek an improvement in the process of developing skills for manual drawing?

In response to this question, only one student answered no.

Are the level of detail of the set of methods and their techniques adequate for the development of manual drawing skills and their quality?

In response to this question, only two students answered no.

1. In your experience in the Disciplines of Representation Design I and II, which methods and techniques do you find most efficient?

Cube Method............

Perspective with Vanishing Points.

axonometric perspectives.

Master Line..............

Light and shadow.......

Axonometric grid with vanishing point..

In terms of preference about the methods and techniques experienced, 12 answered the Cube method, 01 answered perspective with vanishing point, 01 answered axonometric perspective, 14 answered the Master line, 07 answered Light and shadow and 02 answered the axonometric grid with vanishing point. It is noted a significant preference for the Master Line method, followed by the Cube method that appears in second, and third the method of Light and Shadow in the preference of students.

From the results presented it is possible to observe that the three methods and their techniques are more efficient in the teaching-learning relationship, the Master Line method offers a lot of spatial freedom and the decomposition of the objects in sections facilitates the visualization and morphology of the object being drawn. In the case of the Cube method, for those students who still don't have much practice or skill in drawing, the construction of the box and the folding of the main views of the object inside the box help in the visualization and definition of the object's

contours. The Light and Shadow method closes the sketches and sketches, amplifying the three-dimensionality effect of the drawn objects; this resource is very important in the production of ideas.

We believe that the other methods of less preference detected in this research, are equally important for the teaching of manual drawing in the early stages of the project.
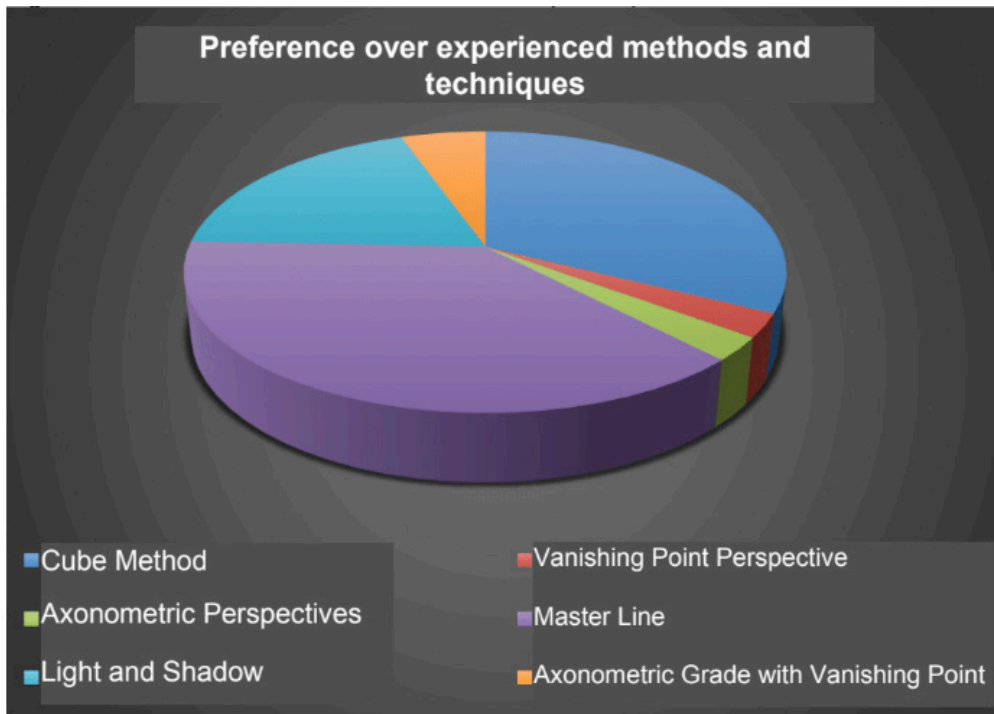

Figure 1: Preference on the methods and techniques experienced

In the second part of the questionnaire based on the criteria below, each student highlighted the most effective one or ones:

- It does not improve the ability to draw;

- It improves in a few respects the ability to draw;

- Improves the ability to draw in many ways;

- It totally improves the ability to draw.

Cube Method
- Does not improve drawing ability:

- Improves the ability to draw in a few ways:..

- Improves the ability to draw in many ways:.....

- Fully improves drawing ability:.........

Perspective with Vanishing Points
- Does not improve drawing ability:

- Improves the ability to draw in a few ways:......

- Improves the ability to draw in many ways:........

- Fully improves drawing ability:..

Axonometric perspectives
- Does not improve drawing ability:

- Improves the ability to draw in a few ways:.......
- Improves the ability to draw in many ways:.......
- Fully improves drawing ability:.

Master Line
- Does not improve drawing ability:
- Improves the ability to draw in a few ways:
- Improves the ability to draw in many ways:......
- Fully improves drawing ability:.........

Light and shadow
- Does not improve drawing ability:
- Improves the ability to draw in a few ways:

- Improves the ability to draw in many ways:......
- Fully improves drawing ability:.........

Axonometric grid with vanishing point
- Does not improve drawing ability:
- Improves the ability to draw in a few ways:.....
- Improves the ability to draw in many ways:.....
- Fully improves drawing ability:....

As for the answers about the efficiency and effectiveness of the Cube method, 09 responded to the criterion that it totally improves the ability to draw, 05 improves the ability to draw in many aspects and 02 and improves the ability to draw in a few aspects. It is noted that these responses corroborate the preference index pointed out by the students.
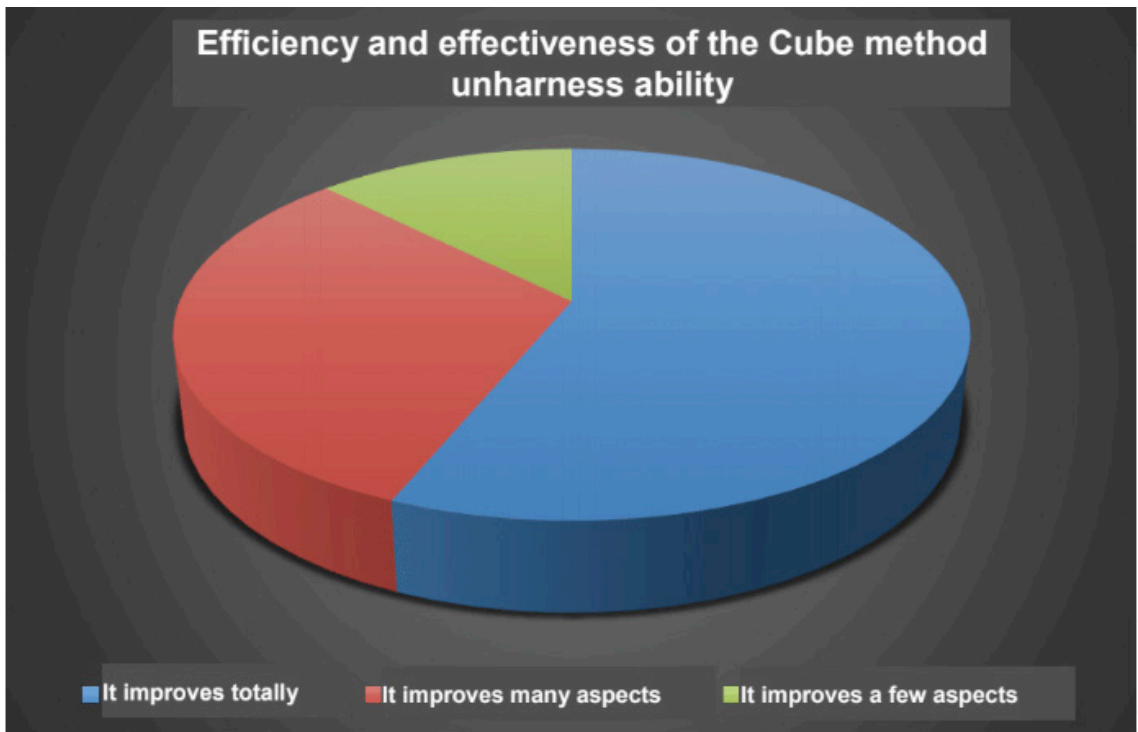

Figure 2: Efficiency and effectiveness of the Cube method

The answers for the Perspective with Vanishing Points method, 06 answered that it improves in a few aspects the ability to draw, 05 that it improves in many aspects the ability to draw and 02 that it totally improves the ability to draw. The answers to this question were more diffuse.
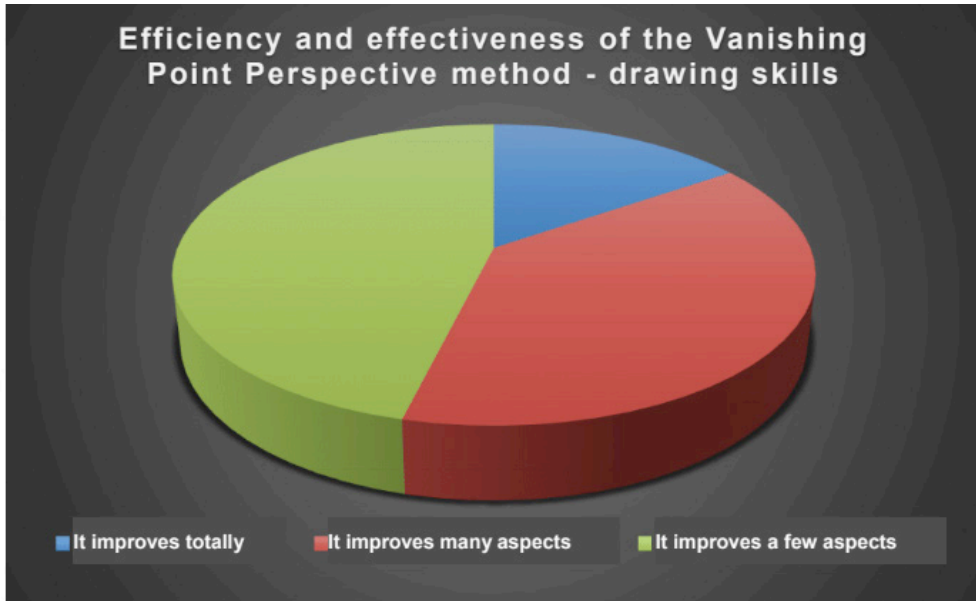

Figure 3: Efficiency and effectiveness of the Perspective method with Vanishing Points

In the Axonometric Perspectives method, 07 answered that it improves in a few aspects the ability to draw, 07 that it improves in many aspects thedrawing skill and 01 which fully improves the drawing skill. As these are constructive principles of a more technical nature, the responses were more divided between the second and third criteria.
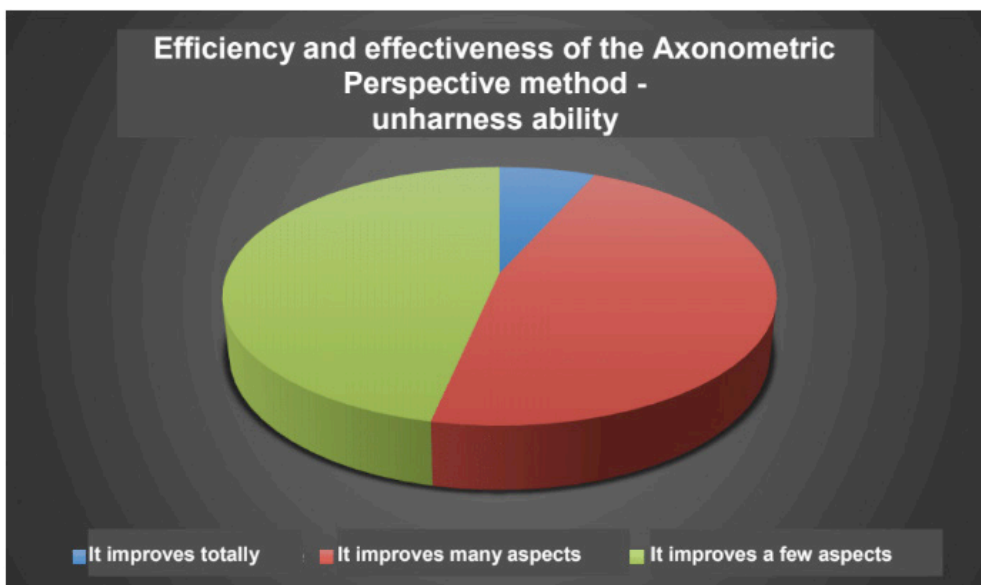

Figure 4: Efficiency and effectiveness of the Axonometric Perspectives method

The Master Line method stands out from the others with 06 answers that improve in many aspects the ability to draw and 09 that it totally improves the ability to draw. The results demonstrate the efficiency and effectiveness of the method.
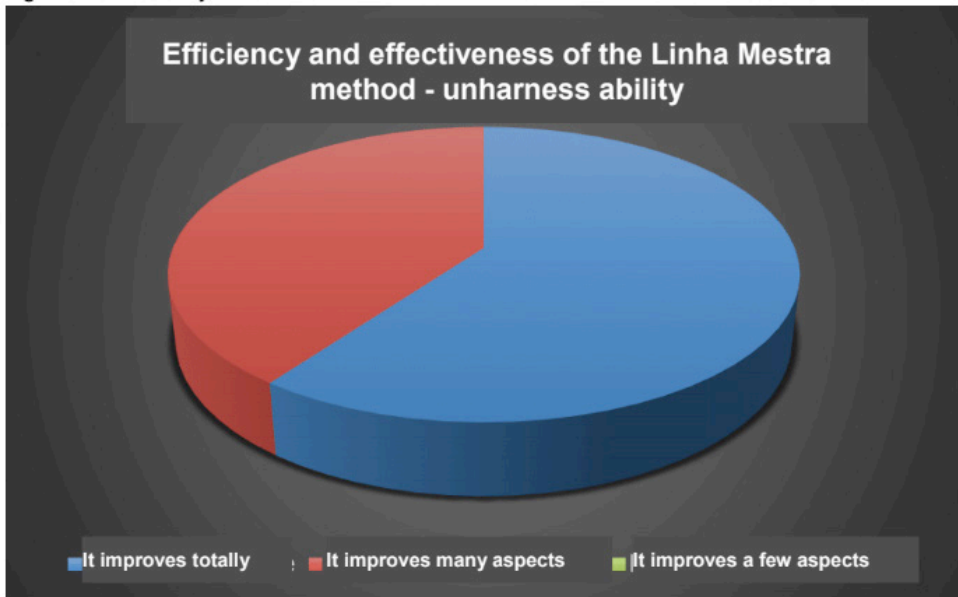

Figure 5: Efficiency and effectiveness of the Master Line method

The Light and Shadow method was the third in the preference of the students, and as for its efficiency and effectiveness, it obtained 06 answers that it improves in many aspects the ability to draw, and 09 answers that it totally improves the ability to draw, confirming its importance for the teaching of drawing.
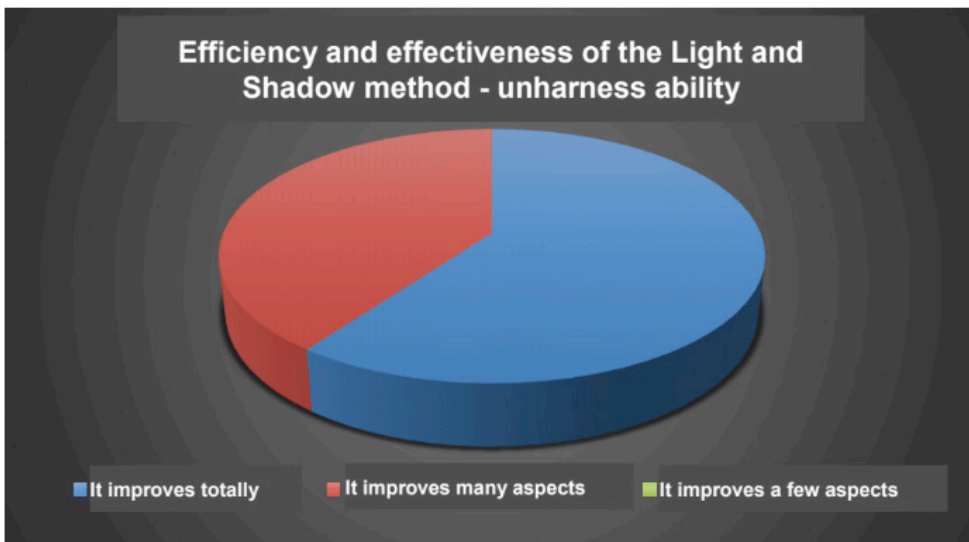

Figure 6: Efficiency and effectiveness of the Light and Shadow method

The responses to the Axonometric Grid with Vanishing Point method also obtained more divided responses, 05 responded that it improves the ability to draw in a few aspects, 05 responded that it improves the ability to draw in many aspects, and 04 that it completely improves the ability to draw. to draw. In an analysis regarding the efficiency and effectiveness of the grid, it is noticed that the students see that this technique is important and can improve the quality of their manual drawings.
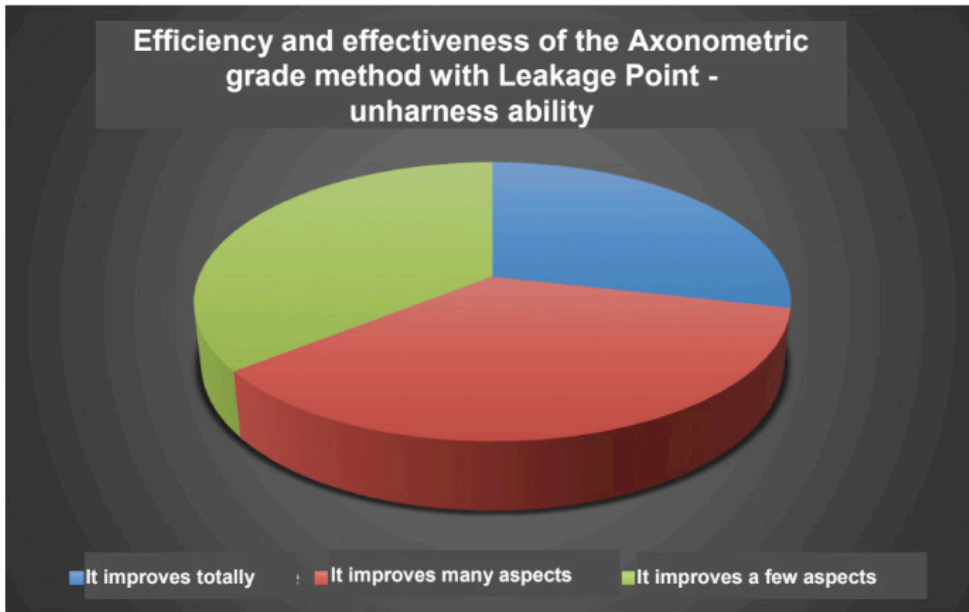

Figure 7: Efficiency and effectiveness of the Axonometric Grid with Vanishing Point method

Here are some comments made by some students:

"I tend to do a mixture of construction techniques, such as the cube method with perspective with vanishing points, cube and axonometrics and cube with grid".

"The ballpoint pen exercises helped a lot in developing the skills of creating and volumetric composition of artifacts".

"The use of the ballpoint pen brings a great improvement in drawing".

"It depends a lot on the student's individual quest to exercise the methods even more".

"The ballpoint pen brought the benefit of high confidence not to erase the drawings".

"I would like to explore the light and shadow and structure of the drawing in more depth first, before rendering. I think it would be more effective".

FINAL CONSIDERATIONS

Some reflections deserve to be shared in this closing, bearing in mind that, demonstrably, the methods and techniques studied in this research, and seen in a vast literature in representation drawing books, and other no less important ones that were left out of this work, have a key role in teaching-learning processes. A phenomenon we have noticed over the years is that those students who grasp the constructive principles of these techniques and practice drawing develop more of their skills and spatial visualization skills. This ability enables the development of more complex forms or objects.

The apprehension by the students of these

12

fundamentals, help in the passage from manual drawing to computerized drawing, the student leaves the condition of software driver and assumes a more conceptual posture and of relative mastery of a purpose.

What we have noticed in the mandatory internships, carried out by sixth or seventh phase studentsin design offices, is that many do not practice or do not maintain the habit of drawing, resorting directly to drawing on the computer. Reports point out that in many projects of products with different complexities, they need to be corrected because they present constructive errors and often the morphology of the object itself. It is possible to intuit that it is not just a matter of little design experience, because in design studios, professionals accompany interns or training designers, but apparently there is a gap in this passage from manual design to computerized design. This gap points towards the lack of apprehension of at least some constructive principles exemplified here and others that were left out of this study.

What we're discussing is not a question of hand-drawing versus computer-drawing and who's better. We are emphasizing that basic drawing contents continue to play a fundamental role in teaching, aimed at improving the technical and communication skills of students and professionals, and this understanding leads to the improvement of spatial visualization skills, in addition to contributing more effectively to thetransition to computerized design during the development of product designs.

The task of instructing starts from the reflective principle and the instruments used by teachers as stimuli to learning are possible ways of continuous construction, built by students imbued with apprehending knowledge.

REFERENCES

EISSEN, Koos, STEUR, Roselien. Sketching: técnicas de desenho para designers de produto. Ed. Bookman. Porto Alegre. Brasil. 2015.

MONTENEGRO, Gildo. A Perspectiva dos Profissionais. 2ª Edição, Editora Edgard Blucher. São Paulo, 2010.

HENRY, Kevin. Drawing for product designers. Laurence King PublishingLimited. London, 2012.

JULIÁN, F., ALBARRACÍN, JESÚS. Desenho para designers industriais. Editorial Estampa. Lisboa, 2005.

ROBERTSON, Scott. Howto Draw. Design Studio Press. Culver City, CA. 2013.

ROBERTSON, Scott. Howto Render. Design Studio Press. Culver City, CA. 2014.

POWELL, Dick. Técnicas de Presentacion. Herman Blume. Rosário, Madrid. 1986.