The Use of Computer Tools in the Design Process of Students’ Architectural Projects. Case Studies in Algeria

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Abstract. This paper particularly deals with the way in which computer tools are used by students in their design studio’s projects. Four institutions of architecture education in Algeria are considered as a case study to evaluate the impact of such tools on student design process. This aims to inspect in depth such use, to sort out its advantages and shortcomings in order to suggest some solutions. A field survey was undertaken on a sample of students and their teachers at the same institutions. The analysed results mainly show that computer tools are highly focusing on improving the quality of drawings representation and images seeking observers’ satisfaction hence influencing their decision. Some teachers are not very keen to overuse the computer during the design phase; they prefer the “traditional” approach. This is the present situation that Algerian university is facing which leads to conflict and disagreement between students and teachers. Meanwhile, there was no doubt that computer tools have effectively contributed to improve the competitive level among students.

Keywords: Computer tools, Architecture, Design process, Survey

1. Introduction
Since the late 1990s and until recently, students hesitated between buying tracing paper or personal computers. On the other hand, some students (for some other reasons) find it hard to express themselves and make plainly their ideas through paper. So, they would use the computer to make the virtual image speaks on their behalf. This has in fact led to a well-known situation among students which made them dependent on their data bank and/or e-libraries.

As far as teachers are concerned, two diverging behaviors can be distinguished. There are those who believe in the valuable and necessary use of computer tools during the design process, and those who prefer the pencil and the traditional method named by Sabine Porada “the paper architecture” [1]. From the latter, some might go further up to forbid their students to rely on computer, especially in the design stage, arguing that computer inhibits personal creation. The trend of such tools at schools/departments of architecture in Algeria has seemingly led to a dilemma among both students and teachers. However, such conflict can only be transitional and will likely disappear soon.

For reminding, at universities, computer courses are introduced very late (the fourth year: a year before graduation) in the architectural curriculum. This is worsened by the very low credit hour allotted to computing (5.58% out the total weekly credit hour).

2. Methodology
To better grasp the present situation, a first survey was carried out during two consecutive academic years: 2008-2009 and 2009-2010 at the department of architecture, university of Constantine. On 2011-2012, a second field study has covered four institutions (An independent school and three departments at universities: Epau-Algers, Department of architecture-Constantine, Department of architecture-Oran, Department of architecture-Biskra). The aims were to make a horizontal comparison (within the same year), a vertical one (between different years) and assess any eventual evolution. The questions mainly dealt with the use of computer tools by students within their projects during the different years. In addition, students’ preferences (in relation to computer use) were also tested. The questionnaires were distributed to students of third, fourth, and fifth years, as these years are the more oriented towards the core program. The first field study carried out at Constantine has been more detailed in a previous paper [2] based on a sample of 290 students. While the sample of the second field study encompasses 254...
students. Another survey was conducted with the teachers of the targeted groups, collecting their opinions on the same issue.

3. Results And Discussions
Through our teaching experience and involvement within different architectural agencies, we have been able to witness such a situation, which gave us the opportunity to share with teachers and students the issue about the role and the contribution of computer tools in the project’s process. Some of the results are detailed in what follows.

Students
The results of the field survey (2011-2012) show that students calling for computer aid to their studio projects exceed at least 65% by year level. The statistical analysis shows a significant correlation between the two variables: the use of computer tools and the year level (sig<0.05, Chi-square=36,315).

Indeed, by mean of comparison between the three levels, positive answers (yes) increased by 31.07% from the 3rd year to the 5th one “Figure 1”. This is due to the objectives of the program content set for each year level; for the third year, where students are asked to design several architectural projects, third (1/3) of theme do not use computer.

The four institutions concerned by the survey show close figures. The average percentage of computer use for all institutions is around 88.54%. However, Algiers is the only school where we notice a total use of computer by students regardless the year of the cursus. For the department of Constantine which benefited from the first field study, the use of computer tools has risen by 38.97% through the three academic years.

These high percentages do not mean that students carry out their works without help. The more they progress in their studies, the more contact they make with architectural agencies asking for different services “Figure 2”. Statistical analysis shows a significant correlation between the contact of architectural agencies and the year level (sig<0.05, Chi-square=8,673). By this contact, students want to compensate some deficiencies; they know that “beauty/esthetic” has a crucial role for project approval. They tend to impress their tutors and the examiners board through high-quality printing, nice colors and attractive virtual tours. However, the percentage of answers with “yes” which is 32.28% (between the three level years and the four institutions) is misleading. It represents projects carried out outside the university. The observed percentage of Constantine department for the same academic year (2011-2012) is higher (43.48%), it evolved by comparing it to the results obtained in the previous academic
years. During the first field study, it reached 34.39% [2]. The school of Algiers seems to be the least “tolerant” concerning the contact of architectural agencies (among the four institutions), with the lowest percentage (17.28%). At the 3rd year level, no student from Algiers has contacted any architectural agency. This can be explained according to our investigation by the firm evaluation, as the juries’ members are usually external to the institution.

Figure 2. Contact of architectural agencies for different tasks for students’ projects.

Authors: field work, May-June 2012.

Despite the objectives set for each year, a small percentage (15.44%) is noticed showing students’ contacts with architectural agencies seeking help during their first year of studies, although the first-year training objectives concentrate on mastering free hand drawing. We wonder then upon students’ attitudes and teacher’s requirements. Teachers certify through the survey, that they are sometimes surprised -the day of the exhibition- about their students’ projects that clearly show a part of the product carried out outside the university. This leads to an evaluation problem putting the staff in subjective situation. They are aware that students should undertake each project under their own supervision until the final exhibition. The difficult mission lies on the fifth year’ students (final step of the curriculum). They benefit from a large time before projects’ exhibition. Most of it seems to be used to polish the quality of the work, with the help of the architectural agencies.

For this reason, students need to spend money that (the more often) exceeds 450 euros for each project. 27.36% of them spend for one project more than the average of their annual grant. These expenditures increase from one year to the next. Indeed, the Spearman test shows us a significant correlation between the spent amount and the year level; the more students progress in their studies, the more they spend (sig<0.05, the correlation coefficient = 0.3).

Such services (digitalization and finishing the incomplete plans, 3D models, rendering and virtual tours) has become a common and fruitful business. The survey demonstrates that 18,65% of students contact architectural agencies mostly for rendering their works as we noticed from the first interpretation of the results. In a second sort, all “other” answers to this question gathered from the questionnaires have been categorized, as well the percentages have been recalculated. We were surprised to find that 25,81% of students who contacted the architectural agencies did it for drawing. Their concern, then, does not lie on the image of the project, but it is rather located at the standard of drawing (ability to draw). Hence, questions may arise; we wonder whether the student cannot achieve his work “alone” or the teachers’ requirements are beyond his ability to draw.

These students bring their laptops to classrooms and studios to discuss their projects with their teachers. The field survey has showed that the percentage of students who had a training or trained themselves in CAD/BIM raised at the department of Constantine from 73.89% during the academic year 2008-2009 to...
86.96% during 2011-2012. This is actually not far from the percentage average (75.59%) of the four institutions. The percentage increases as students pass from one year to another. The more the student advances in his studies, the more interest he develops towards this specific training. The analysis confirms a significant correlation between the training and the year level (sig<0.05, Chi-square = 6.059).

Should we mention, that from the trained students, only 22.04% of them had their training at the university. The remaining percentage call upon self-training and a training that took place outside the university. This could have a bad side effect on teachers’ evaluation upon real students know how (competences) gained outside the classroom. But whatever the place, students in Algeria struggle to train themselves in the use of software to improve their skills during their studies in order to prepare themselves for their future professional career. They are fully aware that mastering computer tools is a criterion to get a job. This was confirmed through our interviews with agencies’ managers.

Students make use of a rich range of specific software in their projects. Majority of students (93.75%) seem familiar makes use of AutoCad software. SketchUp comes in second position with 60.94%. The dominant situation of AutoCad is due to its wide adoption by all administrations, architectural agencies and firms. At Constantine, it is a widespread software since the early 1990s. At that time, a public company - dealing with study and urban construction- purchased this software and trained its employees to use it. In fact, AutoCad is the favorite software used by students, since it is suitable for drawing and representing. It is well confirmed through students’ choices detailed in the title 3.3. Actually, the dominant use of AutoCad is our first indicator showing that the majority of students does not use the computer and its tools to be helped in designing.

**Teachers**

A glimpse towards teachers shows that some of them do not allow the use of computer as we said before. We asked students if they were “authorized” to use such tools. The results obtained were as follow:

![Percentage for each year level](image)

![Percentage by institution](image)

*Figure-3. “Authorization” to use computer by teachers.*

Authors: field work, May-June 2012.

The questionnaires submitted during 2008-2009 showed that teachers of the fourth-year level are divided into two groups (at nearly equal percentage) [2]: those “authorizing” the use of computer tools, and those “forbidding” it and arguing that the objectives of this year level did not match with the use of such tools. Few years later, the situation has changed. The second field study (2011-2012) reveals that teachers are more “tolerant” towards the use of computer; 80.95% of interviewed students appeared to be affirmative. The answers by No in the 3rd year level are higher: 41.30% which is justified by the
pedagogical aims of the year. This is well seen through the results showed in the “Figure 1”. On the other hand, teachers of Algiers are the most “tolerant” among the four institutions, with the lowest average of NO equal to 6,17%, confirming the widespread use of computers by students “Figure 1”. Consequently, “Figure 3” confirms the results showed in the “Figure 1”; the answers for the use of computer tools through the three years matches proportionally with the teachers’ agreement. The statistical test confirms this point; a positive correlation exists between the use of computer tools and their teachers’ “authorization” (sig<0,05, khi-square = 62,977)

These teachers do not deny the advantages of the computer for graphic presentation, editing possibilities, printing with different scales, but they blame students for using it in the design phase, which can eliminate individual creativity. They claim -as what collected- the lack of sensitivity: the architectural project has become an object reduced to its technical and functional character, putting aside the artistic and symbolic dimension. That, in fact, what Gehry calls: the missing link when evaluating an architect's work [3]

Teachers’ point of view and their antagonist positions are backed up by the lack of a clear educational policy at universities. Besides, there are no rigorous rules dealing with the use of computer tools through students’ works, although architects’ attitudes are erratic. There are those who would still prefer the use of the pencil and free hand sketches, considering the computer tools as a burden and an obstacle at early stages of designing (this issue has been developed and solutions were suggested through Mascaro’s paper [4]). And there are those who believe that the computer pushes “architects to become architects more than any time before” [5] as it sustains the process of the project and highlights its strategies.

The teachers’ opinion concerning the use of computer tools in the process of an architectural project has been collected through their own survey. The results show that 65,22% of teachers leave the initiative to their students. Only the third, affirms that the use is suggested or imposed by the pedagogical approach. Other teachers have preferred to precise that the computer tools are essential. According to the survey, 60,78% of the latter are familiar with CAD-BIM.

Using computer tools in the process of students’ projects
Students were asked which tool they use at every step of their project, especially for representing and designing. Computer tools (used alone) were found as the first choice to represent projects: 63,78% for the academic year 2011-2012. High percentage is prevailing from one year level to another and in all institutions. Unlike the use of the pencil and hand drawing which decreases from one year to another “Figure 4”.

![Figure 4](image_url)
Authors: field work, May-June 2012.

For designing, the pencil (used alone) and the use of both of tools “are jostling” to have the highest percentage during the three years according to the students’ choice (44,49% for the first tool and 47,64% for the second one). The use of computer tools “alone” seems to be insignificant regardless to the year level or the institution (7,87% as an average) “Figure 5”

As results of our observations and surveys, the majority of students use computer as an alternative for sketch board and the paper in order to digitalize projects produced in the traditional way. Once the work on paper is finished, students go for digitalizing it using the computer and specific software. Thus, in most cases, the computer and software are used as a tool of drawing. Unfortunately, till our latest survey, computer seemed not to be well integrated in the design process (genesis of the main idea, forms, search of solutions and simulation of projects...). Although small progress is noticeable. Some students believe that the computer tools can help in designing but with the help of the pencil, as proved by their explanations to the choice “both of tools”, eg:

- Pencil deals first with primary ideas while improving them rely on computer.
- Free hand sketches in 2D are transformed to 3D owing to computer tools before choosing the final model.

This attitude is, in fact, confirmed by the results showed in the “Figure 6”. Through a direct question addressed to students about their first reaction towards the design of projects, the majority of students preferred free hand drawing as a first step. A high percentage exceeding the two-thirds in each year level (at least), expresses such a choice. As an average between levels and institutions, the percentage reaches 90,12%. Students’ arguments rely on the fact that the pencil is the basic tool for architectural design and inspiration. It allows first ideas to freely emerge while the computer could not draw ideas. Some students added that the pencil gives the feeling that project belongs to them; once ideas are clearly formulated, computer is left for the last step of the design process.
However, the majority of those who answered the question dealing with the first reaction for designing insist that projects are carried out back-and-forth between the paper and the computer tools. Any changes are then brought by hand on printed plans. Students and teachers are still insisting on the use of the hand for exploring and modifying suggested layouts. This is, in fact, an “old” behavior which sticks that computer can never replace the hand and the tracing paper, which are essential for searching and correcting [6].

Generally speaking, the project process appears to be totally accomplished with computer tools. The different steps consist of: designing, representing and communicating the project to the others (without mentioning the construction and manufacturing). But, among the four study institutions, the survey confirms that we’re still talking only about the two latest phases (representing and communicating) while the first one is not reached yet. Although we cannot dissociate these phases one from one another; according to Leandro Madrazo, the real effect of computer on architecture starts when there is no more separation between design and representation [7].

Historically speaking and since the emergence of information technologies in the world of architecture, Alireza Razavi writing in 2008, relied on three eras: The first one goes back to 30 years ago, the second to 15 years ago, which is characterized by the discovery of the great potentials of rendering and simulation owing to computer. The current phase (according to his paper) is characterized by a real partnership with the computer which greatly contributed to the development of digital design [8]. However, in Algerian universities, computer tools (as we cannot talk about digital technologies) have not been yet developed to help in the design. We are still living the second phase, dazzled and confused between the tool and the objective (the project). This is the period of hesitation and confusion as we described it at the beginning of our research.

4. CONCLUSION

Owing to LMD reform (License, Master, Doctorate), Algerian university is reaching new perspectives. Thus, all institutions encroach for this new educational system. It has significantly integrated computer in teaching, since this topic is taught in every year level with appropriate objectives. Institutions are keen in including more optional courses for students wishing to improve their knowledge in this issue. We also hope to offer to Master students some workshops specialized in computing and its applications on building, as it is performed, for example, at Media x Design Lab at the Swiss Federal institute of Technology in Lausanne [9]. The latest initiative of the department of Oran (Algeria) that offers a Master dealing with new technologies is another alternative. We seek to give more attention to students’
comments gathered from our surveys, among which: creating a digital library at the universities, enhancing design studios with computers, ensuring training sessions on appropriate software and integrating them as part of the curriculum, providing some digital technologies, (as we observed at the ETH Zurich during our internship).

Our aim is to improve students’ academic level in accordance with these computer tools issue, not to train technician mastering computer tools. We are rather more involved in the content of the programs and how we can fit the specific courses in order to reach the fixed objectives. The target is to make students able to better use the digital and give suitable attention to their projects rather than focusing only on those tools.

University education undergoes technological improvements. Hence, it needs, not only, to up to date its educational system but has to predict the possible changes in order to evaluate their concrete impact on design, creativity and the architecture in this country. A full understanding and better use of computer tools will certainly help future generations of architects to deal harmoniously with new technologies.

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