



**10TH INTERNATIONAL CONFERENCE OF
EDUCATION,
RESEARCH AND
INNOVATION**

CONFERENCE PROCEEDINGS

**SEVILLE (SPAIN)
16-18 NOVEMBER 2017**

Published by
IATED Academy
iated.org

ICERI2017 Proceedings
10th International Conference of Education, Research and Innovation
November 16th-18th, 2017 — Seville, Spain

Edited by
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IATED Academy

ISBN: 978-84-697-6957-7
ISSN: 2340-1095
Depósito Legal: V- 2851-2017

Book cover designed by
J.L. Bernat

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IMPROVING THE UNDERSTANDING OF THE TRIDIMENSIONALITY OF THE PRODUCT: NEW METHODOLOGIES FOR THE TEACHING OF MANUAL DRAWING IN INDUSTRIAL DESIGN

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Abstract

This work presents the results of implementing a new drawing methodology in the subject 'Artistic Expression II', from Bachelor's Degree in Industrial Design and Product Development Engineering in Jaume I University, abandoning the learning of tridimensionality of objects through copying or tracing two-dimensional images. The new implemented learning strategies are centered on the one hand in allowing the students to know different instruments and techniques of sketching and, on the other hand, to practice in a more enriching way the direct and meticulous observation of everyday products. In this way, they can better understand the language of volume in space and thus be able to effectively represent the geometry of those new shapes they have in mind for product design. The paper describes the activities of the subject, the details of implemented methodology and discusses the scope of the results.

Keywords: Industrial design, freehand drawing, sketching techniques.

1 INTRODUCTION

Drawing is a fundamental tool both for communicating complex ideas and for representing simple and intuitive concepts about new products and for this reason its practice is necessary for every industrial designer. Line, composition, color, perspective and chiaroscuro are issues related to drawing that give expression to graphic representations, and through which it is possible to recognize and understand those ideas that are represented.

Drawing is indispensable for the teaching of architecture or space design [1] as well as for industrial or product design, by sharing their creative approaches. Carnevale [2] emphasizes the importance that understanding the space and the volume of objects has for the design field, and highlights the role of the manual sketching and the construction of three-dimensional models in this regard.

In architects and designers, the acquisition of perceptual skills is positive for the practice of drawing because it contributes to develop their capacity for representation, conceptualization and abstraction, being useful to improve communication with a client. But although it requires the learning of some skills, drawing is only a part of the design process: it is possible to draw without designing, but not to design without drawing, and therefore drawing is necessary in the teaching of industrial design.

2 DETECTION OF SHORTCOMINGS IN SUBJECT'S STUDENTS

In the subject 'Artistic Expression II' from Bachelor's Degree in Industrial Design and Product Development Engineering in Jaume I University, drawing is considered as a means or tool for expression to represent, synthesize and concretize the shape of objects. Issues such as composition and form analysis, line expressiveness, stroke, stain, flat ink, chiaroscuro and other techniques of artistic expression, color, descriptive illustration and the intuitive representation of perspectives are taught.

Among the shortcomings that have been detected in the students after the course is finished, we find a lack of fluency when it comes to representing new ideas: it is difficult for them to draw what they can't see and usually they don't know how to represent it, preferring verbal explanations to graphic representations on paper when presenting their ideas. When they represent their ideas about new products they usually do it in a two-dimensional way, although in reality these products would have 3 dimensions and they would be understood more quickly if they were represented in perspective.

The explanation of some of these shortcomings is found in the methodology carried out so far in the subject, too focused on copying and tracing photographs of objects from reality to interpret them

graphically later, instead of drawing objects after manipulating or observing them directly. In order to learn to represent and interpret the objects' geometry that surrounds us, it is necessary to take a close look at our surroundings and familiarize ourselves with the spatial depth that characterizes it, which has a direct influence on our perception and understanding of space. In this way, once the industrial designer learns to represent on paper a volume he or she sees in real space, it may be easier to represent other volumes that are not seen. On the other hand, in order to improve the skill in hand-drawing, a daily, continuous and intensive practice is necessary throughout the subject, applying hand-drawing in each design project that students face.

3 AIM

The objective of this work is to apply a new methodology in the subject 'Artistic Expression II' and to quantify the scope of its advantages. The new implemented learning strategies are centered on the one hand in allowing the students to know different instruments and techniques of sketching and, on the other hand, to practice in a more enriching way the direct and meticulous observation of everyday products. In this way, they can better understand the language of volume in space and thus be able to effectively represent the geometry of those new shapes they have in mind for product design.

4 METHOD

4.1 Students: features

Knowing the students can give relevant information that helps to better adjust the contents and the schedule of activities of the subject. An anonymous and voluntary survey was carried out at the beginning of the course, in which the students were asked about their previous training in high school, the perception of the importance of the subject 'Artistic Expression II' for their formation in the Degree (assessing it in a 10-point scale), what was their level of skills in subjects related to artistic or graphic expression before starting the Degree (assessing it on a 10-point scale), what was their level of skills in subjects related to artistic-graphic expression before beginning the subject 'Artistic Expression II' (assessing it in a scale of 10 points), to evaluate from 0 to 10 points the interest for drawing and the use of techniques of artistic expression in their daily life, and lastly, to indicate the branches related to the design with which they felt more affinity, from higher to lower technical nature: A) engineering / industrial technology, B) the engineering / product design, C) product design / graphic design, D) design / plastic arts, E) Fine Arts and F) other branches.

The survey was answered by 72 students (84.71% of enrolled students). The first question allowed us to see that 55 students came from the technical high school, 4 came from the artistic, 4 came from social high schools, 4 came from the Degree in Industrial Design (Latin America) and 5 came from other high schools. This data allowed us to corroborate the affinity that the previous training of most students has with the technical character of the Degree in Industrial Design that they are taking. Regarding the second question, the average perception of the importance of this subject was 8.55 points out of 10. In the third and fourth questions the students stated that they had an average skill of 4.50 points out of 10 in subjects of plastic arts before beginning the Degree, and of 6.61 points right at the beginning of this subject, which indicates that the perception of their skills improved 2.11 points (46.89%) during the first year of the Degree. The fifth question allowed us to find out that their average interest in drawing outside the academic world was 6.86 points out of 10, which indicated a good predisposition for students to use graphic expression tools in their daily lives. The answers to the last question indicated that their tendency towards engineering / product design and towards product design / graphic design were high, followed by engineering / industrial technology, design / fine arts, Fine Arts and finally others Branches of design.

Overall, this survey showed that although most students had a strong technical background prior to university (76.39%) and a natural tendency towards design branches with an average technical level (75.4%), they considered moderately important the artistic training for the designer profession (6.86 points out of 10). Although they stated that they have a low level in artistic expression skills, they are predisposed to improve them, so adapting correctly the exercises to their initial abilities it is possible to achieve an improvement of their skills at the end of the course.

4.2 Exercises to get the skills

The four skills to be obtained in the subject are the following: A: Creativity and innovation in the field of design; B: Being able to communicate effectively orally and in writing, writing reports and all the written and graphic documentation necessary to communicate ideas and projects; C: To handle techniques and tools for artistic expression and representation; D: Motivation for quality. In order to allow the students to acquire the skills that would enable them to develop the competences of the subject, several exercises were designed in 13 groups (G1-G13):

G1: Analysis and interpretation of geometric volumes (I). Skills: C & D. Techniques: linear perspective drawings with 2B pencil & ball pen on paper (DIN A4). Through 6 conceptual experimentation exercises (1A-1F) we try to reactivate the knowledge acquired in the previous subject. This type of exercises also serves to disinhibit the ability to respond to the new problems of artistic expression that arise.

G2: Analysis and interpretation of geometric volumes (II). Skill: C. Techniques: linear perspective drawings & chiaroscuro drawings in perspective, with 2B pencil, ball pen, crayons & markers on paper (DIN A4). Through several exercises, the tactile perception of the volume or shape that is captured with the hands (practices 2A and 2B) is practiced, experimenting both with geometric forms and with organic forms. After approaching to a model configured with cylindrical shapes and straight planes by rapid sketching (practices 2C and 2D), the interpretation of the proposed model is requested, imagining and drawing a nonexistent membrane to give the sensation of continuity between the different volumes, as if it were a slightly tightened skin on a structure, first through line (2E) and then through chiaroscuro to enhance the volumetric sensation (2F). These are topological surfaces for students to discover that things are not only as they are seen, but can be applied an external organic shape.

G3: Analysis of everyday objects: seesaw toy. Skills: C & D. Techniques: 2B pencil on paper, fine-tip marker pen, pen and ink, stylographs, marker pens, colored inks or tempera paint (DIN A4). Through 4 exercises (3A-3D) we seek to understand the product observed from different points of view, representing it and interpreting it with different graphic techniques.

G4: Analysis of everyday objects: taps. Skills: B, C & D. Techniques: linear perspective drawing with 2B pencil, marker pen, ink, watercolor pencil, HB pencil on paper, reinforcing lines using black marker (fine and medium thickness), ball pen on paper (DIN A4). By means of 5 exercises (4A-4E) the student is expected to familiarize himself with the formal identity of a common industrial product in all households, learning how to operate it from manipulation, direct observation of its volume and the representation of its parts.

G5: Analysis of everyday objects: household containers & packaging. Skills: C & D. Techniques: blue ball pen, crayons & free technique on paper (DIN A4). By means of 4 manipulation and direct observation exercises (5A-5D) students are expected to understand that the volumetry of the products is directly related to their ergonomic characteristics, and learn to propose improvements from the drawing.

G6: Analysis of everyday objects: electrical appliances. Skills: B, C & D. Techniques: 2B pencil, HB pencil & free technique on paper (DIN A4). Through 4 exercises (5A-5C) students have to familiarize themselves with the formal identity of various small electrical appliances. After analysis and perspective representation of one of the provided models (5A), it is necessary to imagine and propose exploded views in order to become familiar with the formal and functional sense of the components of an industrial product (5B). Next, the chromatic interpretation is proposed as a resource to represent the volumetry of a product without using the perspective after having made a linear graphic image of one of the models (5C and 5D).

G7: Analysis of everyday objects: toys. Skills: A, C & D. Techniques: 2B pencil, free technique, fine, medium and/or thick-tip marker pen, inks, watercolors or watercolor pencils on paper (DIN A4 or DIN A3). Two fast-paced exercises are proposed to reinforce the formal uptake of the observed models without any superfluous details through a synthesis that serves to exercise a more spontaneous expression of perceived objects (7A and 7B). Next, an incursion into the formal design or redesign of one of the toys (7C) and its interpretation by various graphic techniques (7D) is initiated.

G8: Analysis of everyday objects: vehicle. Skills: A, C & D. Techniques: blue ball pen, 2B pencil & free expression technique, on paper (DIN A4 or DIN A3). Three exercises for practicing observation of large industrial products and representation with different techniques from different points of view (8A

and 8B). On this occasion, besides continuing to insist on the immediacy of the rapid sketch, it is also proposed the design or redesign of a special beach vehicle in order to reinterpret the functional aspect of a conventional vehicle to another more playful (8C).

G9: Furniture (urban / domestic) and architecture. Skills: C & D. Techniques: ball pen and/or fine or medium-tip marker, pencil on paper & free technique (DIN A4 or DIN A3). By means of 4 exercises it is intended that students, after having concentrated on the analysis and expression of furniture or lighting objects (9A and 9B), relate these products to the habitat with its spatial context, representing both as a single set (9C), but, in addition, the integration of a schematized human figure is proposed to consider the importance of the scale and relationship of the human being with the architectural environment (9D). The concept of 'graphic animation' is introduced: to enhance the visual expressiveness of the drawings by means of textures or tracings of student's style, avoiding to represent the surfaces blurred in excess.

G10: Designing a pet for an event or for a company. Skills: A, B, C & D Techniques: work in teams from three to four people; pencils, ball pens or fine-tip markers (DIN A3). Through this exercise it is intended that the students learn to work as a team, sharing their ideas quickly through sketching and working collaboratively.

G11: Resources to show ideas: presentations and digital assemblies. Skills: A, B, C & D. Techniques: digital image retouching. Through exercise 11A students become familiar with the use of digital photo retouching tools, learning to integrate various photographs into a single one modifying various parameters such as color, brightness, contrast and saturation. Practice 11B also serves students to practice their oral communication skills by objectively defending a personal portfolio.

G12: Abstraction and formal synthesis. Skills: A & C. Techniques: pencil (HB-2B), ball pen or fine-tip pen on A4 paper. Through 11 individual exercises students should develop the ability to imagine different creative solutions based on proposals related to the abstraction, synthesis and formal schematization of objects.

G13: Design project: design of an element of furniture or lighting. Skills: A, B, C & D. Techniques: representation of the design through a visual panel that includes several previous concept sketches, the orthogonal projections with basic dimensions, elemental product specifications, and a color rendering of the final design (DIN A3). Through exercise 13 the graphic composition of various elements in a space is practiced, learning to distribute them with the intention of creating a narrative discourse of visual character.

5 FINAL MARKS OBTAINED FROM EACH GROUP OF EXERCISES

The groups of exercises were passed by most students presented (88.06% - 97.65%). Overall, the average marks ranged from 6 to 8 points (Fig. 1).

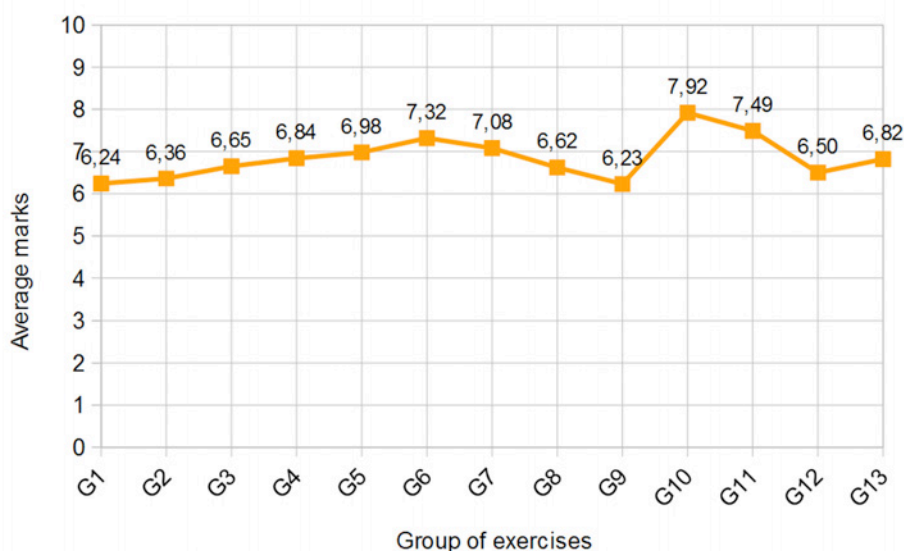


Figure 1. Average marks obtained in each group of exercises (G1-G13).

6 OVERALL ASSESSMENT

The students rated on a 10-point scale the level of improvement they considered to have achieved this course compared to the previous course: 48 students reported improving their skills (53.3%) and 33 said they did not consider themselves to have improved (36.7%). 10% did not respond. In this survey, students were also asked to rate objectively the skills they have achieved after completing the course, obtaining an average score of 7.41 points out of 10, very similar to the average grade achieved in the course. The subject was passed by 96.47% of the students enrolled. It should be noted that the interest of the students in the subject was high, since the attendance to class was massive throughout the course.

7 CONCLUSIONS

The new methodology has been effective. Observing the industrial products while being analyzed through their direct manipulation is effective to become familiar with their geometry, helping students to form a mental image of the product, a fact that contributes to facilitate the representation of ideas during concept design. Experimenting with different drawing instruments and techniques of manual representation contributes to improve the graphic expression of students and allows them to choose with better criteria the most appropriate ones. This new methodology has allowed the expected skills to be reached fairly well for all students who have regularly attended classes, regardless of their previous training. The only students who did not pass the subject were those who did not attend or who did not perform the exercises.

ACKNOWLEDGEMENTS

The methodologies conducted in this subject are part of the competitive educational improvement project with reference 3204/16, funded by the Educational Support Unit (U.S.E.) of Jaume I University.

REFERENCES

- [1] S. Travis, "Sketching as a Tool for Seeing: A Method for Teaching Drawing to Architecture and Interior Design Students", *International Journal of Design Education*, vol.7, no.3, 63-74, 2014.
- [2] V. Carnevale, "To Design or To Draw: Two Different Verbs, Two Different Abilities, One Result", *International Journal of Designed Objects*, vol.8, no.1, 17-25, 2015.