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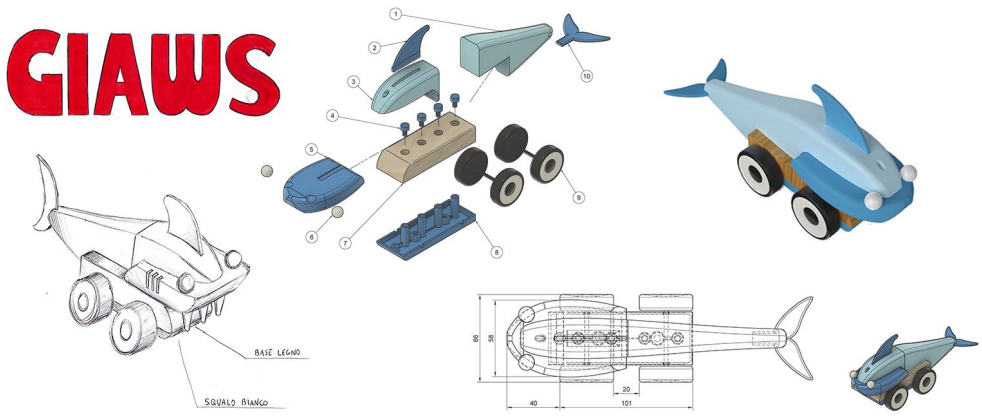
Do Students Dream of Electronic Worksheets? The 'Grade Runner' Dilemma

Luca Rossato

Abstract

Grades are frequently regarded as the definitive indicator of educational accomplishment, and educational investigators frequently work to identify the variables that influence academic achievement. While placing a priority on academic accomplishment is crucial, some educators have neglected students' wellbeing as a result. Students who exhibit more positive emotional patterns, less anxiety, and better health typically achieve higher grades and are less likely to drop out of university path, so positive feelings, low stress, and good health are fundamentally advantageous to students. The playful approach that this contribution describes was created through a reverse modelling process that highlighted how important could be for young pupils to have hands-on engagement with objects. The subjects of this educational experiment were some simple toys available on IKEA catalogue. The items were observed and investigated in order to achieve their formal and conceptual transformation, which gave rise to renewed creative actions following an understanding-drawing-altering-modelling-rendering-prototyping process that improved the digital skills of students and their positive feelings about their future as industrial designers.

Keywords
Reverse modelling, re-drawing, representation techniques, industrial design, prototyping



Transformation of the IKEA's toy: from concept sketching to 3D parametric drawing and rendering.

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Introduction

Playful and non-playful behaviours are difficult to distinguish between animals. In fact, the game, as Erik Erikson said, is a "frontier line that divides a series of human activities and tries to avoid any definition" [Erikson 2008]. The psychological framework that makes playing possible is therefore extraordinary and blends non-trivial actions (mimesis, fiction, freedom, abstraction, assimilation, etc.). As an intermediate phenomenon, it is possible to mix conscious and unconscious processes by operating some mechanisms for the development of brain and creativity: the games are the false tokens that, in a splendid image of Ernst H. Gombrich, "trigger our biological locks" [Gombrich 1963]. These locks guarantee the mental digestion, as Jean Piaget wrote, so much needed for the cultural creation of the individual [Piajet 2011]. In our species creativity is very prolonged during development and for some adults (amongst which are the designers and architects) it is socially allowed to continue playing all their lives [Huizinga 1938]. That's why this research has been analysing and experimenting possible combinations of ideas, objects and behaviours. This combination of factors has always produced cultural innovations that are socially selected and adopted. This experience deals also with the translation contest and therefore a kind of transformation and metacommunication [Barilli 1979], between the students of the first year of the bachelor programme in Industrial Design. The playful experience has been developed through a survey/drawing path that emphasized the young students need for direct contact with shapes and materials. The activities were carried out with some toys concerned by the Swedish company IKEA (fig. 1).

Subjects of study

The selection of objects was based on the apparent simplicity of shapes and components as well as on their assembly; these aspects were ideal for an exercise that involved unskilled students in their first year of the bachelor course in Industrial Design. Furthermore, to redraw pieces of design could be for a young student an important exercise able to improve skills in both drawings techniques and design approach [Galloni 2002]. For these reasons the IKEA's toys LILLABO have been taken as the starting point for an interpretative process concerning space and the relationship that game and perception can trigger. The toys of the LILLABO series are ideal for children. They can be combined in many ways to stimulate creativity and encourage the development of motor activities. The children can create different combinations, and this helps develop the child's imagination, fine motor skills and logical thinking [Valeri 2017]. The toys were conceived by the designer Henrik Johansson. The main goal of the LILLABO toy cars is to include driving and puzzle play. For this reason, they are perfect for industrial design students that can deal with in a variety of ways. They may combine the new components in their own ways, fostering creativity and stimulate the imagination, going back to their childhood and experimenting good feelings about this. To make the toys strong and long-lasting solid wood is used for the base. Children can enjoy holding them in their hands because of the lovely weight and high-quality sensation that the wood offers them. Following this approach, it was decided to do not transform the original IKEA base and the wheels working only on the puzzling plastic (ABS) pieces.

Fig. 1. The toys of the IKEA's series LILLABO have been chosen as subjects of the digital elaborations along the course (image by the author).

The methodology

In the initial phase of this educational experience, students were engaged in research and cognitive analysis of the objects. After a direct survey, using callipers and other tools for measuring widths, depths and angles, the students were required to compile a list of the parts (fig. 2a) with all the related dimensions [Gaiani 2002]. By hand-drawing drawings, the primary objective was to comprehend the toys as they were originally intended (fig. 2b). After that the 3D model of the original toy was built (fig. 2c), and they were allowed to move on choosing the transformation criteria. According to theory [Celaschi 2016], sketching helps to facilitate a cycle of re-interpretation thoughts process and to improve recalling of prior ideas [Celaschi 2016]. Students have been learning by doing using technical drawing and representation approaches, from surveying the items and their visual representation (always primarily by hand sketching and only later by 3D modelling) to the development of new types and solutions. Although the representative experience had a strong descriptive, formal, and geometric component, it also had a strong emotive and representational capability, which served as the process' primary trigger [Falcidieno 2002]. Each group of young students (3 members each for a total of 35 groups) was able to create a new series of three toys based on a specific concept (i.e., three F1 cars, three buses, three emergency vehicle, three animals on wheels, etc…) that was described, at the end of the course, by rendering techniques and a solid prototype. An effort was made to transmit 'meanings and functions',

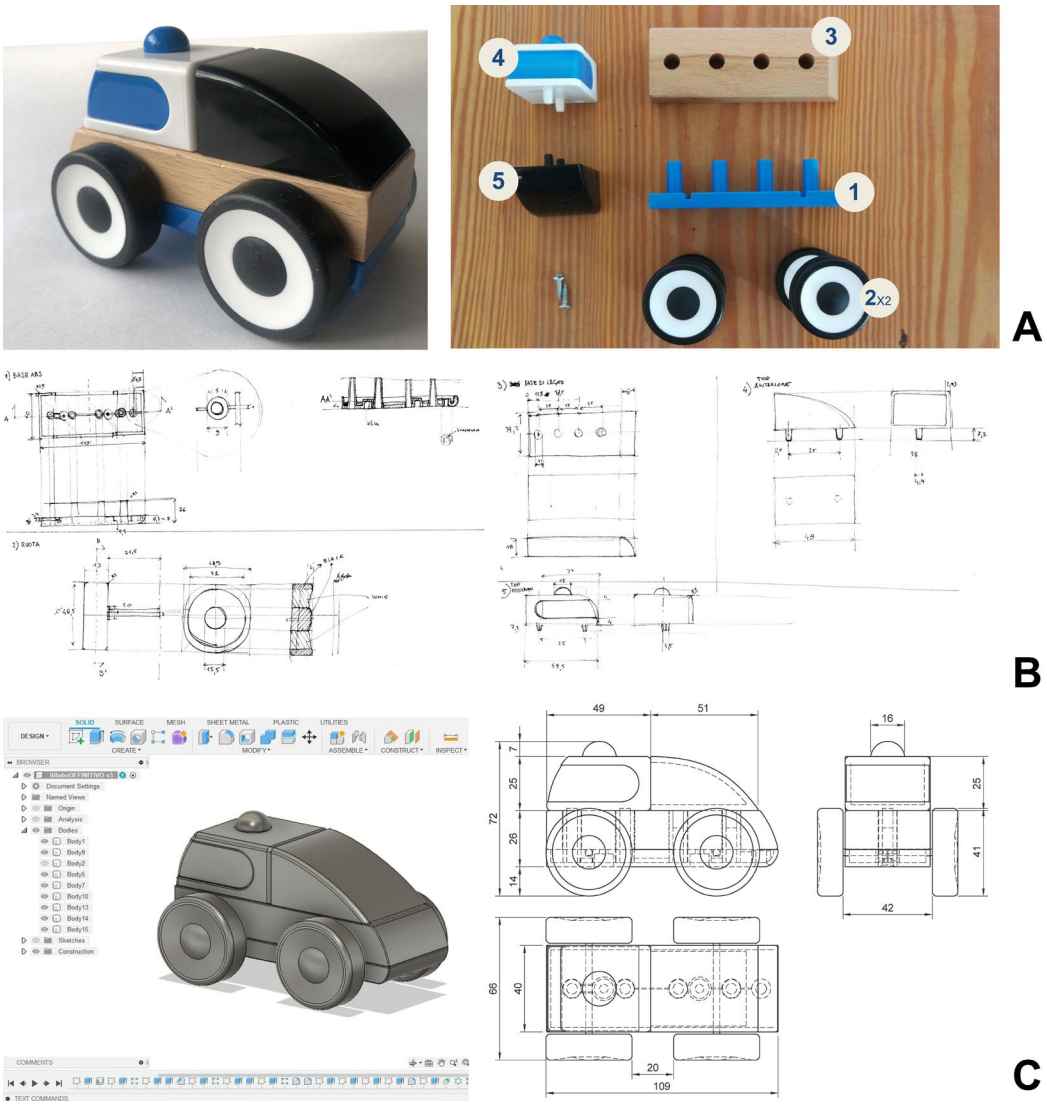

Fig. 2. The reverse modelling process of the original IKEA's toy: understanding phase (A), survey phase (B) and 3D modelling + 2D elaboration from model phase (C), (graphic elaborations by F. Petrocchi).

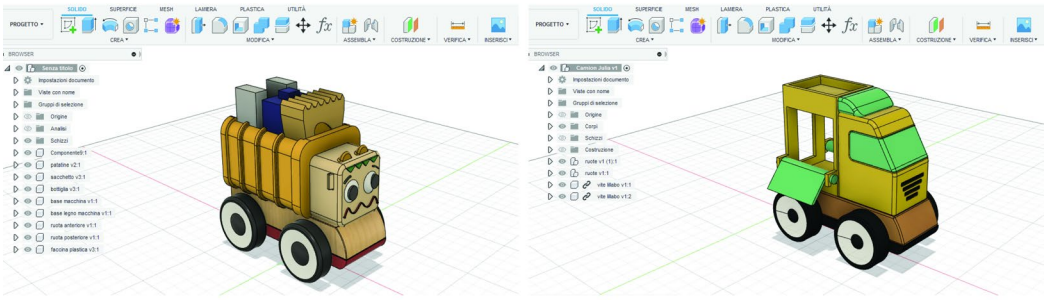

Fig. 3. Parametric models developed by students using Autodesk Fusion360.

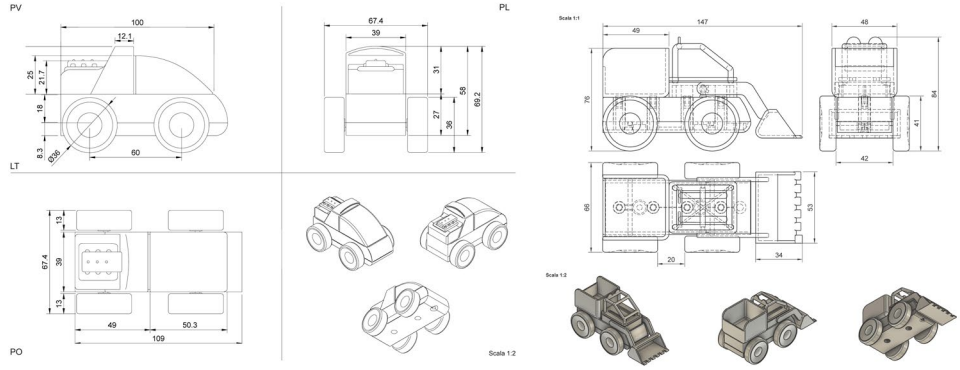

Fig. 4. 2D and 3D views of original toys elaborated setting the software output options of Fusion360.

keeping always in mind that the new objects must be used by young children leading to a variety of interpretations and, in certain situations, highlight the significance of simple toy within the development path of a child. This was one of the goals of this experience (academic year 2021-2022) the which was also accomplished taking advantage of the involvement of the prototyping laboratory of our department.

Step by step

The inspiration for selecting these toys was the spatial articulation of the components, and the simplicity of the design, suitable for first year academic students that very often do not have any informatics skills: students were engaged in inquiry and cognitive examination of the items throughout the initial stage of their educational experience so the objects couldn't be much complicate. After a first examination of the artifacts by measurements, colours and shapes analyses, the Autodesk parametric program Fusion360 was used to recreate the objects three dimensionally. The students started disassembling the selected toy (one out of the three each student) making a list of the pieces and documenting the items. With these data the then go ahead modelling the object by Autodesk Software Fusion360. Fusion 360 is CAD, CAM, CAE and PCB software that combines design, simulation and manufacturing functionality for industrial and mechanical products in a set of tools that support the entire process, from concept to production, in a single platform. In recent years, this software has become one of the most widely used tools by industrial designers, electrical engineers, machinists, amateurs and start-ups. The parametric approach allows the students to modify the objects quickly while they discover thickness and materials constrains (fig. 3). Furthermore, 2D drawings were elaborated calibrating the software output settings and each view was generated automatically and then just assembled into the paper sheet ready to be printed with a very calibrated thickness and following the representation rules (fig. 4).
A meta-model was subsequently created using the reconstructed model, and it involved changing the toy in accordance with predetermined guidelines:

- basic components of the original toy (wooden body, abs plastic base and wheels) could not be modified: it was only possible to redesign the interchangeable plastic pieces;

Fig. 5. Some concept images of each new series elaborated by the group of students using evocative names.

- the conversion had to adhere strictly to the original toy's dimensions: the additional components must fit the base to allow the playful experience;
- the news series should be suitable for children of 24 months; it must have an evocative name and should improve the child's curiosity and the development of motor activities (fig. 5).

Applying these few rules resulted in new versions of the LILLABO series, initially conceived and studied by concept sketching activities. No design decision made during the process could be duplicated, which resulted in the creation of 35 different variations of the series. It wasn't necessary to replicate the original project; rather, it was necessary to take the first step toward a more ambitious personal meta-project, the goal of which was an interpretation process, capable of establishing a relationship between form, space, colours [Longoni 2002] and children's' needs in a strong connection with the emotional aspect of the game. Educated at first to the interpretation of the configurational genesis of the surfaces and their geometric intersections, the students of the course, translated into equivalent flat images, through the projective processes of descriptive geometry, the shapes and conformations of small toys by IKEA. The expanded flexibility of geometry, together with the acquired rendering capabilities (fig. 6) and the model reproduction potential, has allowed each group of students to revisit and elaborate a personalized virtual compositional solution of the original toy [Maldonado 2007]. They transformed the various geometric component directly into the three-dimensional environment dealing with shapes and textures (fig. 7). The representative and modelling outputs are a powerful example of how the students of the course have learnt about the combination of double interpretative process of the object/game [Maeda 2006], which is the reverse modelling approach on one side and modelling-prototyping of a new object on the other.

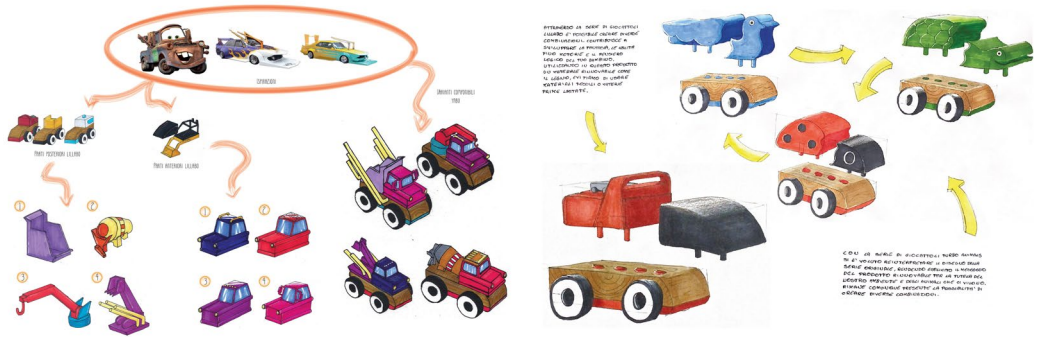

Fig. 6. Concept sketching activities by hand drawing are still crucial for the evaluation of the first ideas and transformation possibilities.

Fig. 7. Some 3D models with texture developed by the students of the course.

Conclusions

Going back to the question of the title of this contribution *Do students dream of electronic worksheets?* borrowed (and transformed!) from the original one conceived by the writer Philip Dick *Do androids dream of electric sheep?* [Dick 1968] we can say that, after few years of academic investigation and didactic project, the students are very keen to explore all the potentials of new technologies, but they also need to be in touch with physical objects and 'feel' the shapes, the colours, shadows and materials. This project has shown how technology for representation could be used as a strong attractor for young students to develop drawing techniques, but only physical interaction allows young students to make choices that are significantly related to their dreams and desires, inviting them to deepen the elaboration of the project. Play introduces a different reality to the everyday sort, with precise limitations of space and time and according to predetermined rules to which the player must submit. It is always a game. In this case, the game was developed through an understanding of the form and by means of its reconstruction and the transposition of the real three dimensions to the digital one learning representations systems and design skills, dealing with technology that probably are going to be an important part of their future as industrial designer such as the prototyping techniques (fig. 8).
Furthermore, from the point of view of the research potentials, this investigation could provide a possible asset of research activities specifically design for first-year university students. Nowadays most young people face higher education at the same age that a number

Fig. 8. Some PLA prototypes printed by 3D Printer WASP are fitting the original base of the toy creating new variables.

of problem behaviours (such as substance abuse and internet addiction) and mental health issues (such as depression and anxiety) begin to manifest [Yu 2018]. These psychosocial issues have come to light more and more recently due to their rising prevalence and severity as well as their strong correlation with a poor quality of life, including subpar academic achievement, a decline in life satisfaction, and even suicidal ideation. Developing a new way of student's engagement could be crucial to investigate such phenomenon in order to assist students in managing developmental and transitional challenges in higher education and to enhance their benefits from such a degree.

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