Free Software Usage in Subjects of the Industrial Design and Product Development Engineering Degree

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Abstract. In recent years, the availability of funding for acquiring licenses for the different computer tools used by students, that are so common in scientific and technical careers, has been reduced. Learning in the use of technological tools of information and communication by students is considered essential for its application in daily life and in their work. These facts, together with the current rise offree software, is generating a migration towards free tools, both in teaching and in the industrial world. The increase in its use entails the reduction in expenses by institutions, as well as it encourages the scientific curiosity of the student outside the classroom. In detecting this need, free substitutes to the commercial software previously used in the subjects of Artistic Expression II and Graphic Design Applied to Product of the Industrial Design and Product Development Engineering Degree have been introduced. It was done in order to, on the one hand facilitate the access of students to the prograrns, and on the other hand, share the philosophy of using free media, working with the com-munities where the source code of the program is developed in response to the problems of the users. This experience has served to verify the benefits of teaching with free software versus commercial.

Keywords: Free software · Graphic design · Artistic expression

1 lntroduction

"Free software" [l] means software that respects users' freedom and community. Roughly, it means that the users have the freedom to run, copy, distribute, study, change and improve the software.

Thus, it is considered that the software is free if it guarantees the following four freedoms [2]:

• Freedom 1, to run the program for any purpose (private, educational, public, commercial, etc.).
• Freedom 2, to study and modify the program (for which it is necessary to be able to access the source code).
• Freedom 3, to copy the program so that you can help the neighbor or to anyone.
• Freedom 4, to improve the program, and make improvements public, so that the whole community benefits.

Its origin is related to the activity developed by the first computer programmers, the "hacker" culture, emerged in laboratories of American universities and research centers at the beginning of the computer age, such as the Artificial Intelligence Laboratory of the Massachusetts Institute of Technology (MIT) [3]. In that time, it was considered that sharing knowledge (and the code) freely was usual and even beneficia! for the advancement of knowledge. Based on these premises, the ideological foundations of the free software movement were established in the 1980s thanks to the vision of Richard Stallman [4].

From other point of view, the use of free software in higher education, is a practice that extends itself both nationally and intemationally. Spanish universities such as the University of Oviedo [5], the Carlos III University in Madrid [6], or the Polytechnic University of Valencia [7], University of Rioja [8], are using free software in their teaching methodologies. In Italy University of L' Aquila and University of Modena and Reggio Emilia [9], University of Bologna [10--12] University of Messina [13]. Also, American universities are joining this initiative [1, 2, 14-18]. However, the bet for the use of free software in Asian universities is not very widespread, but there are initia-tives to implement its use in the educational system of Central Asia [19] (Fig. 1).

Fig. 1. Spanish universities best committed to the use of free software in 2016 [20]

It is worth mentioning the role of the RuSL (ranking de universidades en software libre/universities and free software ranking) Free Software Universities Network when it comes to providing a standardized methodology that allows to know in detail the impact of the actions carried out by educational institutions regarding the use of free software, as well as in which areas they stand out and how they disseminate their use in relation to other universities. Its analysis is based upon the analysis of 65 indicators, assessing 11 dimensions of the university: production, externa! collaboration, research, help, teaching, culture in free software, technological, disclosure, webmetry, institution and adrninistration.

2 Context

This communication describes the experience of introducing free software: Gimp [21], Inkscape [22] and Scribus [23] in the subjects of Artistic Expression II and Graphic Design Applied to Product in the realization of graphic projects in both subjects. Inside this experience, students from the 2nd year of Industrial Design and Product Devel-opment Engineering Degree at the University of Zaragoza (IDPDE) participated.
Toe use of free software in these subjects supports and contributes to promote the values of the University of Zaragoza and its O:ffice of Free Software (OSLUZ) [24].

3 Methodology

3.1 Description of the Experience

To carry out the experience, the main utilities of the free software programs are explained in class to do the exercises, leaving the student to choose whether working with free or with commercial software. In order to compare the benefits offered by free and commercial software, no changes have

been made in terms of the teaching methodology or the content included in the teaching guides. The same calendar of activities planned for the two subjects has also been applied. Regardless of their choice, students must mainly perform the following tasks corresponding to the subjects:

- In Artistic Expression II, they perform 2D graphic representation tasks, starting from the digital drawing, chiaroscuro treatment, representation of highlight back-grounds, color ranges and image filters. These tasks can be solved both with the use of commercial software Adobe Photoshop, and with free software Gimp. Both programs allow the manipulation of images, they have numerous tools for digital retouching, color editing and composition. Toe learning process is developed through practica! and theoretical classes, computer practices, workshop practices, tutored works and autonomous student work. These actions are framed in a col-laborative work environment. The evaluation process is developed continuously in which the supervised works weigh up to 80% and the global test of contents of the subject up to 20%.

- In Graphic Design Applied to Product the tasks include typographies, branding, packaging, surface and interface graphics, composition and layout. For creating and editing vector graphics students can use Adobe Illustrator or Inkscape (free soft-ware). Toe Adobe Indesign layout software or Scribus, free software, allow the management of image frames and blocks of text organized through a structure of pages, guides and grids for obtaining printed and digital documents. The learning process is developed through practica! and theoretical classes, computer practices, supervised works and autonomous student work. These actions are framed in a collaborative work environment with an important presence of the service learning model. Toe evaluation process is developed continuously in which the supervised works weigh up to 70% and the global test of contents of the subject up to 30%.

The teachers solve the doubts arising from the use of the programs that the students have chosen to work.

The objectives of the implementation of the free software have been as follows:

- To use and evaluate free software in the subject.
- To contrast the quality of free tools with respect to those commonly used.
- To avoid costs to both students and the university for the licenses of the software used.
- To support the philosophy of the Free Software of the CRUE Spanish Universities group and to increase the degree of involvement and implementation of the use of free software at the University of Zaragoza.
- To prevent students from working with tools without an official license.

As this project is part of the strategy of the University of Zaragoza, it has had the participation of OSLUZ (Free Software Office of the University of Zaragoza), which made the presentation of a talk for knowledge of philosophy, possibilities and benefits of the free software.

3.2 Experience Evaluation

In order to analyze this experience, two ways of collecting information have been established: on the one hand, the perception of students through the survey carried out on Google Forms and distributed to students by email, and on the other hand, the comparison made by the teaching team between the commercial programs used in previous courses and the free software, through the use of a rubric.

The survey proposed to the students has been structured as follows: previous use of software and choice of software with which to carry out the projects of the subject. The answer to this last question conditioned the rest of the survey.

The survey addressed to students who used free software consisted of 8 questions, 5 were assessed by means of a Likert scale of 5 points (1-totally disagree and 5-totally agree) and 3 questions were open. Students were asked about accessibility (download, installation, versions), usability (intuitive interface, easy handling), their expectations and the satisfaction of the results obtained.

On the other hand, the survey aimed at students who used commercial software consisted of 4 questions, of which 2 were qualitative regarding the use of official license and their willingness to continue using this type of software or not and 2 open questions regarding considerations and motivations when deciding the software.

It has only been possible for students of the subject of Artistic Expression II to respond by referring to the Gimp and Photoshop programs, since the subject of Graphic Design applied to Product is still being studied at this time.

For the evaluation of teachers, a rubric has been designed that compares key aspects regarding accessibility, usability, structure, formats and exit modes. The items of this rubric have been incorporated after the previous evaluation process between four professors following the model of the Delphi method proposed by Williams, Boone and Kingsley (2004) [25].

4 Results and Discussion

A total of 58 out of the 83 students (69.8%) enrolled have completed the survey about the use of Photoshop and Gimp.

Regarding the knowledge of image treatment programs, the results indicate that all students know sorne of these programs. 51.7% of students knew Photoshop (30 stu-dents), 12.1 % Gimp (7 students) and 36, 2% handled both programs (21 students). For the work of the subject 60.3% decided to use Gimp (35 students).

4.1 Results of Surveys of Students Who Have Used Gimp
These students have evaluated the following aspects of the program:
Accessibility: Students rated the accessibility of the software positively (48.6% agree that the accessibility is satisfactory -4 points on the Likert scale and 22.9% evaluate this aspect as completely satisfactory -5 points on the Likert scale) (Fig. 2).
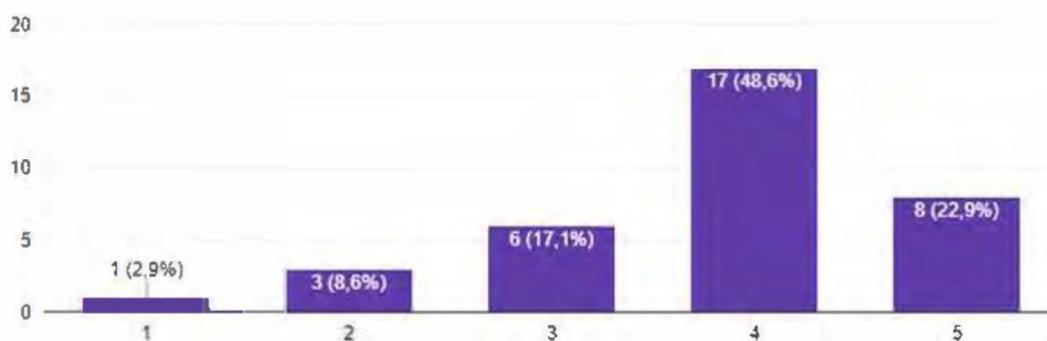

Fig. 2. Students' perception of Gimp's accessibility (download, installation and versions)

Usability: The surveys reveal some lack of satisfaction, being clear that none of the students was fully satisfied (Fig. 3).
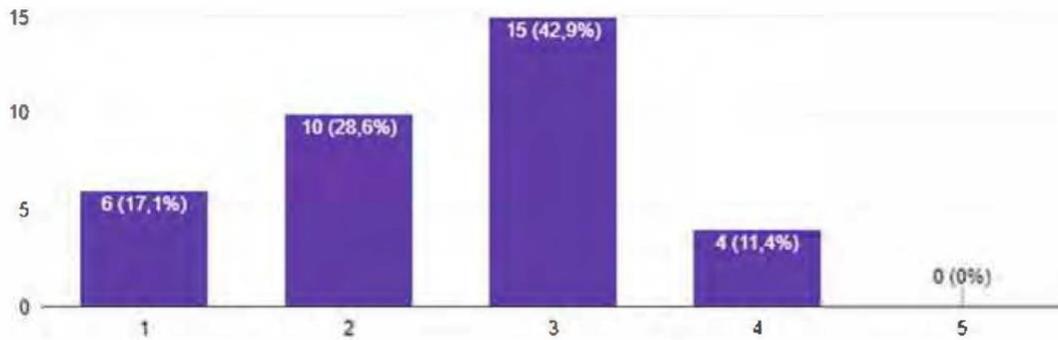
Fig. 3. Students' perception of the usability of Gimp (intuitive interface, tools and easy handling)

Software recommendation: 34.3% of students indicate sorne indecision about the possible recommendation of the software, however there is a group of 54.3% that would not recommend it, so only 11.5% would recommend the use of Gimp (Fig. 4).
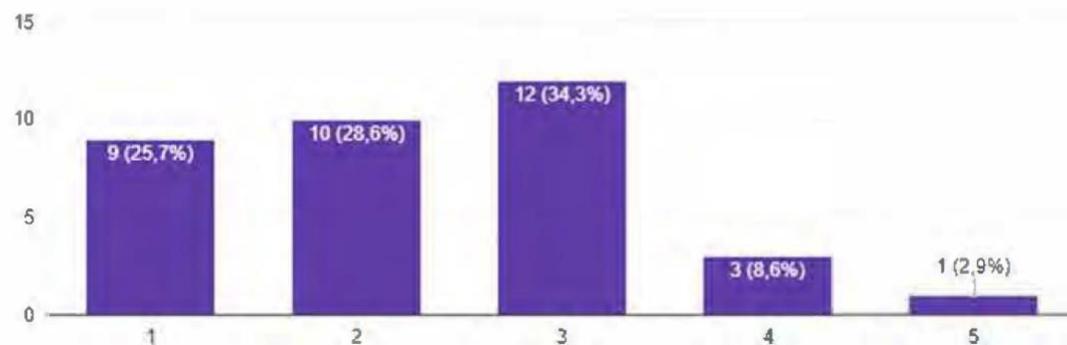

Fig. 4. Recommendation of the use of Gimp

In the open questions the students stand out as an advantage the free access and easy download, however they do not see other advantages and they are convinced that it will not be the program that is demanded in the labor market.

4.2 Results of the Surveys of Students Who Have Used Photoshop

Of the students who have decided to use the pay-per-use software (39.7% ofthe total, 23 students), 91.3% have used the program without the official license (21 students). And the vast majority ofthem (82.6%, 19 students) intend to continue using it in the future.

In the open questions students highlight the extended use of Photoshop in the professional world, and the previous knowledge of it as reasons for not using the free software proposed in class.

4.3 Results of the Comparison Made by the Teaching Team

The perception of the teaching team (four teachers) is summarized in the following tables that compares the aspects of accessibility, usability of tools, structure, formats and exit modes in the free software proposed in class and commercial software (Tables 1, 2 and 3).

Table 1. Comparison made by teaching team between free software (Gimp) and commercial software (Photoshop) for bitmap image edition

Parameters	Gimp	Photoshop
Accessibility		
– Download – Installation – Compatibility platforms	– Free – Quick – Windows, Mac and GNU/Linux	– Payment – Slow – Windows and Mac
Usability of tools		
– Vector traces – Bitmaps work – Filters	– Ease of creation and edition of vector outline – Multiple bitmap treatment options with some difficulty in their use – Wide variety of filters for free download	– Ease of creation and edition of vector outline – Multiple bitmap treatment options with intuitive use – Gallery of sufficient filters included in the license with possibility of extension by payment
Formats and output modes	– Saves as xcf – Possibility to save in different formats (jpg, tiff, png, etc.) – Difficulty saving files in CMYK – Low possibility of visualization of the change results in color mode	– Saves as psd – Possibility to save in different formats (jpg, tiff, png, etc.) – Easy and direct change of color mode
Structure and interface	– Intuitive structure – Customizable interface	– Clear structure, although overwhelming for novice users

Table 2. Comparison made by teaching team between free software (Inkscape) and commercial software (Illustrator) for vector image edition

Parameters	Inkscape	Illustrator
Accessibility		
– Download – Installation – Compatibility platforms	– Free – Quick – Windows, Mac and GNU/Linux	– Payment – Slow – Windows and Mac
Usability of tools		
– Vector traces – Bitmaps work	– The tools meet expectations, some interesting options in form modification – Free and downloadable filters	– Good functionality of the tools – Gallery of sufficient filters included in the license with possibility of extension by payment
Formats and output modes	– Saves as svg. – Does not support spot colors, does not allow export in CMYK directly – Crop marks, limit and color bars must be done with extensions and have to appear in the workspace itself (impractical)	– Saves as ai. – It allows outputs for virtual environment and for printing – It incorporates pallets of spot color – Option to add crop marks, limit and color bars when exporting to pdf
Structure and interface	– There are options that are not located where it would be logical to look for them	– Clear structure, although overwhelming for novice users

Table 3. Comparison made by teaching team between free software (Scribus) and commercial software (In Design) for publishing

Table 3. Comparison made by teaching team between free software (Scribus) and commercial software (In Design) for publishing

Parameters	Scribus	InDesign
Accessibility		
– Download – Installation – Compatibility platforms	– Free – Quick – Windows, Mac and GNU/Linux	– Payment – Slow – Windows and Mac
Usability of tools		
– Blocks of text – Images	– Good functionality, especially in the loading of the text and its edition	– Good functionality
Formats and output modes	– Save as sla, export to pdf, eps, svg, tiff, jpg, png. – Supports CMYK and spot colors	– Save as.indd, export to pdf, eps, jpg, png. – Supports CMYK and spot colors
Structure and interface	– There are certain structure failures that make it not intuitive, however, the properties menu that allows you to modify almost every aspect is very useful	– Clear structure, although overwhelming for novice users

Although the Adobe interface can be overwhelrning for novice users, the 3 pro-grams share similar structure and interface, so if the user knows one of thern, learning the other two is rnuch easier. On contrary no relation between the structure and interface of Girnp, Inkscape and Scribus has been observed.

5 Conclusions

The experience presented shows the perception of teaching staff and students enrolled in the subjects of Artistic Expression II and Graphic Design Applied to Product of the Industrial Design and Product Developrnent Engineering Degree, at the tirne of introducing free software in the works carried out so far by students with cornrnercial software.

The introduction of free software in the two subjects has been an additional effort, however it has shown that free software designed to work with irnages, vector graphics and layout represents an altemative to cornrnercial software, although there are aspects of structure and intuitiveness of interface that could be irnproved.

Although there are certain difficulties observed in the use of free software related to the use of sorne tools, rnodes and output formats, the teaching team considers that free software has allowed a satisfactory performance in all the tasks that address relevant issues in the graphic cornrnunication processes that are closer to the profile of Graphic Expression in Engineering.

Since the research in Graphic Expression focused on 3D open source software has been broadly developed, the authors consider that the 2D graphic design, based on the visual cornrnunication codes and esthetics requirernents represents the potential to develop new educational research. The detection of the limitations of free software, can provide a starting point to introduce possible improvements in a software design more suitable for higher education that takes into account the market requirements.

With the use of free software, access to the software has been facilitated both in the classroom and outside of it, preventing illegal downloads of commercial software.

The students' prior knowledge of commercial software has led to a preference for this one, so it is considered important that in previous educational stages the use of free software must be disclosed.

The students emphasize the importance of the use of commercial software since this is the one that is mainly used and is currently demanded in the business environment. However, the teaching team considers free software as a good alternative for entrepreneurs.

The experience has gathered the conviction of the students of the dominant position of the commercial software in the labor market, however from the teaching point of view we are convinced that the students can be the carriers of change by offering the companies in which they are going to work free software, stable and in constant development, while the management of free software can facilitate their impulse in actions/entrepreneurship situation.

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