

Design Thinking: Difficulties of Making Its Implementation*

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Design Thinking is a methodology or a concept that assists in the creation of new ideas. The need to innovate is a market requirement and a skill that is not developed in the academy just from a discipline or from lectures. It arises from the moment that the student can get in touch with the practice, when he/she has the possibility to develop products and discuss ideas that originate from problems. The big problem is how to develop it in the face of a series of rules that exist in the curriculum. The features of Design Thinking can help teachers understand and apply in their alternative disciplines to make this innovation process a reality. The objective of this work is to present the difficulties encountered in the development of the tool, in spite of its importance. Such difficulties are found by both teachers and students in understanding its advantages and benefits.

Keywords: design thinking, learning, integration

Introduction

The job market has undergone changes and demands that make innovation to be used as a tool. Without it, it is difficult to develop new products that can be presented to the consumer and beat the competition effectively. But it cannot be just a change of design or product; it must generate benefits for the consumer. It needs to perceive gains in value for the environment or energy gains or changes in product use or economic gains.

Innovation emerges from the moment that the needs of the consumer are discussed and collected and this is aligned with the needs of the company to release new products. The releasing of new products is not enough by itself, as this can cause consumer dissatisfaction. As it could be seen in the creation of the tomography machine scanner (T. Kelly & D. Kelly, 2014).

This example is interesting, because it shows that innovation is not enough. It is necessary to analyze the reasons for the innovation being made. Design Thinking is a tool that helps in how this process of perceiving the customer can be developed. This needs to be started during the period when the student is starting his/her

* **Acknowledgement:** We thank the teachers who helped us answer the questionnaires. We also thank Centro Paula Souza that allows us to do research in the area of Technology and Engineering Teaching. And we thank the teachers who worked together with the Design Thinking Group of FATEC Itaquera.

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training process, because when he/she becomes a professional, he/she can develop this work in a more efficient way.

The purpose of this paper is to present the difficulties of implementing Design Thinking in technology courses due to several factors. For example, how teachers understand innovation, how they perceive projects, how students understand knowledge, how to integrate knowledge, what to do to have products developed within technology courses, and what can be developed to motivate the innovative thinking. The need for change exists and is visible in the vocabulary of all disciplines and lectures, but when beginning a work that requires a work of integration between different kinds of knowledge and seeks a change in posture, it is possible to observe a series of difficulties. This paper presents some of these problems identified in two years of follow-up work at a Faculty of Technology in São Paulo.

What Is Design Thinking?

According to Vianna, Vianna, Adler, Lucena, and Russo (2012), the designer is the professional who can see the problem in a systemic way (aesthetic, emotional, and cognitive). He can perceive people's need for well-being in their most diverse places of life, such as work, home, and leisure, making it easier to generate solutions to the problems identified.

In this way, it is not possible to think of a problem in a unique way and through a single point of view, since people have several needs and several influences so that their quality of life will exist.

In 2000, IDEO Company, located in Silicon Valley, started to use the idea of design way of thinking that is systemic and borrows knowledge from many other professionals and it was called Design Thinking (Bonini & Endo, 2017).

This is an approach that decentralizes the practice of the design from the hands of specialized professionals, allowing their principles to be used by other types of professionals and with this they can generate varied applications and new solutions.

Design is the creation of something that enables the person to act or respond to a need that has been detected or an identified challenge. It does not happen in a random way; it has a system that assists in the structuring of new products and new processes.

One of the differentials brought by the Design Thinking theory is that the solutions developed bring value to the consumer; they are created with the consumers and thought about with them and what is not viable is adapted to the reality the consumers need (Bonini & Endo, 2017).

This issue is interesting, because when you think about innovation, the main concern is to create technology or create something new. Many times, the user of the product is left out. This example can be verified in the development of the magnetic resonance machine, which was very efficient, but the children had to be sedated to use the equipment. One innovation was to turn the machine into a large ship and make the child think he/she was entering an adventure by the sea. This made the device be used more effectively and the value perceived by the children was different from what it previously was (T. Kelly & D. Kelly, 2014).

One of the issues raised by Design Thinking is the need to find an optimal point between what is practical, what is necessary and the technical part, that is, what the person needs, but what is necessary for the product to exist and what is technically feasible to be economically marketed and produced. Figure 1 summarizes this issue well (T. Kelly & D. Kelly, 2014).

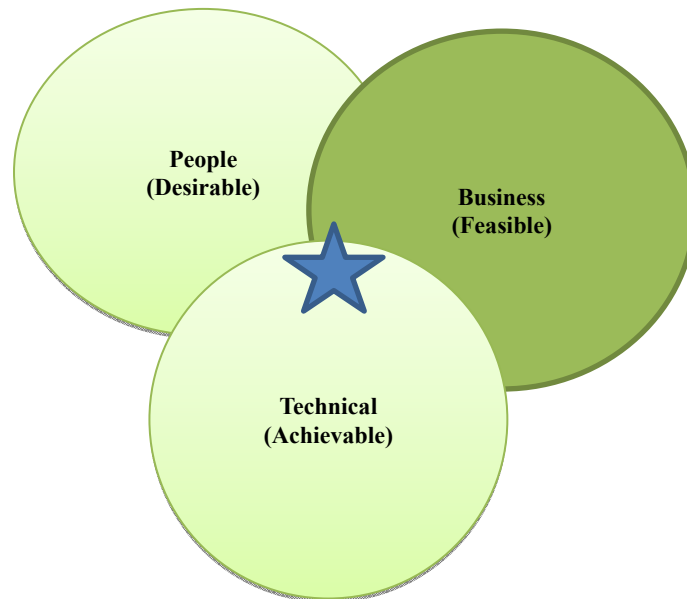


Figure 1. Relation among factors involved in Design Thinking (Source: T. Kelly & D. Kelly, 2014).

What is feasible for a business that can generate a lot of money and that can be technically developed is not always necessary or what people need. It is not possible to offer innovation in an imposing way. People's needs can generate the beginning of the search for new processes or products, but the challenge is to technically meet a specific demand. This can also create a possibility for innovation. In this way, this relationship of factors must always be combined, so that the process of Design Thinking can meet the desired goals.

What Design Thinking brings along with it is the process of innovation. An important element is essential for survival in businesses today. How to survive in a market that needs differentiation, but more than that, needs to meet the needs of people with new technologies, and thereby, generate new business opportunities (Vianna et al., 2012).

From 1986 onwards, the concept of innovation was about technological solutions to satisfy the needs of customers and explore new markets, making innovation a direct consequence of the thinking or the methodology of Design that seeks, in a multidisciplinary way, to understand how to solve problems that are presented in already existing situations and that often need transformations.

Methodology

Action research is the methodology used to develop this research. Action research emerged around the 1930s. It has been enhanced by the idea that a process of analysis needs to be developed in the experience that is being developed (Tripp, 2005).

The cycle starts from the moment a problem is identified and needs analysis. This process of analysis is done by the researcher himself who is involved with the problem. That way what can be improved and what actions are necessary can be planned for that improvement. Being applied to the actions, it is necessary a follow up to identify the results obtained and if there were differentiated facts. After obtaining the results, it is interesting to evaluate if they are suitable to what was planned.

Action research follows this cycle in all processes of analysis and differs from other methodologies, because the authors themselves accomplish all these steps. It can be defined as a form of action investigation

that uses research techniques to improve an action that has been identified as needing improvement (Tripp, 2005).

In this research, the teachers' and students' view of their participation in the integrative project was analyzed. It consists of developing a project based on a theme defined by field research by the guiding teachers. These themes are always linked to the daily life of the faculty, the reality of society, sustainability, or professional issues. Students need to define a work group in the semester they are studying, make a work schedule, and choose a project to develop from the proposed topic. At the end, they must present a final report with the participation of each one of the subjects of the semester, a prototype and make a presentation of this work in a show for other students and teachers.

For each semester, there is a supervisor and the teachers of the other disciplines are knowledge mediators who will guide the knowledge of these disciplines, contributing to the resolution of the project to be developed. This project has been under development since 2014. And a series of dissatisfaction and noise have been observed ever since. In this way, we decided to develop a series of interviews with students and teachers.

Unstructured interviews with students and teachers were carried out in 2016 and 2017. In the courses of Mechanical Manufacturing, Industrial Automation, Welding and Refrigeration Process, 60 teachers and 100 students were interviewed. On-site observations were also made during the presentations of the works and in the evaluations that were carried out throughout the semesters.

The results of the identified problems are described in the items below.

Description of the Integrating Project or Design Thinking Methodology

The integrating project is considered part of the Design Thinking methodology, since it is a multi-disciplinary project, whose objective is to help the students to pursue a problem in the ongoing project from a theme, because the deadline is determined as a project, and define a prototype that solves this product efficiently and takes into account the three factors cited in Figure 1.

One of the variations is that the students need to work in groups, work with a deadline, and must integrate the subjects of the semester in which they are studying. This project is developed during all semesters of the technology courses of the Faculty of Technology of Itaquera.

It was created in 2014 in order to help students to develop the ability to work in groups, develop creativity, entrepreneurship and the ability to work on projects, which is also one of the characteristics of the Design Thinking methodology.

For teachers, this project aims to improve their orientation skills, their creativity, their research skills, their skills in specific areas, the possibility of developing academic papers with the works developed, as well as the capacity of knowledge integration between the teachers of different areas, which is also a characteristic of the methodology of Design Thinking.

In the faculty, there are four courses in the area of Mechanics. They are Technology in Welding Process, Technology in Refrigeration, Air Conditioning and Ventilation, Technology in Automation, and Technology in Mechanical Manufacture. These courses work in three different shifts: morning, afternoon, and evening. In this way, we have about 130 projects being presented each semester. Figure 2 describes the flow of the integrating project.

Every semester problem is generated by the coordination of the course together with the guiding teachers of the integrating project. From then on, students need to divide into groups in the semester they are developing

the term subjects, discuss which project or issue they can propose to be developed, propose a solution to the issue along with their guiding teacher, and periodically talk to the teacher who is appointed for that semester. This solution of the problem must include the subjects of the semester in which it is. That is, the content that they will study will be discussed along with the problem to be solved. At the same time, the prototype that students must present at the end of the semester will be developed.

The teachers of the disciplines of the semester are mediators to the students in solving problems and constructing the prototypes together with the supervisor.

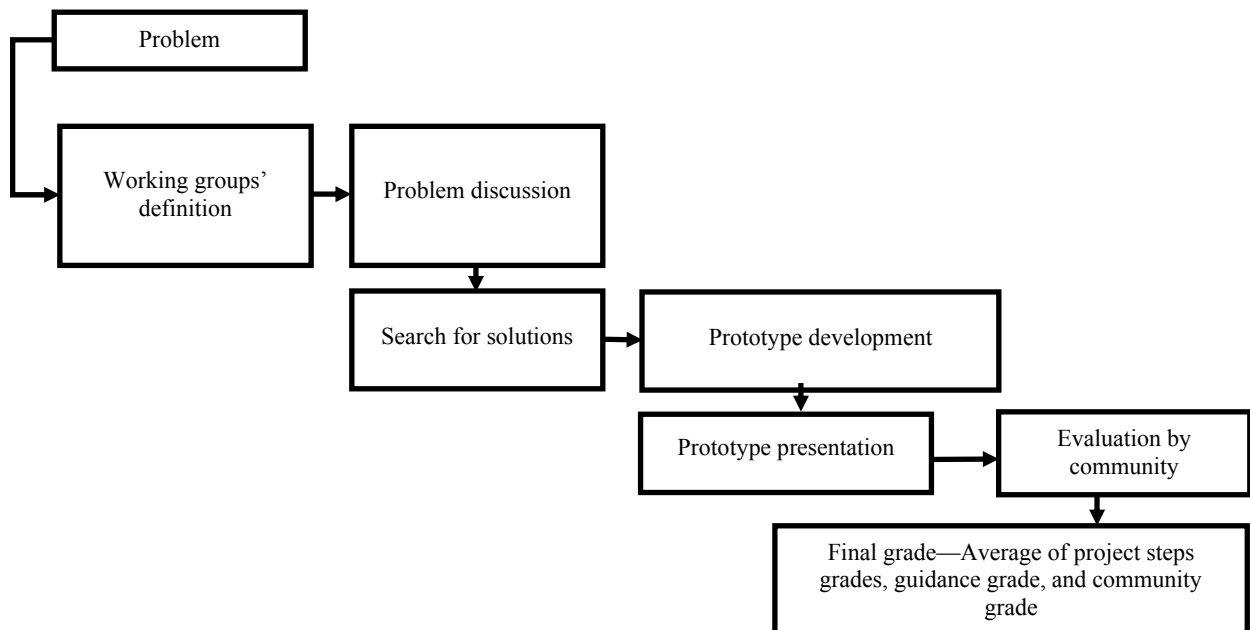


Figure 2. Integrating project flow (Source: Author's adaptation).

Development of the Research

The results obtained by the project during four years were very positive. Dropout rates were reduced to 20%. The failure rate in Calculus, Physics, and Electricity, which had been 80%, went down to 50%.

However, we identified some problems that have not yet been solved and were identified through interviews with students and teachers, in observations made during the execution of the projects and also in the evaluation meetings we had with students and teachers.

The students of the first semester put forth some questioning issues as follow:

1. We do not know all the subjects and we already have to think about a project; how can we do this?
2. We cannot get organized and we have to get things moving; it is a lot of work for the first semester.
3. We lack more effective guidance.
4. Is it really mandatory to include all the disciplines in the project?
5. Why are not there different themes according to the courses?
6. Students do not meet deadlines.

These questions are repeated every semester. We can say that 80% of the students raise these questions mainly at the beginning of the semester. At the end of the semester, when we talk to them, some of the issues are dispelled, but others are not.

With regard to teachers, other problems were identified, such as:

1. Lack of vision of the teaching body, students cannot talk to the teachers of the semester to exchange experiences;
2. Teachers do not evaluate the projects of all students so as to motivate them; and sometimes they do not evaluate them correctly;
3. Teachers do not know the methodology of the project and do not know the methodology of Design Thinking methodology;
4. There is no commitment to make students understand the results of what they are developing throughout the process;
5. Teachers do not deliver the evaluation results within the agreed deadlines.

These are issues that were raised by 50% of the guiding teachers and by 60% of the teachers who act as mediators of the subjects in the semesters. Although every semester there are meetings for discussion about the project and these are open for suggestions and adjustments, many teachers do not participate and omit to say what can be done. At the end of each semester, they make the same mistakes and make the same complaints. These complaints are noted and again they are called for improvements to be discussed for the coming semesters.

The issues involving integration between teachers and their knowledge of active methodologies are very important for the project results to work and for the changes to be generated with the students to emerge.

The implementation of new concepts and new models is difficult to get when there is resistance to change or when the idea of knowledge arises as if it existed without a practical application as it occurred with the creation of the CT scanner.

In the case of integrating projects, there is no concern with applications and with making changes, but with compliance with rules. And the results are not always what are expected: The students are able to develop skills that will help them grow as competent professionals capable of working in job market in a flexible and creative way, which is the current reality.

Final Considerations

This work raised a series of issues related to the application of the methodology of Design Thinking in a project that has been developed since 2014. The observations were developed with more care in 2016 and 2017, because the project is already more mature and can undergo larger improvement.

Overall project results are positive, but issues related to teachers' involvement and changes need to be improved.

The activities that are being developed are: seminars on active methodologies, constant training with teachers working with this project; students' follow-up throughout the project and teachers' follow-up before, during, and after the project.

A research group is being created in order to develop further research to create new application forms to be tested in the courses. This group is being formed with some universities that already work with Active Methodologies.

Future work is to answer these questions and choose some basic disciplines of one of the courses to do some tests applying active methodologies in the complete discipline and not only in the integrating project.

References

- Bonini, L. A., & Endo, G. B. (20/06/2017). *Design Thinking: uma abordagem para inovação* (Design Thinking: An innovation approach). Retrieved from <http://www.techenet.com/2013/11/o-design-thinking-como-uma-nova-abordagem-para-inovacao/>
- Kelly, T., & Kelly, D. (2014). *Confiança criativa*. San Paul: Ed. HSM.
- Pinheiro, T. (2014). *The service startup: Inovação e empreendedorismo através do Design Thinking* (The service startup: Innovation and entrepreneurship through). San Paul: Ed. Alta Book.
- Tripp, D. (2005). Pesquisa-ação: Uma introdução metodológica (Action research: A methological introduction). *Educação e Pesquisa*, 31(3), 443-466. São Paulo: Set/Dez.
- Vianna, M., Vianna, Y., Adler, I. K., Lucena, B., & Russo, B. (2012). *Design Thinking: Inovação em negocios* (1st ed.). Rio de Janeiro, RJ: MJV Press.