

► *Design Thinking* en línea en la educación superior

ONLINE DESIGN THINKING

in a higher educational environment



By:  Anna Herold · Manuela Gutiérrez-Leefmans



Herold, Anna y Gutiérrez-Leefmans, Manuela. (2024). Online Design Thinking in a higher educational environment. *Entorno UDLAP*, 23

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◆◆ ABSTRACT

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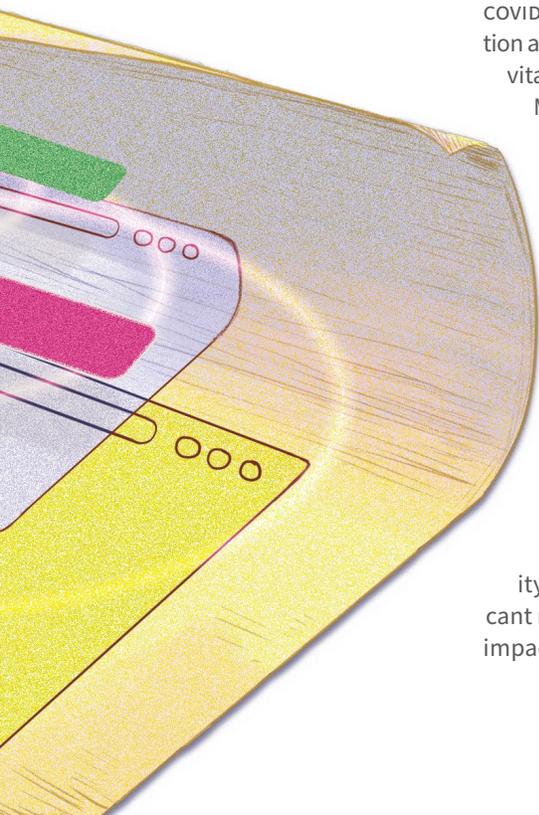
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◆◆ KEYWORDS:

Design Thinking · Online education · Pandemic · Creativity · T-test

◆◆ RESUMEN

El COVID-19 trajo desafíos para la educación en línea en los diferentes niveles. El trabajo en equipo y la creatividad, actividades vitales para la innovación, se vieron afectadas. Además, el surgimiento del trabajo híbrido enfatizó la necesidad de analizar las herramientas colaborativas. Este estudio realiza un experimento de dos grupos de estudiantes, uno de licenciatura y otro de posgrado, que utilizaron un *software* para lluvia de ideas, parte del enfoque del pensamiento de diseño (DT, por sus siglas en inglés), para la solución de problemas. Nuestro cuestionario mide seis variables de la metodología





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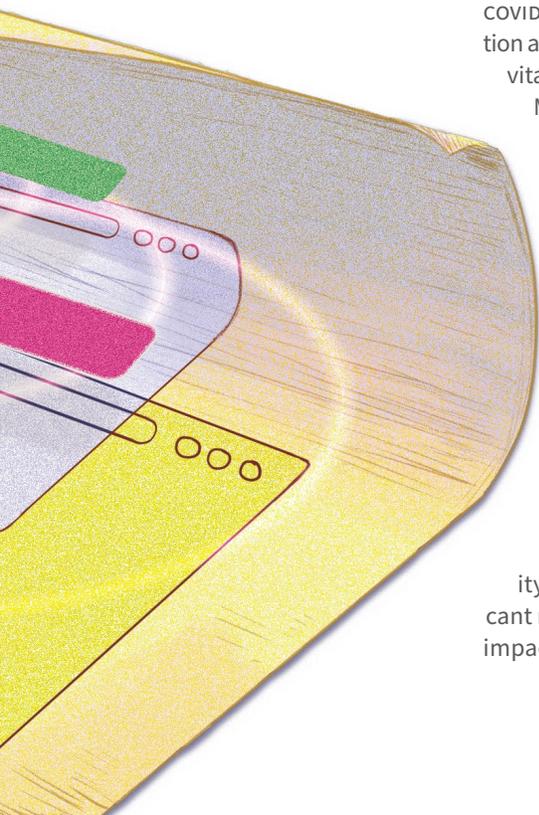
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propia del DT y añade la capacidad técnica. Al ejecutar dos pruebas de t independientes de muestra, la mayoría de las variables resultaron no significativas, pero la capacidad de «pensar desde diferentes perspectivas», parte de la creatividad e intuición, resultó significativa, indicando que el *software* afecta de manera diferente a ambos grupos en dicha habilidad. Se describen las implicaciones teóricas y prácticas, tanto para educadores como para organizaciones.

◆◆ PALABRAS CLAVE:

Pensamiento de diseño • Educación en línea • Pandemia • Creatividad • Prueba de t

◆◆ INTRODUCTION

The COVID-19 pandemic affected much of our behavior due to the limited contact with family and friends. Working life, especially teamwork and creative work, was also impacted, and this may have a lasting negative effect on the development of innovations and ideas, hindering the further success of universities and companies (Bertelsmann, 2020). Hence, in post-pandemic times, a trend of hybrid-working for certain industries emerged (The Oxford Group, 2023), which urged the need to validate certain collaborative tools, in particular, for brainstorming. The creativity method of Design Thinking—subject of our study—works through workshops and the joint development of ideas. Until the outbreak of COVID-19, these mainly took place on-site (Brown, 2009); a condition that, in some industries, is no longer desirable today.

Another reason why DT workshops that are executed online may become more important, besides the growing relevance of flexible workplaces, is the environmental protection and cost reduction for companies. As people work further apart in an international and more flexible environment, traveling is increasingly avoided. The same applies to the field of education, in particular to universities, which are an essential hub for the development of new ideas and solutions. Hybrid master's programs are becoming more popular, with an ascending amount of remote study programs as well as other distant learning courses (Lester, 2005; Bertelsmann, 2020).

DT has led to good ideas and solutions for problems in the past and, therefore, has become widely spread overtime (Micheli *et al.*, 2018). However, one could assume that when adopting such practice online, there could be differences among users' adoption and usage of certain collaborative tools. Specifically, the question to be

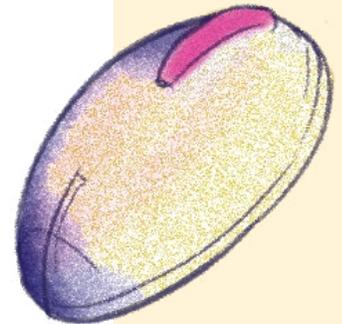
answered in this study is, within the university context, *are there differences among the diverse educational levels when adopting online DT collaborative tools?*

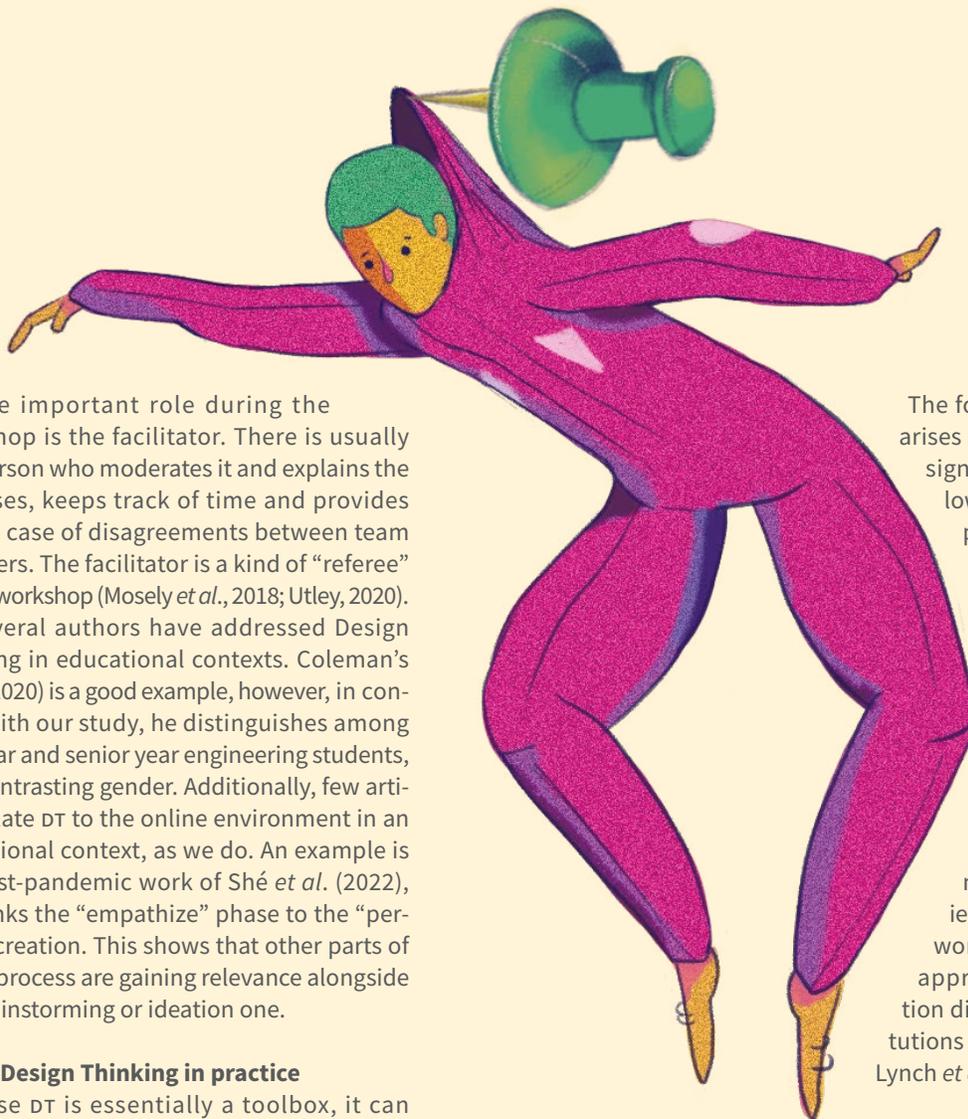
For this purpose, the DT method is examined. Special attention is paid to its central elements and roles. Afterward, a framework is proposed for its use in an online setting. First, we discuss assumptions about the differences between the online and offline settings, which are based on research and previous experiences in online workshops. Then, the results of the two workshops that we conducted are presented in the methodology section, together with the t -test analysis performed. The differences between the two student groups are presented, as well as a discussion section that suggests practical implications and further research venues.

Theoretical foundation and practical application of Design Thinking

During the last years, the popularity of the Design Thinking method, which was developed at Stanford in the middle of the 20th century, has been rising (Stackowiak and Kelly, 2020; Ideo, 2021; AJ&Smart, 2021). A great influence on the spread of DT was created through the foundation of the so-called *d.school* in Stanford, along with the agency Ideo. David Kelley, one of its developers, described it as “a method for how to come up with ideas. These are not just ideas, but breakthrough ideas that are new to the world, especially with respect to complex projects, complex problems” (Camacho, 2016, p. 88).

Depending on the source, the number of phases of DT and their labelings can vary. The model of the *d.school* in Potsdam, Germany consists of a six-phase model (Hasso-Plattner-Institute, 2021a; 2021b). The six phases are “understand”, “observe”, “point of view (POV)”, “ideate”, “prototype” and “test” (2021a). The Stanford model refers to the first phase as “empathize” and does not include the “observe” phase. We decided to follow the latter model, as the extra phase in the former would require additional resources. The observation of potential user groups is difficult to organize and takes more time, as it involves gathering potential consumers. Our study focuses on the “ideate” phase, as it is concerned with the use of an online tool for idea generation. The first three phases are explained during the workshop, for practical reasons a POV is given to the students previously. The goal of DT is to develop ideas, solve problems and create innovations by combining technology, business, and the human factor.





One important role during the workshop is the facilitator. There is usually one person who moderates it and explains the exercises, keeps track of time and provides help in case of disagreements between team members. The facilitator is a kind of “referee” for the workshop (Mosely *et al.*, 2018; Utley, 2020).

Several authors have addressed Design Thinking in educational contexts. Coleman’s work (2020) is a good example, however, in contrast with our study, he distinguishes among first year and senior year engineering students, also contrasting gender. Additionally, few articles relate DT to the online environment in an educational context, as we do. An example is the post-pandemic work of Shé *et al.* (2022), who links the “empathize” phase to the “persona” creation. This shows that other parts of the DT process are gaining relevance alongside the brainstorming or ideation one.

Use of Design Thinking in practice

Because DT is essentially a toolbox, it can be used for almost any problem-solving or ideation situation. Its resources are not necessarily focused on a specific area or topic (Knapp *et al.*, 2016; Camacho, 2016; Ideo, 2021; AJ&Smart, 2021; Retna, 2016; Brown, 2009). How long Design Thinking is used for depends greatly on the context. Some teams or agencies use it continuously, whereas other universities and companies may only use it for short periods of time, such as a day or a few hours (Brown, 2009; Knapp *et al.*, 2016; AJ&Smart, 2021). Another popular way of using it is the so-called *Design Sprint*, developed mainly by Jake Knapp and his colleagues at Google Ventures. It summarizes the Design Thinking process in a five-day workshop (Knapp *et al.*, 2016).

DT is becoming increasingly popular in the educational sector, as well as in other areas. Users in practice are, for instance, independent faculties, foundation centers of universities and lecturers (Camacho, 2016).

The focus on DT in schools mostly arises in connection with a new design of education. The trend follows a focus on solving practical problems and developing new ideas that also create value in the real world and not only in the classroom (Koh *et al.*, 2015). One focus of DT in education is the field of management and entrepreneurship, (*i.e.*, business schools). Hence, it has become an almost mandatory exercise in business-related majors, since this makes it easier for graduates to apply in their working life later on. Again, the approaches for its implementation differ among educational institutions (Matthews and Wrigley, 2017; Lynch *et al.*, 2019).

A framework for online Design Thinking workshops

The Design Thinking model used in this study is mostly based on the framework of Micheli *et al.* (2018). They conducted a systematic review of the DT literature and identified ten principal attributes. A focus is set on the attributes and codes that are associated with Design Thinking and the frequency with which they are mentioned in articles. In addition to the attributes used by these authors, we added *technical ability* to our framework, since it plays a crucial role in the online setting. The technical literacy, as well as the equipment of the participants, are vital in online workshops. Experimenting is also considered in newer frameworks (Ericson, 2022), where the abilities to criticize, judge, identify and analyze arguments, as well as decision making, emerge as relevant in the DT process.

This analysis measures six different aspects of the DT approach: creativity and in-

novation, problem-solving, collaboration, ability to visualize, design tools and methods, and technical ability. Creativity and innovation can be understood as the ultimate goal of the entire Design Thinking approach, and achieving it depends on the right environment and conditions. Since DT is a problem-solving method, in this context it means that a given situation which cannot be solved using classical analytical methods is framed neither too broad nor too specifically. Recent literature on DT in educational contexts, highlights the “reasoning” part of the process, (Rusmann and Ejsing-Duun, 2022), where factors, such as problem setting, modeling and process management, become relevant.

Collaboration is the successful execution of the Design Thinking process in a team and without a hierarchy, so that different perspectives on one issue can be easily provided. The ability to visualize allows students to think nonverbally. It involves listening, thinking and drawing. Design tools and methods are the exercises that are executed by the teams during the workshop (e.g., the use of sticky notes for brainstorming). Technical ability means that the participants have the technical skills and the needed equipment for online workshops (Brenner, 2016; Brown, 2009; Camacho, 2016; Ideo, 2021; Micheli *et al.*, 2018; Stephens, 2015). Based on the variables selected, we developed the following hypotheses:

H0 = The means of the graduate and undergraduate group does not differ in any of the variables.

H1 = The means of the graduate and undergraduate group differ in the creativity and innovation variable. MBA students, for example, may have different abilities and perspectives due to their working experience in diverse industries, besides their different professional backgrounds.

H2 = The means of the graduate and undergraduate group differ in the problem-solving variable.

H3 = The means of the graduate and undergraduate group differ in the collaboration variable.

H4 = The means of the graduate and undergraduate group differ in the ability to visualize variable.

H5 = The means of the graduate and undergraduate group differ in the design tools and methods variable.

H6 = The means of the graduate and undergraduate group differ in the technical ability variable.

Figure 1 shows the proposed framework.

METHODOLOGY

To investigate the adoption of the Design Thinking method in an online educational setting, online workshops were conducted at different age and educational levels. The methodology is based on the work of Meinel *et al.* (2020). This experimental research design was selected in order to give the participating students the possibility to experience an online Design Thinking workshop before evaluating it according to the parameters of the elaborated framework through a questionnaire.

Both workshops took place in lectures in a private university, one of them in the undergraduate Marketing program, and the other one in the MBA program. The participants of the undergraduate program have similar backgrounds and are in a similar range of age, while the master's students come from a more diverse academic, as well as professional, background and a broader age bracket. Both classes were selected because the lectures have a focus on Innovation studies. Therefore, a convenience sampling design was used (Emerson, 2015).

Both workshops were conducted under the same conditions: the teams have the same amount of time, the same problem to solve, and the same resources (both used Mural boards). Mural is a software for collaborative work that uses visual aids and interactivity to facilitate teamwork. It aims to improve communication and workflow via the use of sticky notes, canvas, mapping and diagramming, images, and templates. It allows sharing ideas in real time—a very appreciated feature (Brown, 2009, p. 31). Some important features are how sticky notes can be moved around the board used for the workshop depending on the phase (Mural, 2020a; 2020b). An additional resource used was Blackboard, an educational tool for video collaboration. A general statement about the usability of online workshops that use DT in the educational sector should be possible due to the experience of both groups with online tools. The analysis of the workshop is mostly



done by means of a questionnaire, which participants filled in directly afterward.

Furthermore, the facilitators went from group to group to support the teams in case of difficulties. While doing so, one facilitator took notes, which were validated by the other after the workshop. Those observations include the assessment of the flow of the workshop, as well as the Mural boards that the groups used to elaborate their ideas. Due to the technical infrastructure of Blackboard, it was not possible to record each group’s interactions (it is not possible when breaking out into groups), hence, the evaluation can only be based on the observations of the groups.

Preparation of the workshop and development of the Mural

We describe here the process followed for the workshop. At the beginning, the professor gave a short introduction to the topic of Design Thinking, which lasted about ten minutes. They presented the most important elements and goals of the process, as well as facts about the development and delimitation of the method. Afterward, a short introduction about the tool was given with recommendations on how

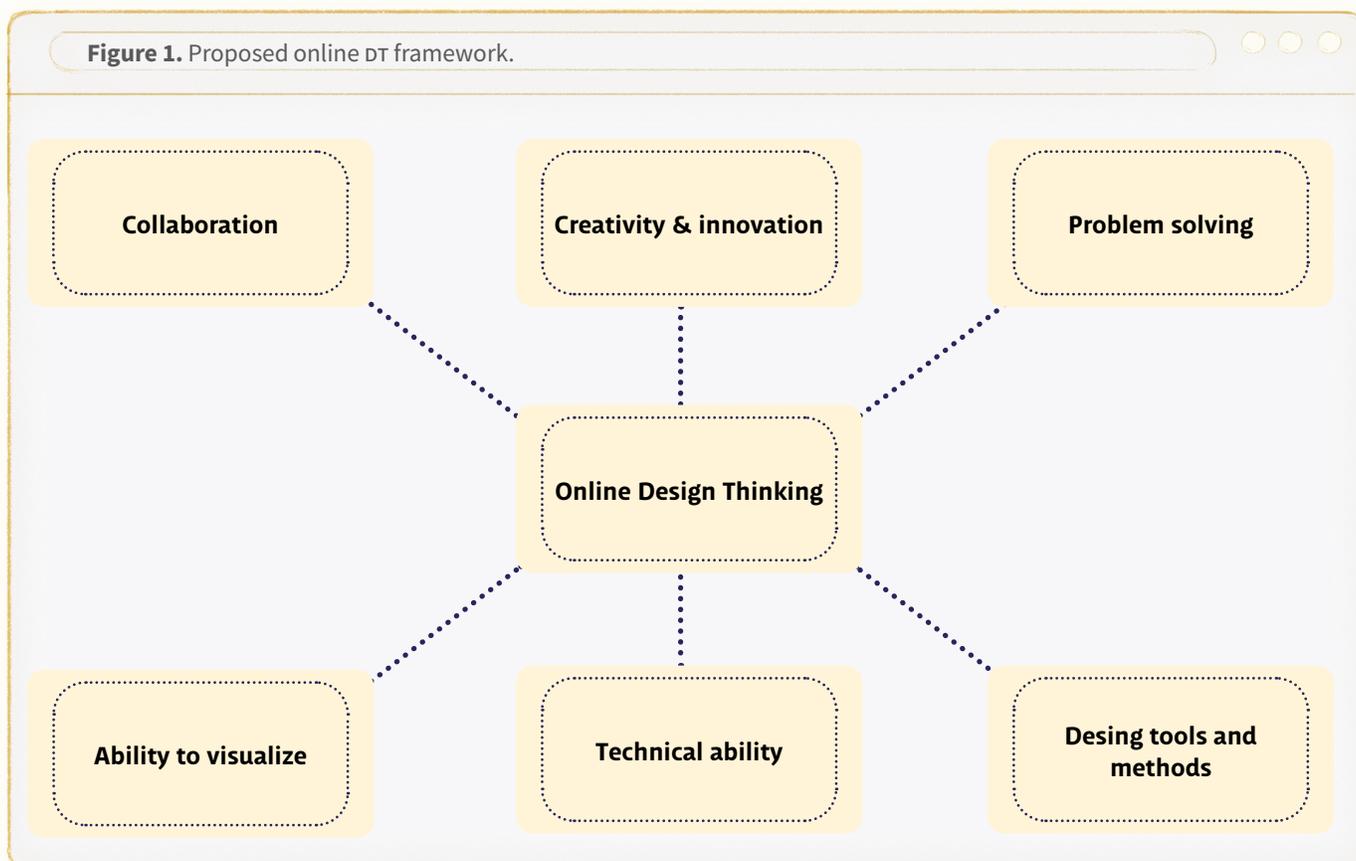
it should be used. In this case, it was a combination of Blackboard, where group spaces were formed, and Mural, a tool that allowed virtual collaboration, creating a workspace close to the DT environment, described before.

Each team had their board, and thus, its workspace, where they could move from task to task. During the introduction, the individual steps were discussed together with exercises that the participants had to perform independently. The rules for working together were also presented.

The main step was brainstorming, where solutions to the question need to be found. In English, the instruction was: *What product can be developed to address the changing needs of customers during the pandemic?* Each team member had four minutes to solve the task — as slight time pressure favors productive work. After an individual brainstorming exercise, then came the group one. Each participant had to present their ideas to the group. Afterward, these ideas were sorted, and so-called clusters were formed, where the same or similar ideas lay next to each other. Further time was allotted for voting, where each participant picked their favorite ideas and gave them up to three points. In the end, the idea with the most points



THIS ANALYSIS MEASURES SIX DIFFERENT ASPECTS OF THE DT APPROACH: CREATIVITY AND INNOVATION, PROBLEM-SOLVING, COLLABORATION, ABILITY TO VISUALIZE, DESIGN TOOLS AND METHODS, AND TECHNICAL ABILITY.



Source: own elaboration.

was taken to the next phase and developed further. The used sub-method of brainwriting—the so-called “idea tower”— worked as follows: in round one, each participant tried to answer the question *Which attributes should the new product have?*, for the selected idea. The participants first developed their own idea for three minutes. Afterward, in round two, they had to go one field down and then to the right. That is, the participant was below the developed attribute of one of its team members. In the following three minutes, they had to attempt to develop its team member’s idea further, while adding their own components to it.

After this process, it came to step five, which, involved a vote for the most important parts of the developed attributes. Three minutes were allotted for this. Finally, the developed idea and its most essential components were summarized on a sticky note, which was basically an initial new product concept. This was the end of the workshop, when the participants filled out a questionnaire.

The presented approach focused mostly on the “ideate” phase of the DT process. We are assuming that the students are also consumers and, therefore, able to empathize (phase 1), hence, the “point of view (POV)” phase, or problem definition, was already given to students. The two last phases were not part of the workshop.

Development of the questionnaire

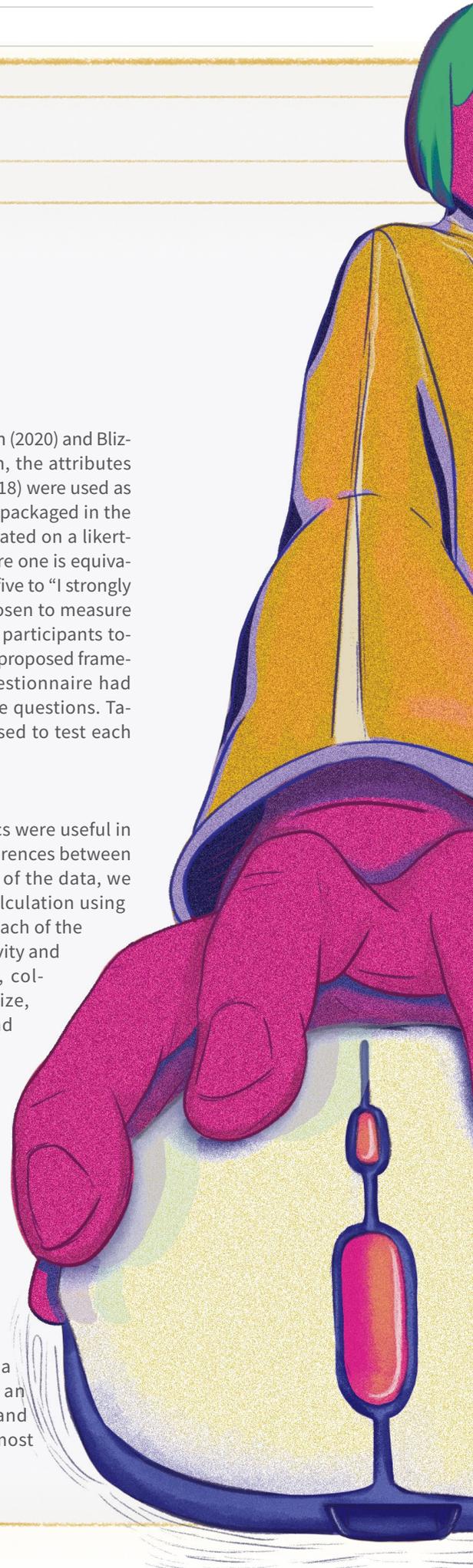
In the questionnaire, two or three questions are asked for each tested construct of the framework, as well as some supplementary ones that included age, preference for online or offline workshops and additional comments. The master’s program was also asked to report its academic background.

The development of the questionnaire was based on questions from other studies, like

Saroghi *et al.* (2019), Coleman (2020) and Blizard *et al.* (2015). In addition, the attributes and codes of Micheli *et al.* (2018) were used as a guide. These questions are packaged in the form of statements that are rated on a likert-type scale of one to five, where one is equivalent to “I strongly agree” and five to “I strongly disagree”. This method is chosen to measure the different attitudes of the participants towards the components of the proposed framework (Likert, 1932). The questionnaire had a total amount of twenty-one questions. Table 1 shows the questions used to test each construct.

Data analysis

Although descriptive statistics were useful in the beginning to see the differences between both groups, in the analysis of the data, we did an independent *t*-test calculation using SPSS statistical software for each of the variables under study: creativity and intuition, problem-solving, collaboration, ability to visualize, ease of use, design tools and methods and technical ability. Parametric tests, such as the 2-sample *t*-test or independent *t*-test, assume a normal, continuous distribution, but with a sample of sufficient size—as is the case of our data—, *t*-tests are robust enough to handle departures from normality (Minitab Blog Editor, 2016). Another solution to work with non-normally distributed data is to use a non-parametric test, such as an *u*-test. However, De Winter and Dodou (2010) find that, for most



pairs of distributions, the difference between the statistical power of the two tests is trivial. This is confirmed by Vieira (2016), who finds that a *t-test* is valid to compare groups even when the variable measured is a Likert scale and the population does not have a normal distribution.

Hence, a one-tailed two-sample *t-test* was applied to both groups (group A: undergraduate students and group B: graduate students). Each group comprises thirty-one students. A five-point Likert scale was used for all of our questions, where 1 meant “strongly agree” and 5, “strongly disagree”. Therefore, the *t-test* was used to explore whether the null hypothesis (H0), there is no difference between the means from group A and group B, could be rejected.

◆◆ RESULTS

A significance level of 0.05 was used to run the test. As shown in table 2, most variables were non-significant. However, for one of the questions under the category “creativity and intuition”, “ability to think out of different perspectives”, the result was significant. Namely, in this question the null hypothesis was rejected, meaning that there is a statistically significant difference between the means in both groups. Therefore, being part of a specific group does affect the ability to think out of different perspectives when using the software. This means that the thirty-one students in group A ($M = 2.26$, $SD = 43.94$), compared to the thirty-one students in group B ($M = 1.74$, $SD = 23.94$), report a higher ability to think out of different perspectives when using the software. For this variable, the *t-test* renders a *t-value* of 1.91, which is significant with a *p-value* of 0.03.

Observation of the process indicates that the students understood the tasks and were able to follow the procedure presented and the instructions within the Mural board. All teams successfully worked on all parts of the board. In total, the master’s program participants took about five more minutes for the workshop compared to the undergraduate’s program students, which finished in about 40 minutes. The design tools and methods were transferable to the online environment and could be implemented by most of the participants. Whereas, for the technical ability, students were able to overcome any difficulty encountered.

◆◆ DISCUSSION AND CONCLUSIONS

Overall, results indicate that perceptions of the use of the software for Design Thinking among both groups is similar. Undergraduates,



BOTH WORKSHOPS WERE CONDUCTED UNDER THE SAME CONDITIONS: THE TEAMS HAVE THE SAME AMOUNT OF TIME, THE SAME PROBLEM TO SOLVE, AND THE SAME RESOURCES.





being part of a younger generation, are more used to technology, however, graduate students are also very used to online meetings and training. This means that, for both groups, online Design Thinking workshops are viable. This coincides with Döring and Bortz (2016) findings, who contrast offline and online DT workshops.

The salient variable on the ability to “think out of different perspectives” when using the software, indicates that the software does affect each group differently when it comes to creativity and innovation. Hence, although MBA students come from a rich variety of backgrounds and working experience, they appear to have a barrier in terms of creativity and innovation (as per our results, H1 was supported). For older students, there may be contagion issues that do not let them think out of different perspectives and therefore, conform to the group. This has been wide-

ly acknowledged by researchers and practitioners, claiming that in the “marshmallow challenge” (an activity where students build a spaghetti structure that should hold a marshmallow on top), young children do better than postgraduate students. The former experiment much more on their own, while the latter spend more time planning and analyzing. That is, by devoting less time to experimentation, there are fewer opportunities to think out of different perspectives.

In line with Coleman (2020) and Micheli *et al.* (2018), who conducted offline studies on DT and highlighted the “different perspectives” role on creativity and innovation, our work adds to such body of knowledge by testing the same variable in an online setting. Also, Coleman (2020) contrasted first year versus senior year engineering students, while our study compares undergraduates and graduates. Our study also confirms the work of Gutiérrez-Leefmans (2016), who stresses that the multitasking ability and short-term information overload of young generations

Table 1. Questionnaire items according to constructs.

Framework construct	Items to test
Creativity and innovation	I was able to develop ideas easily. I was able to think out of different perspectives. (Based on Coleman, 2020, Micheli <i>et al.</i> , 2018 and Sarooghi <i>et al.</i> , 2019).
Problem-solving	We analyzed the problem broadly to find a solution that will have the greatest impact. It was easy for me to solve the problem in an online setting. (Based on Micheli <i>et al.</i> , 2018 and Sarooghi <i>et al.</i> , 2019).
Collaboration	I enjoyed the teamwork during the workshop. The communication between the team members worked without any problems. (Based on Blizzard <i>et al.</i> , 2015).
Ability to visualize	My team members’ visualizations were easy for me to understand. The software made it easy for me to present my ideas. (Based on Micheli <i>et al.</i> , 2018 and Sarooghi <i>et al.</i> , 2019).
Design tools and methods	It was easy to use the brainstorming method in the software. It was easy to use the dot voting in the software. It was easy to use the brainwriting method in the software. (Based on Micheli <i>et al.</i> , 2018 and Sarooghi <i>et al.</i> , 2019).
Technical ability	I did not have any technical issues. The combination of the work with the software and Blackboard was not a problem for me. The operation of the software was intuitive. (Own elaboration).

Source: own elaboration.

Table 2. T-test results for variables under study.

Question	Variable	t-value	p-value	Result
1	I was able to develop ideas easily.	1.17471	0.122376	Non-significant
2	I was able to think out of different perspectives.	1.91055	0.030422	Significant
3	We analyzed the problem broadly to find a solution that will have the greatest impact.	1.08663	0.140774	Non-significant
4	It was easy for me to solve the problem in an online setting.	0.72023	0.23709	Non-significant
5	I enjoyed the teamwork during the workshop.	0.55351	0.290986	Non-significant
6	The communication between the team members worked without any problems.	0.32681	0.372475	Non-significant
7	My team members' visualizations were easy for me to understand.	0.45565	0.325145	Non-significant
8	Mural made it easy for me to present my ideas.	0.10557	0.45814	Non-significant
9	It was easy to use the brainstorming method in Mural.	1.06561	0.145436	Non-significant
10	It was easy to use the dot voting in Mural.	0.10628	0.457858	Non-significant
11	It was easy to use the brainwriting method in Mural.	0.44796	0.327897	Non-significant
12	The operation of Mural was intuitive.	0.65439	0.257679	Non-significant
13	I didn't have any technical issues.	0.89682	0.186699	Non-significant
14	The combination of the work with Mural and Black-board wasn't a problem for me.	1.25357	0.107431	Non-significant

Source: own elaboration.

is a result of technology use, which can lead to different perspectives and bisociative thinking (Rawlinson, 1981) and therefore, to innovation.

Results related to gender were not evaluated, as the questionnaire did not ask for such personal information. Further studies could explore whether relevant differences exist between genders when using the software, as well as other tools to complete the remaining Design Thinking steps online. For example, to do as in offline workshops, where prototypes are developed.

Thinking out of different perspectives is key to innovation, hence, facilitators (either educators or organizational coaches) should be ready to help stimulate a diversity of re-

sponses when necessary. It is important to remember that skills are transferable, from the classroom to companies and the other way around.

Among the limitations of the study is the fact that the survey was conducted within a private university, where students are likely to have more access to developing their technical skills than in other contexts in the country. However, the differences found between undergraduate and postgraduate groups should still be salient. Other methodologies might also be used to get further insights, such as focus groups (already used in DT processes). Quantitative studies that use regressions to explore the predictability of creativity and innovation based on other variables are also encouraged.



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Her research on Design Thinking started with her thesis, which was directed by Dr. Manuela Gutiérrez-Leefmans. Nowadays, she works as an IT Business Analyst in Frankfurt, Germany, and is pursuing her master's degree in Data Science and Business Analytics.

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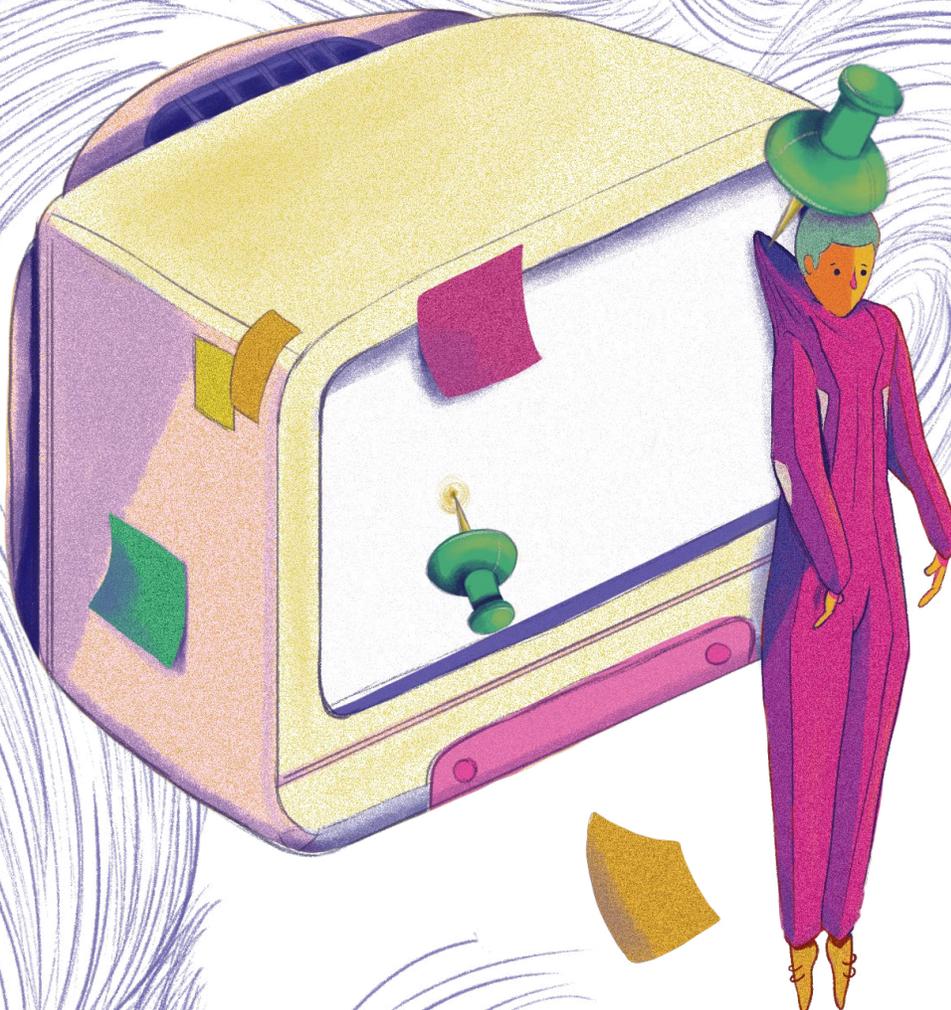


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