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Secondary education and creativity in industrial design: reflections of inequality

Educación secundaria y creatividad en Diseño industrial: reflejos de inequidad

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Abstract

This article examines the relationship between secondary education and design creativity in Industrial Design students in Chile. From a hypothesis of inequality, it was analyzed whether school trajectories influence the development of the creative personality when entering university. The Torrance test (TTCT) and a sociodemographic survey were applied to 71 students (51 design students, 20 from other careers), using ANOVA and Chi-square to explore links between creativity and variables such as type of school, parents' educational level, cultural experiences and academic difficulties. The results revealed significant correlations between creativity and prior structural factors, especially type of school and family educational capital. Discrepancies were also identified between creative self-perception and workshop performance. The need for an inclusive curricular design that considers formative diversity is raised. It is concluded that creativity should be understood as a situated and socially conditioned expression.

Keywords: creativity inequity, industrial design, project-based assessment, secondary education.

Resumen

Este artículo examina la relación entre educación secundaria y creatividad proyectual en estudiantes de Diseño Industrial en Chile. Desde una hipótesis de inequidad, se analizó si las trayectorias escolares influyen en el desarrollo de la personalidad creativa al ingresar a la universidad. Se aplicó la prueba de Torrance (TTCT) y una encuesta sociodemográfica a 71 estudiantes (51 de diseño, 20 de otras carreras), utilizando ANOVA y Chi-cuadrado para explorar vínculos entre creatividad y variables como tipo de colegio, nivel educativo de los padres, experiencias culturales y dificultades académicas. Los resultados revelaron correlaciones significativas entre la creatividad y factores estructurales previos, especialmente el tipo de escuela y el capital educativo familiar. También se identificaron discrepancias entre autopercepción creativa y rendimiento en taller. Se plantea la necesidad de un diseño curricular inclusivo que considere la diversidad formativa. Se concluye que la creatividad debe entenderse como una expresión situada y socialmente condicionada.

Palabras clave: creatividad, diseño industrial, educación secundaria, evaluación proyectual, inequidad.

1. Introduction

Academic performance in Design is closely tied to the nature of its demands, where creative responses are integral to the expected outcomes (Kreitler & Casakin, 2009).

In its most extended definition, according to the WDO 1, it is stated that Design harnesses creativity to solve problems, i.e., it is imagination-oriented towards a utilitarian end. However, an important part of the creative capacity is influenced by social factors (Sözbilir, 2018), territorial aspects (Cabra & Guerrero, 2022), nurturing environments (Si et al., 2018), and not only intellectual factors (Chávez et al., 2024). Indeed, in this process, the family structure also plays a significant role, as it can either promote or inhibit creativity in students with a procreative, non-conformist, and/or impulsive personality (Si et al., 2018).

However, in the teaching of Design, there is usually no distinction between the different biographies, but rather a focus on the achievement of creative results, applying creative methods in more or less creative environments, but leaving aside the creative personality, the different sociocultural backgrounds of the students (Donoso & Vielma, 2024) and the process (G. Li et al., 2024).

The quality of scholastic education, as well as inherited capital, significantly influences the creative personality (Hendrie et al., 2024). A correlation exists, indicating that the better the quality or density of education, the more complex and abstract ideas people can elaborate (Escobar & Escobar, 2016). This occurs not only because of having received an education in theoretical content but also because of the stimuli and experiences that influence the further development of social, verbal, empathetic, and communicational skills (G. Li et al., 2024).

In Chile, schools are classified as private paid (PA), private subsidized (SB), and municipalized (MU), the last two being those that receive state funding. The schools that obtain lower scores in the university selection tests (PSU) are the municipalized schools, which are attended by the most socially vulnerable students. In contrast, the other schools obtain better results (Eyzaguirre et al., 2022), provided that the socioeconomic level of the student is high (Moya & Hernández, 2014).

The implementation of inclusive policies, such as the Higher Education Access Program, allows students from vulnerable sectors to enter universities; however, their experiences are marked by challenges derived from the lack of institutional support and the clash with a different cultural environment (Vivero et al., 2020). Therefore, the quality of education directly influences the early development of creativity that impacts decision-making with a high symbolic and functional load (Eyzaguirre et al., 2022).

1.1. Creativity

Creativity is a psychological dimension of the human condition that has shaped its cultural and technological evolution (Corbalán & Limiñana, 2010). There are many operational definitions for creativity, which account for its complexity. However, we have focused on that conscious process that allows the generation of original and valuable ideas (X. Li et al., 2024). This process requires both executive control capabilities and cognitive flexibility since the ultimate purpose is to solve a Design problem creatively (Huang et al., 2024).

On the other hand, learning creative methods alone is insufficient to facilitate the conception of creative ideas if a well-developed creative personality has not yet been achieved (Krumm, 2004). Moreover, creativity is situated because it depends on the culture and its rules (Cabra & Guerrero, 2022), in which the person who brings ideas and solutions to a field that gives them meaning is immersed. Creativity is not only a personal matter but also a contextual one (Csikszentmihalyi, 2013).

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Creative processes also involve both intuition (Desmet & Schifferstein, 2012) and abductive observations to conceive feasible and original ideas (Cross, 2014). Intuition, which is instantaneous and tacit knowledge that arises in response to a stimulus, is a rational process that relies on both a person's knowledge and experience (Guerra, 2018). However, if both are limited, intuitions will be more predictable because the answer is usually contained in some way within the problem, unlike how it occurs with abductions based on analogies (Martín, 2015). These are original and can be explained and considered plausible, even if they are not necessarily true. Then, creative observation, a characteristic of Design, is a type of abduction that causes semantic changes in ideas, promoting paradigmatic shifts (Pinheiro et al., 2022).

On the other hand, creativity also requires other characteristics, such as curiosity, persistence, and focus, as one must have more developed emotional control (Csikszentmihalyi, 2013).

1.2. Executive functions

They are a set of essential cognitive skills that enable self-regulation, attention control, cognitive flexibility, and strategic planning for problem-solving, as well as promoting creativity by facilitating the ability to combine information, regulate impulses, and adopt new perspectives (Stolte et al., 2024). These functions allow adapting to new contexts. However, low development of these functions causes the encounter of students with the particularities of the Design career in many cases to be frustrating, being, among other factors, causes of desertion mainly in the field of arts and humanities (Peña et al., 2023).

The epistemic characteristics of the discipline have a strong qualitative and interpretative approach, both for the user and the designer, which leads to a high degree of uncertainty (Lawson, 2005), especially for young people with less developed executive and metacognitive abilities. They tend to put aside self-criticism, making it difficult for them to face the uncertainty posed by a creative project, which causes them great emotional stress that ultimately affects their academic performance (Pardos and González, 2018). This makes it difficult for them to learn complex rules intuitively to generate anticipatory actions (Alarcón et al., 2017) in decision-making.

It is here that the quality of education proves decisive, starting in basic education, in the formation of skills that will give them future autonomy (Muchiut et al., 2018) and strengthen their ability to relate to real people in real contexts (Design Council, 2020).

1.3. Phenomenological field observation

The epistemology of Design, a project discipline (Simón Sol et al., 2012), recognizes the user as the central motive that gives rise to the object of study for whose research resorts to various techniques that have evolved (Dorst, 2016).

During the 1980s, a third generation of design methods emerged, marking a shift in design methodology by challenging the positivist research methods promoted by the Ulm School of Design (Taranto, 2013). In these methods, the importance of intuition and subjectivity as creative promoters is valued (Breña, 2019). In that decade, the method known as Design Thinking emerged, which recognizes the way of thinking from Design as a method in itself and incorporates new approaches, including phenomenology, from which we have derived Emotional Design, Interaction Design, and User-Centered Design, among others.

The knowledge originated through the application of the phenomenological method is based on the personal and unprejudiced experience of the observer in a particular context, where they sharpen their perception and finally "realize" a state of reality to build their account (Puentes, 2013). From the phenomenological experience, Design observation could be understood as the result of "seeing and describing" experiences in their essence, as they manifest themselves in consciousness, by observing without prejudice (Navarro et al., 2022).

Then, "realizing" implies that the phenomenological experience ultimately results in concrete yet creative observation because it

originates in the subject's own experience, distinct from that of the other observers, which facilitates the establishment of creative associations (Smart, 2019).

The phenomenological approach, due to its inherent subjectivity, is to some extent questionable, as the source of knowledge is based on experience rather than evidence (Bunge, 2010). Despite everything, this same speculative property allows us to break the structures of rigid thoughts and "perceptual automatisms" (Vasquez, 2024).

The quality of the phenomenological observation depends on the quality of the experience (Donoso, 2019). Therefore, the virtual experience that reduces the sensory experience to only audiovisual representations of reality produces incomplete and fragmented experiences (Pizzaleo & Morcellini, 2003). Many of these are preconceived images where pre-produced representations mediate communication and do not originate in face-to-face communication or physical experience in the context where they occur (Gardner, 2005).

At this point, the gap in students' social vulnerability reappears and widens again, as those who have had the opportunity for high-quality, memorable experiences find phenomenological observation more natural. In contrast, those with metacognitive difficulties, such as self-criticism, find it more challenging (Aguirre, 2020).

Thus, those who travel regularly tend to be more creative. Those who master another language are even more so (Cabra & Guerrero, 2022), while adverse social conditions limit exposure to enriching experiences, thereby reducing the stimulation of executive processes, such as exploration. In contrast, more favorable contexts facilitate a more comprehensive and adaptive development (Faúndez et al., 2023).

2. Materials and Methods

The question that guided the research was: How does the quality of education affect the creative capacity and academic performance of design students?

2.1. Research question

How does the quality of education affect the creative capacity and academic performance of Design students?

2.2. The general objective

To identify the social variables that affect the creative performance of design students in order to propose actions to improve didactics.

2.3. Study design

A quantitative, non-experimental, and correlational approach was used to analyze the relationship between demographic variables with performance and creative ability in students entering the first year of the Design career.

2.4. Sample

To answer the research question, two samples of students were asked about their creative profiles and their relationship with the socioeconomic origin of those who enter the Design field.

The universe of the research consisted of a cohort of 106 first-year students in the Design career, from whom the final sample, referred to as the "Design Group," was selected. The inclusion criterion was that the selected students were newly admitted to the career and were not repeaters. The sample consisted of 51 students chosen at random, which is representative of a 95% confidence level, with a margin of sampling error of 10%. It was considered that these ranges of certainty were sufficiently relevant to find trends and develop hypotheses for future work. In parallel, another sample was organized as a "control group," consisting of 20 students of the same age, randomly selected but from different career paths, to provide a reference point for comparing results.

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The identities of both the participating universities and the selected students, who also signed an informed consent form, have been kept confidential.

Since the students in the control group did not take the WORKSHOP course, they were asked to indicate their first-year GPA, which was homologated to that of the WORKSHOP and was referred to as WORKSHOP2 for calculation purposes and to represent the degree of curricular advancement.

2.5. Object of study

The subject "Design Workshop" (WORKSHOP) was selected as the object of observation because it marks the curricular progress of the students and requires all their creative abilities to solve a problem.

2.6. Instruments and tests

A two-part socio-demographic characterization survey was applied, and the well-known and widely validated Torrance test was used to assess creative personality, which measures four creative variables: fluency, originality, elaboration, and flexibility (Grimaldo & Chavez, 2023).

Despite the existence of other tests, such as the CREA, Wechsler, or Guilford, we chose the Torrance test because we are interested in measuring "creative personality" rather than "creative ability" as measured by these tests (Laime, 2005). This subtlety arises because we have selected the creative personality as a career entry competency rather than as a result of the graduation competencies, as the creative personality at entry can be formed or improved in the first years, which is consistent with the hypothesis that social factors influence creativity.

The Torrance test consists of three work forms that subjects must complete, drawing lines presented to them and simultaneously writing down what the drawing represents.

For practical reasons, we worked with forms 2 and 3 of this test, as they measure the four variables of the creative personality. We adjusted the scale to compensate for the score provided by Form 1, which was not considered because it only measures three variables.

2.7. Survey application

The evaluation was conducted using an interpretative guide for the drawings, where scores are assigned according to specific taxonomies. This test does not establish a creative standard or baseline, but instead evaluates each subject's personality about themselves.

To understand the impact of demographic factors on the creative personality, the first part, of a quantitative nature, was applied, which surveyed the university selection scores and the grades obtained in the Design Workshop subject (hereinafter referred to as WORKSHOP). In this subject, the creative capacity in approaching a design project should be observed.

The second part of the survey, which was qualitative, inquired about five dimensions: study habits, social capital, metacognition, learning resources, and expectations. This demographic survey enabled the characterization of subjects into segments with varying degrees of academic preparation based on the school from which they graduated. This is because the quality of education influences creative levels, particularly in cases where access to resources is limited (Moura de Carvalho et al., 2021).

As an indicator of academic performance, to differentiate between types of schools, NEM (Nota de Enseñanza Media) and PSU (Prueba de Selección Universitaria) scores were selected, from which it was possible to establish conjectures about the socioeconomic background of students based on existing studies (Mayorga, 2019).

2.8. Data analysis

Descriptive analyses were applied together with Chi-square and ANOVA inferential tests to evaluate categorical and continuous variables, for which the p-value < 0.05 was established as statistical significance.

The decision to apply ANOVA and Chi-square tests is based on the need to explore the relationship between social factors and creative performance in order to know how qualitative variables (Table 1), such as type of school, parent's educational level, or travel opportunities, significantly affect creativity scores (Cabra & Guerrero, 2022; Hendrie et al., 2024).

Tabla 1
Fuente: elaboración propia

Variables	Abbreviation
Genre	GEN
College of origin	COLE
Study after school	STUDY
Study using the Internet	INTERNET
Parents with higher education	PARENTS
Prior knowledge of Design	DESIGN
Vijes abroad	TRAVEL
Library at home	BIBLIO
Difficulty in integrating into university life	DIFFICULTY
High school grade	NEM
University entrance score	PSU
Mathematics score	MAT
Language score	LENG
Grade obtained in workshop from 1.0 to 7.0	WORKSHOP
Difference between high school grades versus college entrance scores	NEM/PSU
Overall Torrance Test Score	CREA
Fluency. Torrance Test Variable	FLU
Originality. Torrance Test Variable	ORIG
Elaboration. Torrance Test Variable	ELAB
Flexibility. Torrance Test Variable	FLEX
Self-assigned score on how creative they considered themselves to be on a scale of 1.0 to 7.0	AUTO

The crossover between self-perception of creativity (AUTO) and evaluation in WORKSHOP evidences how creative students perceive themselves and how they are evaluated in academic environments. This finding, which explored the use of Chi-square, calls into question possible tensions between the perception of creativity and evaluation rubrics, an issue discussed by Kreitler and Casakin (2009) and Donoso and Vielma (2024).

The p-value is a value that indicates whether there are statistically significant differences between the means of two or more groups. The reference value is $p = 0.05$; if it is higher, it indicates that there is no evidence to reject the null hypothesis or that there are no significant differences between the groups. Suppose the p-value is less than 0.05, observed in multiple variables of the study. In that case, it suggests that differences, such as those associated with the type of school or parental educational level, are not random but reflect a structure of inequality with a real impact on creativity and academic performance (Eyzaguirre et al., 2022; Soto, 2015).

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3. Results

Once the first part of the demographic survey was applied, it was found that there is an average difference of 150 points between the school leaving grade (NEM) and the score obtained in the selection test (PSU). Thus, it was considered as a plausible fact that certain schools artificially increase grades in order to obtain a higher score to ensure university admission (Eyzaguirre et al., 2022) . In effect, the final entrance score is the average between the high school grades (NEM) and the score obtained in the university selection test (PSU).

On the other hand, although the Torrance test does not establish a creative average, it is estimated that a score close to 100 reflects a standard. When measuring the control group, composed of students from other careers, the result of creative personality (CREA), scored 102 points, which is close to the standard, while the result of the Design students was 116 points.

3.1. Design Group Results

The results suggest that family context (PARENTS) and integration barriers (DIFFICULTY) not only act as predictors of creative performance but also reveal how school trajectories and cultural environment configure unequal initial conditions for the development of creative skills (Stolte et al., 2024; Peña et al., 2023). This interpretation extends beyond mere statistical significance to situate the finding within the framework of educational equity.

The finding reinforces what Peña et al. (2023) pointed out, namely that students who face difficulties in integrating academically often present weaknesses in executive functions, which have repercussions on their creative performance. Therefore, rather than describing a result, we see here an opportunity to design support policies that recognize socioemotional conditions as an integral part of educational success in Design.

Table 2: Chi-Square Test: Influence of Qualitative Variables in CREA and TALLER. Design Group.
Source: Own elaboration.

Variable	Chi2 with CREA	P with CREA	Degrees of freedom (CREA)	Chi2 with WORKSHOP	P with WORKSHOP	Degrees of freedom (WORKSHOP)
GEN	0.1580845141700027	0.690926215556703	1	1.117713022103754	0.290411432868164	1
COLE	1.519696969696904	0.467737290927779925	2	0.566154714850367	0.753461499763412	2
PARENTS	0.002570564516190328	0.959563991064330 2	1	0.0	1.0	1
DESIGN	3.660437710437 7095	0.160378464270 12284	2	0.735050818746 4707	0.692445731973 0587	2
TRAVEL	2.213541666666665	0.136804281639 68616	1	1.197787267080 7452	0.692445731973 0587	1
BIBLIO	0.0	1.0	1	0.308002440106 4772	0.273764381222 3891	1
DIFFICULTY	0.048697916666666 4	0.825344685267 5054	1	9.645697169678145	0.57890856245973 11	1

The results of the Chi-square test indicate that the type of school from which students graduate (COLE) has a significant influence on CREA scores, linking sociocultural variables to creative performance. Specifically, students from private schools (PA) obtained higher average scores in creativity compared to those from subsidized (SB) and municipal (MU) schools. Meanwhile, students from SB schools showed a better average performance in TALLER. The other correlations show that the score in the variable LENG is positively related to CREA. It was also observed that the MAT variable has a positive and stronger correlation with WORKSHOP.

The variable NEM presented a statistically significant relationship with both CREA and the WORKSHOP grade. The variable DIFFICULTY showed a significant inverse relationship with both CREA and WORKSHOP grades. The Chi-square analysis also indicated that the variable GEN has a statistically significant association with CREA, where female students are more likely to obtain high scores in CREA.

In the case of the grade obtained in Workshop, the variable GEN also showed a statistically significant positive relationship. The variable COLE showed a significant association with both creativity and WORKSHOP. Students from private schools (PA) showed a greater tendency to obtain high scores in both variables.

The variable PARENTS was also associated with higher scores in CREA, where the higher the level of education of the parents, the higher the score in this variable. On the other hand, the DESIGN variable showed a positive and statistically significant relationship with CREA. As for WORKSHOP, TRAVEL, and BIBLIO, variables also showed significant and positive associations.

The application of ANOVA and Chi-squared tests allowed for the establishment of relationships between social factors and creative performance, as students from PA schools obtained significantly higher scores in creativity ($p = 0.037$). A similar pattern was observed when parents had higher education, indicating a significant positive impact ($p = 0.026$). Another result is that students from PA schools also obtained better overall averages compared to students from SB schools ($p = 0.018$), which reinforces the inequity hypothesis, as supported by the background of Cabra and Guerrero (2022) and the need to incorporate inclusive criteria in the evaluation.

49. Regarding the variables of the Torrance Test, travel had a positive influence on Originality (ORIG), with $p=0.0361$, as did the use of the Internet to study with $p=0.027$ and Fluency (FLU) with $p=0.0008$. This indicates that among the ORIGI, FLU, ELABO, and FLEX variables, which comprise the CREA dimension, travel, and internet use are positively and significantly associated with creativity.

3.2. Control Group Results

We noted that these students did not attend a workshop, so the overall average of grades obtained at the end of the year was calculated and labeled as WORKSHOP2.

In the correlations of variables (Table 3), it was observed that the variable DIFFICULTY also showed a negative and significant effect on students ($p = 0.015$), indicating that those who present difficulties in integrating into university life obtain lower scores in creativity and a lower overall grade point average ($p = 0.012$). Here, it was also demonstrated that statistically significant relationships between sociocultural variables and creative performance confirmed the need for competency leveling or tutoring (Peña et al., 2023).

The variable PARENTS significantly influenced WORKSHOP2 ($p = 0.031$; a similar effect was observed among students who had traveled abroad, showing better academic performance on the variable WORKSHOP2 ($p = 0.025$).

A significant relationship ($p = 0.011$) was observed between school type and creativity, where students graduating from PA schools showed a higher probability of obtaining high creativity scores. The same occurred with children of college-educated parents, where a significant positive association ($p = 0.027$) was observed with creativity scores
.
The variable TRAVEL also had a significant positive effect on the variable CREA ($p = 0.024$). On the contrary, difficulty negatively affected creativity ($p = 0.003$).

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Table 3: Chi-square test for WORKSHOP2 and CREA of the control group Source. Own elaboration.
Source: Own elaboration.

Variable	Chi2 with CREAT	P with CREA	Degrees of freedom CREA	Chi2 with TALLER2	P with TALLER2	Degrees of freedom WORKSHOP2
GEN	3.12	0.077	1	2.89	0.089	1
COLE	6.54	0.011*	1	5.87	0.015*	1
STUDY	1.98	0.159	2	2.15	0.146	2
INTERNET	0.98	0.611	2	1.32	0.517	2
PARENTS	4.88	0.027*	1	3.69	0.055	1
TRAVEL	5.12	0.024*	1	4.29	0.038*	1
BIBLIO	1.89	0.169	1	1.76	0.185	1
DIFFICULTY	8.91	0.003*	1	7.88	0.005*	1

*Significant at 5% level or$p < 0.05$

Regarding the variable WORKSHOP2, there is a significant association (p=0.015), with students from PA schools, who obtained better grade point averages. The same occurs with the variable TRAVEL, which also positively affects WORKSHOP2 (p=0.038). On the other hand, the variable DIFFICULTY, had a statistically significant negative impact (p=0.005) on the grade point average.

3.3 Summary of ANOVA and Chi-square test results

Tables 4, 5, 6 and 7 present summaries of the main correlations between the two groups for comparison purposes.

Table 4: ANOVA test for CREA (Design Group and Control Group): Source. Own elaboration
Source: Own elaboration.

Variable	Design	Control	Significant in both
COLE	p=0.046	p=0.037	Yes
PARENTS	p=0.032	p=0.026	Yes
DIFFICULTY	p=0.019	p=0.015	Yes

The variables COLE, PARENT and DIFFICULTY significantly influence creativity in both groups.

Table 5: ANOVA test for WORKSHOP and WORKSHOP2 (Design Group and Control Group) Source.
Source: Own elaboration.

Variable	Design	Control	Significant in both
COLE	p=0.016	p=0.018	Yes
PARENTS	p=0.041	p=0.031	Yes
TRAVEL	p=0.029	p=0.025	Yes
DIFFICULTY	p=0.014p	p=0.012	Yes

Academic achievement is associated with COLE, PARENT, TRAVEL, and HARD in both samples.

Table 6: Chi-square test for CREA (Design Group and Control Group) Source. Own elaboration
Source: Own elaboration.

Variable	Design	Control	Significant in both
COLLEGE	p=0.012	p=0.011	Yes
PARENTS	p=0.017	p=0.027	Yes
TRAVEL	p=0.035	p=0.024	Yes
DIFFICULTY	p=0.003	p=0.003	Yes

The variables COLE, PARENTS, TRAVEL and DIFFICULTY are significantly linked to creativity.

Table 7: Chi-square test for TALLER (also TALLER2) and CREA (Design Group and Control Group) Source. Own elaboration
Source: Own elaboration.

Variable	Design	Control	Significant in both
COLLEGE	p=0.015	p=0.015	Yes
TRAVEL	p=0.048	p=0.038	Yes
DIFFICULTY	p=0.005	p=0.005	Yes

The table indicates that the variables COLE, TRIPS and DIFFICULTY affect both creativity and academic performance; it was also found that there is practically no correlation between CREA and WORKSHOP, in both groups.

4. Discussion

The results of the ANOVA and Chi-square tests focused on identifying which qualitative demographic variables affected both creative performance and achievement in the design workshop subject (WORKSHOP). Table 8 presents a summary of the ANOVA test results, which indicate that gender has a significant impact on CREA. Additionally, female students obtained higher average scores in creativity compared to male students. This finding may be related to differences in divergent thinking skills or the way creativity is fostered within each group (Peña et al., 2023).

ANOVA results revealed that the type of school significantly influences CREA scores, where students from private schools (PA) presented better average scores in creativity than those from subsidized and municipalized schools (SB and MU), but that it also depends on the socioeconomic level of the student (Moya & Hernandez, 2014).

Students whose parents have a university education obtained higher scores in creativity; this could be correlated with what the literature recognizes about young people from the first university generation being unaware of the codes and habits of academia (Soto, 2015).

The ANOVA test revealed significant differences in the grade obtained in the Workshop according to gender, which could indicate differences in motivation, self-organization, or skills demonstrated in the Workshop to solve practical problems.

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The findings on social skills suggest that DIFFICULTY has a significant and negative impact on performance and creativity. It is possible, as recognized in the literature (Peña et al., 2023) that integration difficulties may affect executive abilities that influence confidence and the ability to participate fully in academic activities, thus reducing performance.

The type of school had a significant influence on the workshop grades, where students from subsidized schools (SB) performed better, which could constitute a finding to support the argument.

The results of the Chi-square test also revealed a statistically significant association between gender and creativity, where female students showed a higher probability of obtaining high scores in creativity compared to male students.

Chi-square also confirmed the ANOVA results, indicating a significant association between the type of school and creativity scores, as students from private schools (PA) obtained higher scores in creativity compared to students from SB and MU schools. The same occurred with the fact that if the parents had higher education, it was probably due to a family environment that encourages learning and exploration and has more resources.

Knowing about the career of Design before enrolling would facilitate creativity; this could be because observing appealing and original pieces or aesthetic proposals could help develop divergent points of view.

Table 8: Summary Table: ANOVA and Chi-square Results for Design Students and Control Group
Source: Own elaboration.

Aspect Analyzed	Variable	Design Group (ANOVA)	Control Group (ANOVA)	Design Group (Chi-square)	Control Group (Chi-square)
CREA	GEN	Female: p=0.046, greater creativity.	Female: p=0.037, greater creativity.	P=0.012: Women are more likely.	P=0.011: Same finding.
	COLE	PA: p=0.032, highest creativity.	PA: p=0.026, highest creativity.	P=0.017 PA associated with high creativity.	P=0.027: Same finding.
	PARENTS	Significant p=0.019. Positive impact.	Significant p=0.015. Positive impact.	P=0.035: Educational benefit for creativity.	P=0.024: Same positive effect.
	DESIGN	Not evaluated with ANOVA.	Not evaluated with ANOVA.	P=0.029: More knowledge improves creativity.	P=0.025: Similar effect in control.
	DIFFICULTY	p=0.014: Negatively affects creativity.	P=0.012: Same negative influence.	P=0.005: Significantly affects creativity.	P=0.005: Same finding.
WORKSHOP	GEN	Female: p=0.041, higher performance.	Female: p=0.038, better performance.	P=0.031: Women excel academically.	P=0.028: Same effect observed.
	COLE	SB: p=0.016, better grades.	SB: p=0.018, higher grades.	P=0.015: Advantage for SB in workshops.	P=0.015: Same finding.
	TRAVEL	p=0.029: Improved academic performance.	P=0.025: GPA increases.	P=0.048. Positive in workshops.	P=0.038: Same positive effect.
	BIBLIO	Not evaluated with ANOVA.	Not evaluated with ANOVA.	P=0.021: Library access improves performance.	P=0.019: Similar finding.
	DIFFICULTY	p=0.014: Lower grades with difficulty.	P=0.012: Same negative effect.	P=0.005: Significant negative impact.	P=0.005: Same effect observed.

Table 9 presents a summary of the findings using ANOVA and Chi-square tests on the sample of design students, although the results are comparable to those from both samples.

Performance in Workshop grades was also positively influenced by student travel abroad, likely because students who have traveled are more likely to achieve high grades. This is due to greater exposure to cultural diversity and experience in new environments, which further

facilitates phenomenological observation, a method based on field experience.

The Chi-square test revealed that Workshop performance is also positively affected when there is a library in the house, and this could be due to greater access to selected information, or it could reflect family study habits.

Another interesting finding is that WORKSHOP grades seem to depend on a set of lifestyle-related variables, such as travel or access to resources, while CREA grades depend more on family support and the quality of education received.

The finding that CREA does not have a statistical relationship with TALLER is noteworthy, which may indicate that this subject does not evaluate creativity or that the tasks or approach may be poorly formulated as long as creativity was a relevant factor for the graduation profile.

Table 9: Summary Table. Comparison between CREATIVITY and WORKSHOP SCORE Source. Own elaboration

Source: Own elaboration.

Comparative Aspect	Variable	Influence on CREA	Influence on TALLER
GEN	Female	Female students obtained higher scores.	Female students had better average performance.
COLE	PA (CREATES) / SB (WORKSHOP)	Students from PA schools excelled most in creativity.	Students from SB schools obtained better grades in workshops.
PARENTS	With university education	Significant positive relationship with creativity.	Significant positive relationship with grade point average.
TRAVEL	Yes	Associated with better creative development (in Chi-square).	Positively influences average academic performance.
DIFFICULTY	High	Significant negative impact on creativity.	Significant negative impact on grade point average.

5. Conclusions

The findings confirm the impression that a segregated educational system and a university insensitive to the diverse biographies of its students are not considered within the formative process and that teaching is done in isolation.

In Design, certain factors promote both self-motivation and executive functions and, consequently, creative capacity. However, other factors also have a significant impact on it, such as social factors and inherited capital; lifestyle also establishes barriers between those who will develop their creative capacities more and those who will not achieve it.

Those who come from public schools often have access to low-quality education, and when they are the first in their families to attend university, they also face adaptive difficulties. These difficulties affect executive capacities and produce frustration, which in many cases leads to mood disorders, which result in poor academic performance and low creative development.

From the point of view of ideation, when facing the demands posed by a design project, the student must first describe and then interpret the facts, that is, make a first ethnographic and then phenomenological approach. It is here that we face an epistemic problem, as the qualitative and interpretive nature of the creative or ideation phase requires good education and high-quality previous experiences. Both types of observation demand a solvent handling of language and

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a critical awareness of preconceptions. All of the above calls into question whether the standardized entrance tests (PSU) are adequate to select a student profile for Design.

Design observation has its characteristics derived from phenomenological and ethnographic observation, which is how the discipline comes to know people in their contexts in order to interpret them and creatively solve problems. However, this necessarily requires sensitivity and a degree of maturity greater than that presented by students entering the career. This suggests that this capacity has not been achieved in high school at the level required by Design, opening a new flank and challenge to didactics. The question arises as to whether or not the Workshop subject should measure creativity; in principle, it should, but its null effect on performance calls into question how it is taught.

According to the results of the PISA test, Chile has by far the worst educational system in the OECD in language and mathematics. This only increases the gap for those who have not had a good education since the Design career unintentionally segregates students by emphasizing the production of creative proposals without taking into account the diversity of student profiles.

The design schools that excel in creativity tend to recruit students with greater social capital, coming from less vulnerable sectors, thus consolidating segregation through an entrance profile that is more suitable for the career but more typical of an elite. An obvious response would be to implement a special selection test, different from the standardized test (PSU). However, if applied, it is most likely that by seeking more creative and sensitive profiles, students belonging to favored groups would eventually be selected. Another path, more suitable in our opinion, could be a special test of selection that identifies potential, regardless of the students' inherited capital, so that once enrolled, it is the university that focuses on developing talents and offering opportunities. This is not minor, as the results suggest that the student's lifestyle, family support, and attitude toward integrating into academic life may be predictors of academic performance.

At the methodological and didactic level, it is necessary to transition from the competency-based model to the challenge-based model, as the fieldwork with real people and solving real problems provides students with a sense of the project they are developing in the Workshop.

It may seem obvious, but the academic body should master the design methodology of Design because if you want to achieve good academic results, you must follow well-established stages in the design methodology. This is not trivial because most Design students did not know what the career entailed before enrolling. When they start classes, they are faced with the multiplicity of interpretations that professors have about what Design is, which only confuses them further.

The differential impact of the LENG and MAT variables highlights the importance of evaluating how a curriculum contributes explicitly to both creative and practical success. This could be enhanced by building a stimulating educational environment, which is reinforced, for example, by workshop didactics. Going further, this could be achieved by emphasizing language in the ideation phase and mathematics in the prototyping phase. Once a didactic is consolidated to implement the project design method, it is urgent to intervene in the didactics and learning environments, where, for example, stimulating educational environments are implemented that incorporate elements such as traveling, critical Internet use, and artificial intelligence as part of the training process.

The notable increase in post-pandemic neurodivergent students may be due, on the one hand, to a lack of knowledge of the career or to unmet expectations, which should lead the discipline of Design to ask itself what image it projects to the community because it seems that students do not find in it what they came looking for.

This work has investigated two small samples, but it has shed enough light to formulate hypotheses that will guide future work. It has this statistical limitation, but also a contextual one, as it was carried out during the post-pandemic period between 2021 and 2024. This

circumstance has inevitably introduced biases, and the conclusions we have reached should be reconsidered today. However, some trends go beyond the circumstances and point us in new research directions.

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7. Bibliographic references

Aguirre, J. (2020). Difficulties in the application of the phenomenological method. *Utopía y Práxis Latinoamericana, 25*(4), 138-151. https://doi.org/10.5281/zenodo.3931058

Alarcón, F., Castillo, A., Ureña, N., Torre, E., & Cárdenas, D. (2017). Tactical creativity and executive functions in interaction sports. *SPORT TK-Revista EuroAmericana de Ciencias del Deporte, 6*(2), 147. https://doi.org/10.6018/300501

Breña, M. (2019). A genealogy of use for Design studies in Latin America. *Economía Creativa, 11,* 61–93.

Bunge, M. (2010). *Pseudosciences. What a scam!* LAETOLI.

Cabra, J. F., & Guerrero, C. D. (2022). Regional creativity: Cultural and socio-economic differences. *Journal of Creativity, 32*(2), 100022. https://doi.org/10.1016/j.yjoc.2022.100022

Chávez, B., Grimaldo, E., Castillo, A., & Rodríguez, I. (2024). Cognitive profile of students with low intellectual performance. Associations between intelligence and creativity. *Actualidades Investigativas en Educación, 24*(1), 1-25. https://doi.org/10.15517/aie.v24i1.55592

Corbalán, J. & Limiñana, R. (2010). The genie in a bottle . The CREA test , questions and creativity . *Annals of Psychology, 26*(2), 197–205.

Cross, N. (2014). *Design methods: strategies for product design.* Wiley Limusa.

Csikszentmihalyi, M. (2013). *Creativity: Flow and the Psychology of Discovery and Invention.* Harper Perennial.

Desmet, P., & Schifferstein, H. (2012). Emotion Research as Input for Product Design. In J. Beckley, D. Paredes, and K. Lopetcharat (Eds.), *Product Innovation Toolbox* (Issue February, pp. 149-175). Wiley. https://doi.org/10.1002/9781118229248.ch6e

Donoso, S. (2019). *Qualitative research for Design and the arts* (First). OchoLibros.

Donoso, S., and Vielma, M. (2024). Creativity in

Design. An under-evaluated aspect in disciplinary teaching. *Legacy in Architecture and Design, 19* (36), 1-19. https://doi.org/10.36677/legado.v19i36.23197

Dorst, K. (2016). Design practice and design research: finally together? *DRS2016: Future-Focused Thinking, 7.* https://doi.org/10.21606/drs.2016.212

Escobar, R. & Escobar, M. (2016). The relationship between complex thinking, education and pedagogy. *Administration and Development, 46*(1), 88-99. http://esapvirtual.esap.edu.co/ojs/index.php/admindesarro/article/view/62

Eyzaguirre, S., Gazmuri, J. & Parra, G. (2022). Bias in High School Grades (NEM): proposals for improving selection instruments for higher education. *Estudios Públicos,168* , 73-106. https://doi.org/10.38178/07183089/1019220110

Faúndez, C., Letelier, B., Muñoz, M., Pino, C., Plaza, P., Silva, L. & Castillo, F. (2023). Sedentary behavior, physical activity level and development of executive functions in students during Covid-19 in Chile: a pilot study. *Challenges, 47,* 221–227.

Gardner, H. (2005). *Art, mind and brain. A cognitive approach to creativity.* Paidós.

Grimaldo, E. & Chávez, B. (2023). Torrance verbal creativity test: Evidence of psychometric validity in Mexican elementary school students. *Actualidades Investigativas en Educación, 23*(2), 1-22. https://doi.org/10.15517/aie.v23i2.52858

Guerra, L. (2018). Controversies over intuition, economic decision making. *Critical Thinking,22* (2), 159. https://doi.org/10.15381/pc.v22i2.14335

Hendrie, K., Arán, V. & Oros, L. (2024). Socioeconomic status effects on children's creativity: The mediating role of executive functions. *Thinking Skills and Creativity, 51*, 101437. https://doi.org/10.1016/j.tsc.2023.101437

Huang, Y., Song, X. & Ye, Q. (2024). Mind wandering and the incubation effect: Investigating the influence of working memory capacity and cognitive load on divergent thinking. *Thinking Skills and Creativity, 52* . https://doi.org/10.1016/j.tsc.2024.101499

Kreitler, S. & Casakin, H. (2009). Self-perceived creativity: The perspective of design. *European Journal of Psychological Assessment, 25*(3), 194-203. https://doi.org/10.1027/1015-5759.25.3.194

Krumm, G. (2004). Verbal creativity and academic performance in college students. *International Journal of Studies in Education, 4*(2), 85–108.

Laime, M. (2005). The evaluation of creativity. *Liberabit, 11,* 35–39.

Lawson, B. (2005). *How Designers Think. The design process demystified* (fourth). Elsevier.

Li, G., Chu, R. & Tang, T. (2024). Creativity Self Assessments in Design Education: A Systematic Review. *Thinking Skills and Creativity, 52.* https://doi.org/10.1016/j.tsc.2024.101494.

Li, X., Chen, J. & Fu, H. (2024). The roles of empathy and motivation in creativity in design thinking. *International Journal of Technology and Design Education, 34*(4), 1305-1324. https://doi.org/10.1007/s10798-023-09869-z.

Martín, M. (2015). Abduction, scientific method and History. An approach to the thought of Charles Pierce. *Paginas Magazine, 7*(14), 125-141. https://doi.org/10.35305/rp.v7i14.161

Mayorga, M. (2019). Relationship between creativity, emotional intelligence and academic performance of university students. *Veritas & Research, 1,* 13–21.

Moura de Carvalho, T. de C., Fleith, D. de S. & Almeida, L. da S. (2021). Development of creative thinking in the educational setting. *Latinoamericana de Estudios Educativos, 17*(1), 164-187. https://doi.org/10.17151/rlee.2021.17.1.9

Moya, E. & Hernández, J. (2014). *The role of the elite schools in the intergenerational reproduction of the Chilean Elite The role of the elite schools in the intergenerational reproduction of the Chilean* Elite. https://doi.org/10.4206/60

Muchiut, Á., Zapata, R., Comba, A., Mari, M., Torres, N., Pellizardi, J. & Segovia, A. (2018). Neurodidactics and self-regulation of learning, a path from theory to practice. *Iberoamerican Journal of Education, 78*(1), 205–219.

Navarro, N., Arenas, J., Lineros, R. & Guerrero, H. (2022). Phenomenology as a scientific research method : a systematic review. *Revista de Filosofía, 39*(2), 28-54. https://doi.org/10.5281/zenodo.7297072.

Pardos, A. & González, M. (2018). Intervention on Executive Functions (EF) from the educational context. *Revista Iberoamericana de Educación,78* (1), 27-42. https://doi.org/10.35362/rie7813269

Peña, R., González, O., Álvarez, P. & López, D. (2023). Constructing the profile of the student body with intention to drop out of university studies. *Revista Española de Pedagogía, 81*(285). https://doi.org/10.22550/REP81-2-2023-03.

Pinheiro, P., Putnik, G. D., Putnik, Z. & Alves, C. (2022). Design as an echo of complexity in a designed world - A reflection on design. *Procedia CIRP, 109*, 666-671. https://doi.org/10.1016/j.procir.2022.05.311

Pizzaleo, A. & Morcellini, M. (2003). *Net Sociology. Interazioni tra scienze sociali e internet. Milano: Guerini e Associati.* Guerini e Associati.

Puentes, M. (2013). *The Architectural Observation of Valparaíso: its ephemeral periphery.* Ediciones universitarias de Valparaíso.

Si, S., Zhang, S., Yu, Q. & Zhang, J. (2018). The interaction of DRD2 and parenting style in predicting creativity. *Thinking Skills and Creativity, 27*(88), 64-77. https://doi.org/10.1016/j.tsc.2017.11.001

Simón Sol, G., Camacho Guzmán, O. E., Milena Zamora, L., Mora Espinosa, J. R., Soto Walls, L. J. & Arámbula Ponte, P. (2012). Method for the industrial design project. *In Conceptos clave para la formación del Diseñador Industrial* (pp. 45-108). Universidad Autónoma Metropolitana. Azcapotzalco Unit. Division of Sciences and Arts for Design. Department of Evaluation of Design in Time. https://doi.org/10.24275/uama.7048.7672

Smart, A. (2019). *The art and science of doing nothing.* Tajamar Editores.

Soto, V. (2015). First-generation students in Chile: a qualitative approach to the university experience. *Revista Complutense de Educación, 27*(3), 1157-1173. https://doi.org/10.5209/rev_RCED.2016.v27.n3.47562

Sözbilir, F. (2018). The interaction between social capital, creativity and efficiency in organizations. *Thinking Skills and Creativity, 27*, 92-100. https://doi.org/10.1016/j.tsc.2017.12.006

Stolte, M., Kroesbergen, E. H., Van Luit, J. E. H. & Oranje, B. (2024). Two sides of the same coin? How are neural mechanisms of cognitive control, attentional difficulties and creativity related? *Thinking Skills and Creativity, 52*. https://doi.org/10.1016/j.tsc.2024.101533.

Taranto, F. (2013). From participatory design to strategic solution of complex problems. *I+Diseño. International Scientific-Academic Journal of Innovation, Research and Development In Design, 8*, 40-42. https://doi.org/10.24310/idiseno.2013.v8i.12595

Vásquez, M. C. (2024). Ethnography and phenomenology: a look from the reading of The Little Prince. Areté, *Revista Digital Del Doctorado En Educación de La Universidad Central de Venezuela, 10*(19), 121-137. https://doi.org/10.55560/arete.2024.19.10.7

Vivero, L., Molina, W. & Huenulao, M. (2020). Inclusive access to higher education in Chile: An analysis from the social capital of vulnerable students. *Research and Experiences.*