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Natalya Souza

Universidade Federal do Rio Grande do Norte

> " *The edge of **chaos** has been constantly viewed as a metaphor for the current state our world: a constant coexistence of order and disorder. [...] Several authors working within education and organizational environments have highlighted that creators must perform at the 'edge of **chaos**' in order to produce creative and adaptive solutions. [...] This paper aims to discuss the dichotomy between order and disorder in the creative environment (socio-physics aspects) of architecture students from the Universidade Federal do Rio Grande do Norte, Brazil. Particularly, this paper focuses on students who are working on their Final Graduation Work (FGW), because, unlike other tasks, this activity is completed away from the classroom, in a space 'in-between' – in-between work and home spaces, in-between the collective and the individual, in-between order and **chaos**.* "

> Perhaps the most exciting implication is the possibility that life had its origin in the vicinity of a phase transition, and that evolution reflects the process by which life has gained local control over a successively greater number of environmental parameters affecting its ability to maintain itself at a critical balance point between order and chaos (Langton, 1990, p. 13).

The dichotomy between order and chaos has fascinated researchers from many different areas of study for a long time, especially in disciplines that

require the analysis of complex behaviour (such as computer science, communications and creative process) and that are focused in the dynamic transitions between those states. This type of situation – that involves a region of bounded instability between highly-ordered and highly-disordered states – is known as 'the edge of chaos'.

The edge of chaos has been constantly viewed as a metaphor for the current state our world: a constant coexistence of order and disorder. To illustrate that, Christopher Langton (1990), who used the concept for computer experiments with cellular automata[1], associated 'the edge of chaos' to the transition between the solid and fluid states of matter. He observed that both molecules and cellular automata, when getting near this transition, presented the greatest potential for remaining in an aperiodic non-random behaviour. In computers, this supports storage, transmission, and modification of the information.

Based on that analogy, Steven Johnson (2010) explained that this behaviour is similar to the one that takes place in the creative process of generating new ideas. Aleatory connections can produce new configurations in a transitory 'liquid network', which is not as chaotic as gas and not as steady as solid. Thus, it is not unstable enough to immediately destroy the new creations, preserving useful ideas for an indeterminate time. In this process, there are forces pushing towards organization and others introducing unpredictability and random information.

Several authors working within education and organizational environments have highlighted that creators must perform at the 'edge of chaos' in order to produce creative and adaptive solutions (Schwartz, 2014;

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[1] Cellular automata (CA) are a system of many 'cell' objects that have varying states over time, obeying their own physics (Langton, 1990). In computer science, this cell represents a 'bit' (simplest digital element) and has a state (the value 0 or 1) living on a grid with neighbourhood (Shiffman, 2012). According to Stephen Wolfram (1984), CA systems produce outcomes into four classes: (i) uniformity – evolves to limit points at a homogeneous state; (ii) repetition – evolves to simple separated periodic structures in limited cycles; (iii) random – yields to chaotic and aperiodic patterns behaviour; and (iv) complexity – patterned but unpredictable over time, eventually settling into an oscillating state.

Day, 2017). Although this pattern goes against rigid and traditional systems of production, it allows for the existence of more freedom to explore, encouraging diversity and motivating risk-taking procedures (Philip ,2015).

The creative process in design, especially in the early conceptual phase, happens in an interaction between conscious and unconscious work. Regarding that, studies usually point to the need to develop a procedural model, which helps the creator or the design team to understand the nature of the problems (Roozenburg and Eekels, 1995; Alencar and Fleitch, 2009; Lawson, 2005).

Although there is still no consensus on the most effective method to study and encourage creativity, there have been several efforts to understand the issue. The model proposed by Graham Wallas in 1926 is still one of the most renowned. According to the author, creativity happens in four phases: preparation, incubation, illumination and verification. Each phase has its own particularities, but the first and fourth happen in a fully conscious period. The second, on the other hand, requires unconscious progression, a period away from the specific creative task, in order for illumination moments to happen.

Other researches have re-assessed this classification. Some of them have added phases – for instance, George Kneller (1965), who included the 'first insight' or formulation of the problem – and others have reduced the number of stages – like the "analysis, synthesis and evaluation" by Geoffrey Broadbent (1973). However, most researchers seem to agree that there is a step-by-step procedure, often with iterative loops following a progressive path, when it comes to any situation of idea generation or problem solving (Roozenburg and Eekels, 1995).

Bucciarelli (1994), on the other hand, criticized these 'formulas', arguing that they do not relate to the context of production and characteristics of the work carried out by designers. Building on the dichotomy of the process, other authors have proposed cyclic models divided

in two major phases (Figure 1): the scheme of Erik Lerdhal (2001), for instance, contrasts the situations of order (comfort) and chaos (discomfort); and Jorge Cruz Pinto's system (2007) highlights the duality between the analogic (emotional) and digital (rational) sides of the brain, that are present in generating design ideas – which the author divides in five phases (cognition, conception, expression, rationalization, and presentation).
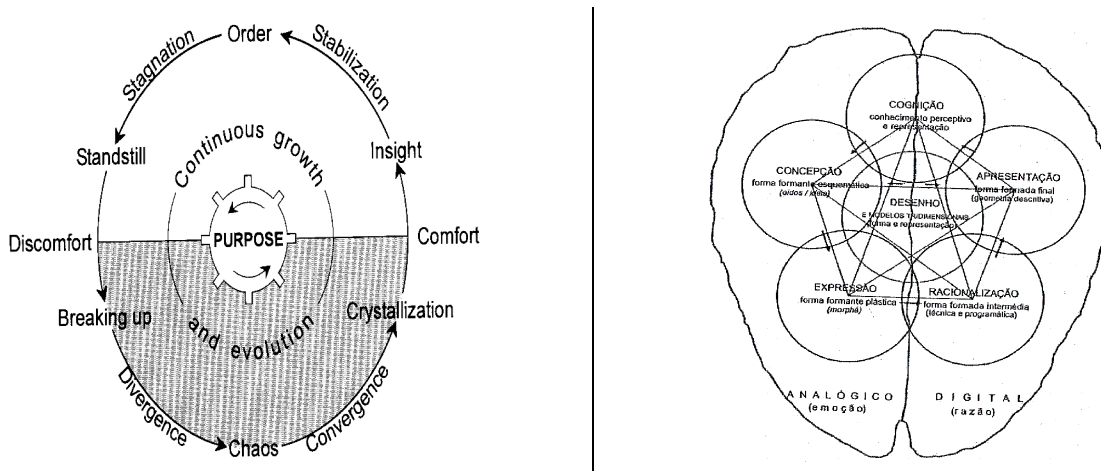

Figure 1: Lerdhal's (2001) (left) and Cruz Pinto's (2007) (right) models of cyclic creative processes in design.

Through the order-chaos scheme, Lerdhal (2001) considered that in a design process "the experience of chaos will not just be related to the solving of the design task and problem, but also [...] to the social process in the group" (p. 94), with the environment influencing the process in different ways. This approach coheres with the perspective offered by the complexity theory (Waldrop, 1992) and with Western definitions that explain creativity as an interaction between the person's thoughts, motivation, acquired knowledge, and the socio-spatial context (Lubart, 2007; Mitjáns Martínez, 1997; Rhodes, 1961, Sternberg, 1999).

Following these ideas, this paper aims to discuss the dichotomy between order and disorder in the creative environment (socio-physics aspects) of architecture students from the Universidade Federal do Rio Grande do Norte, Brazil. Particularly, this paper focuses on students who are

working on their Final Graduation Work (FGW), because, unlike other tasks, this activity is completed away from the classroom, in a space 'in-between' - in-between work and home spaces, in-between the collective and the individual, in-between order and chaos. This paper is based on the author's dissertation, which analyses the perceptions of these students and their advisors about the creative process in architectonic designs.

This paper will present the students' opinions about the activities and environments that they usually are in contact with and how these spaces influence their creativity. The research assumed an exploratory character. Specifically, it is a case study that adopted a mixed-methods approach, integrating instruments that captured the participants' point of view (questionnaire and interview) and observation (photographic registers). Before describing the methodology and outcomes of the case study, this paper will look at the theoretical background, explaining how other researches have explored the duality order-chaos in collective and individual work environments.

Environmental influences on the creative process

The distinction between macro and microenvironments and their respective effects in creativity has been highlighted in theoretical discussions about working environments. Mihaly Csikszentmihalyi (1996) and Klaus Urban (1995), for instance, offer a distinction between the environmental conditions according to the scope of their influences. In one hand, macroenvironmental factors encompass society's cultural and institutional contexts (rules, manners and traditions) and resources (theories, information and technology), which are utilised by a person for producing, achieving and communicating their ideas in a creative way. On the other hand, the microenvironment encompasses the characteristics of a person's immediate setting (at the familiar, educational and organizational level); the social network maintained for personal support (family, teams, friends,

advisors or co-workers); and the physical components of the working space, which can be manipulated in order to create a place where creativity can flourish. The last elements – those that form the creators' microenvironments – are the ones that will be analysed in this paper. Specifically, it will focus on both collective and individual microenvironmental conditions.

About collective microenvironments, Alves et al. (2007) and Bratuškins, Treija and Babris (2018) studied interdisciplinary groups' interactions in design activities. These studies showed the benefits of applying non-traditional models in educational systems. It was found, for instance, that the spontaneous or regular contact with specialists from diverse areas promoted intuitive stimuli (competitiveness, flexibility and complementarity), that helps to bring out ideas and to contextualize problems. However, when it comes to teamwork, one question is relevant: how to organize the setting in order to not compromise privacy nor overwhelm the users? To do that, Johnson (2010) appeals to the "balance between order and chaos" (p. 62), which means to provide structure and support to enable adaptation of the physical space by the possibility of flexibility and self-regulation of its components.

Lerdhal (2001) proposed the adoption of a flexible approach to the physical arrangement of the space in which design teams carry out creative collaborations. Depending upon the desired outcome, six activity zones could exist in the space: (i) informal meeting, (ii) idea development; (iii) construction; (iv) play and performance; (v) library; and (vi) relaxation and reflection. The author implemented the zones in a case study. The outcomes indicate that they had a positive influence on collective work, strengthening the team spirit, stimulating participation and engagement, giving room for unexpected ideas, and stimulating shorter meetings.

According to Colossi (2004) and McCoy (2005), the physical space is comprised of distinctive but integrated components, such as: spatial

organization (proportions, arrangements and circulations), interior design (furniture and type of materials), views (colour, windows and plants), resources and technology (books, supplies, Wi-Fi and electronics) and ambient conditions (light, ventilation, odour and sounds). Most of them can be controlled by one person, in a shared or individual place, depending on the activity that is being carried out and the desired aims.

We can highlight two similar studies that explored the potential effects of these elements on creativity (McCoy and Evans, 2002; Ceylan, Dul and Aytac, 2008). They're not comparable from the standpoint of study population (psychology students vs. managers), environments (educational vs. offices) and cultural differences (United States vs. Turkey). However, they applied the same methodological procedure in their investigation: content analysis of photographs. Initially, the researchers selected a large variety of photographs from offices with different levels of visual complexity, which is related to the number of objects, level of detail or intricacy, variety of materials and surface styles of the overall scene (Scott, 1993; Oliva et al., 2004). Figure 2 presents two examples shown by Ceylan, Dul and Aytac (2008), which illustrate one of the more complex (left) and most ordered (right) spaces in terms of presence/absence of plants, windows, colours, lighting, materials, furniture and resources (books, computer).

Figure 2: Examples of offices with low (left) and high (right) complexity (Ceylan, Dul and Aytac, 2008).

The participants had to sort these pictures into a rating scale from 0 to 10 based on where they would be most likely to solve a problem and generate ideas. Comparing the results, the findings in the first study (McCoy and Evans, 2002) reveal that the environments perceived as having high creativity potential were frequently those with high complexity (spatially and ornamentally). By contrast, the participants of the second study (Ceylan, Dul and Aytac, 2008) preferred offices with low visual complexity (less objects and furniture) and brightly lit.

One limitation of the two studies is the fact that photographs are unable to show some properties of the rooms, such as temperature, ventilation, odours, and noise levels. However, the contrast between the perception of the analysed components is enough to argue that it is extremely difficult to affirm that chaos or order – in the level of visual complexity – are either bad or good for creativity. Preference, furthermore, differs depending upon education, social background and aesthetic preferences on an unconscious and conscious level (Lerdhal, 2001). In that sense, it is important to consider the existence of a space 'in-between', which is not to be associated to a neutral environment.

About individual workspaces, a comparative study by García-García et al. (2019) analysed how changes in the work environment can affect creativity. The researchers distributed the participants in three rooms which they called: neutral (white lighting, no music), relaxing (blue lighting, relaxing music) and arousing (red lighting, arousing music). The space maintained the same basic characteristics in terms of dimensions, openings, furniture and resources, varying only on the two mentioned elements – lighting and acoustics. It was found that that the most generic configuration did not guarantee highly creative designs. It was argued, then, that offering the possibility to regulate visual and acoustics elements favours creativity, as they provoke distractions that enable the generation of new ideas and changes of perspective.

According to these theoretical contributions, then, it is possible to state that the creation of social conditions and the arrangement of the space may improve the status of 'edge of chaos' where creativity can flourish. Likewise, these studies allowed for the identification of the socio-spatial elements that are relevant when carrying out a collective or individual creative activity: group interaction, interdisciplinarity, possibility of regulating physical element, flexibility and alterations of visual complexity.

Explaining this case study

This research is interested in explaining how the socio-physics microenvironmental components affect the creative processes of undergraduate architecture students from the Universidade Federal do Rio Grande do Norte, Brazil (acronym in Portuguese, UFRN). The decision to focus on architecture students is based on the fact that one of the main features of this discipline is its interdisciplinarity.

In Brazil, architecture and urbanism form a single course. The course lasts ten semesters, equivalent to five years (the national education system is based on a two-semester year – February-June, and July-December). Architecture students are described as having a 'chaotic personality', because they combine knowledge from a range of fields in a unique way, and communicate their ideas differently from other disciplines (Lerdhal, 2001; Cruz Pinto, 2007).

The last academic activity carried out by students to complete their undergraduate course (known as Final Graduation Work – FGW) takes place in the 10th semester. It is an individual activity that can be a theoretical analysis or a design project. For their FGW, students must present a written document (with conceptual, empirical and theoretical reviews) and a graphic document that includes different modes of representation (plans, sections and drawings, among others).

The FGW evaluation takes place in two phases: pre-exam board (group) and final-exam board (individual). The pre-exam board is a group evaluation composed by three professors and four to five students that meet in an auditorium in order to present the early conceptual design process and discuss ideas. It takes place in the middle of the semester. At the end of the semester, the students present their work individually to the final-exam board, which includes the advisor, a second professor and a professional architect. This is the final assessment before they become architects.

Apart from the collective discussion of solutions and regular meetings with the advisor, another particularity of the FGW is that they are carried out away from the classroom context. In that sense, most of the time, students work from home, where they can make their own schedule.

According to Mayer (1999), there are six procedures commonly applied in research involving creativity: psychometric, experimental, biographical, biological, computational, and contextual. Long (2014) recommended that in the case of contextual research (those that aim to detect the perception of environmental influences) mixed methods should be applied, as a way of gathering as much information as possible.

Taking this into consideration, this study used mixed methods following an exploratory procedure that involved data collection that was adapted according to the participants' responses (Creswell, 2014; Günther, Elali and Pinheiro, 2008; Tashakkori and Teddie, 2003). Specifically, as it is shown in Table 1, the project included several techniques: identification and classification of the students that made architectural designs; a preliminary questionnaire; observation of pre-exam boards (by taking notes, photos and audio recording); semi structured interviews that included three main questions that were sent in intervals of fifteen days (1st, 15th, 30th days of the month), asking for details of the collective and individual microenvironments and inviting them to register them (taking photographs or making sketches); and observation of final-exam boards.

Techniques	Identification and classification	Preliminary Questionnaire	Observation of pre-exam board	Semi structured interview	Observation of final-exam board
2019.1	February	March	April	May	June
Quantity	18 Students	10 Participants	5 Meetings	4 Participants	14 Presentations
2019.2	July	August	September	October	November
Quantity	21 students	10 Participants	7 Meetings	6 Participants	21 Presentations
Total	39 students	20 Participants	12 Meetings	10 Participants	35 Presentations

Table 1: Techniques applied in the case study.

The contact with the participants happened in person and online. The questionnaire asked for primary information to identify their social experiences and notions about creativity and creative processes. The twenty who answered the questionnaire continued to the next phases of the study.

The interview's three questions were sent in intervals of fifteen days in order to extend the response time and allow students to perform "reflection in action" (Schön, 1983), a practice that stimulates design students to constantly self-review, while producing creative solutions, stimulating reflections about their choices and actions. Also, it gave the opportunity to schedule meetings in person to respond all the questions in one round, if needed. The questions were:

- Comment on how the pre-examining board influenced your design process. You can talk about: the positive and negatives aspects of the meeting; and the contributions of the teachers and students in the generation and conception of your idea.
- Create a mind map and indicate the main characteristics of the spaces where the ideas were developed and discussed collectively (in orientation or informal conversations). You can talk about: routes, spatial organization, lighting, acoustics, views, ventilation, furniture, people, animals, plants and objects.

- Take photos of the places where you spend the most time producing your work alone. Talk about the elements captured (spatial organization, lighting, acoustics, views, ventilation, furniture, people, animals, plants and objects). What elements stimulate or inhibit your design process?

       The research process involved: grouping the data of both semesters; transcribing audio from the interviews; classifying the researchers' photos of the Lab building and their workspace; coding the answers and the participants to guarantee anonymity (identified by: 'Student' and a number from 1 to 20). Although the questions do not emphasize the aspects of order and chaos, they appear in the research results, in the way the participants perceive both their collective and individual spaces.

The collective microenvironment (at university)

In general, most of the architecture students from UFRN spend a lot of time in the Architecture Labs, a building at the Central Campus (Figure 3). This is a three-storey building that contains: a library, an auditorium, two classrooms, computer and model laboratories, and teachers' offices.
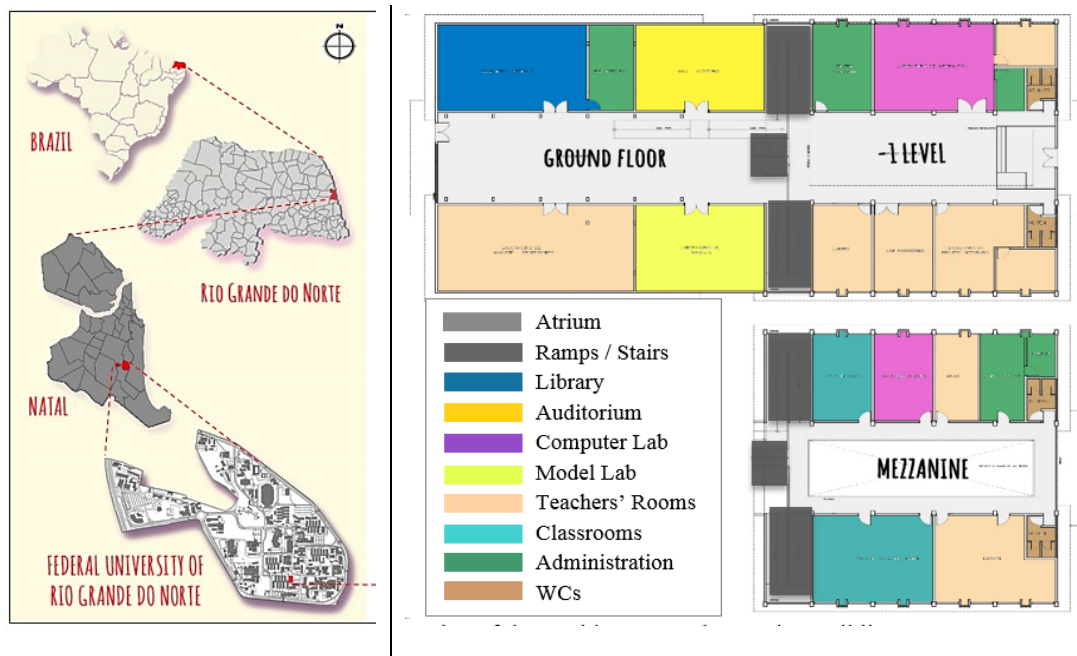

Figure 3: Geographic location and floor plan of the Architecture Labs.

The atriums are usually used for exhibiting projects and doing workshops and group discussions (Figure 4). In there, students can move and personalize the furniture and paintings on the walls, which creates constant movement. Artistic activities, noise, changes in spatial organization and visual complexity – with a diversity of colours, textures and objects – bring some chaos, as a consequence of the unpredictability and randomness of the events.

Figure 4: Examples of activities that take place in the atriums (researcher's photos).

The participants of this study report having stable work itineraries while working on their FGWs. The most common itineraries are: 'home-work-UFRN' and 'home-UFRN-library' (Figure 5). They usually go to the Architecture Labs to: have supervision with their advisors, borrow books from the library, use the labs, or meet with other professors and friends. As examples, the next quotes reveal the ways in which the building is perceived: "a lot of movement, a lot of noise, but that is something that in my case helps the creation" (Student 3); "the spontaneous chats in the smoking area of the building stimulated my creativity" (Student 8).

(Student 2's itinerary: 'home-work-UFRN')
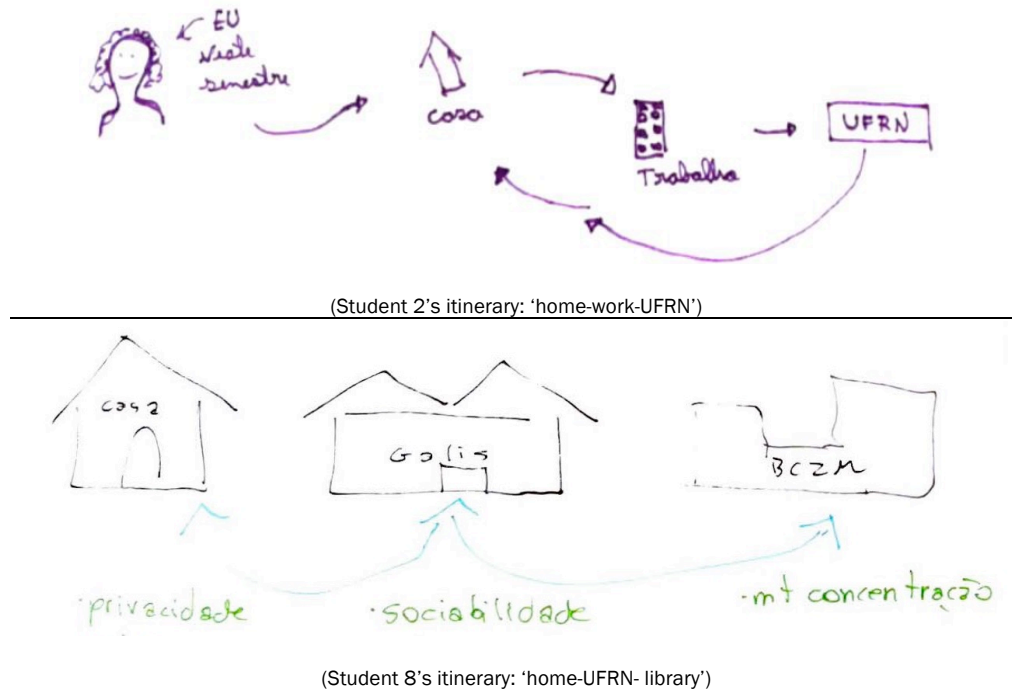

(Student 8's itinerary: 'home-UFRN- library')

Figure 5: Examples of participants' constant itineraries (students' sketches).

Overall, meetings with advisors take place in professors' offices, which have different sizes and spatial organizations. In these meetings, they usually discuss formal references and generation of ideas, and test solutions for architectonic designs (Figure 6). It is common that in some meetings

other people are also in the room – not only the student and the supervisor. As these quotes show: "the supervisions are joint with my advisor and his other students. That is good because I can also see their work and their progress" (Student 12); "sometimes we are mid-discussion and other people come and go from the room, which is distracting. But, at certain times, other professors help creatively, answering questions or indicating new solutions" (Student 10).
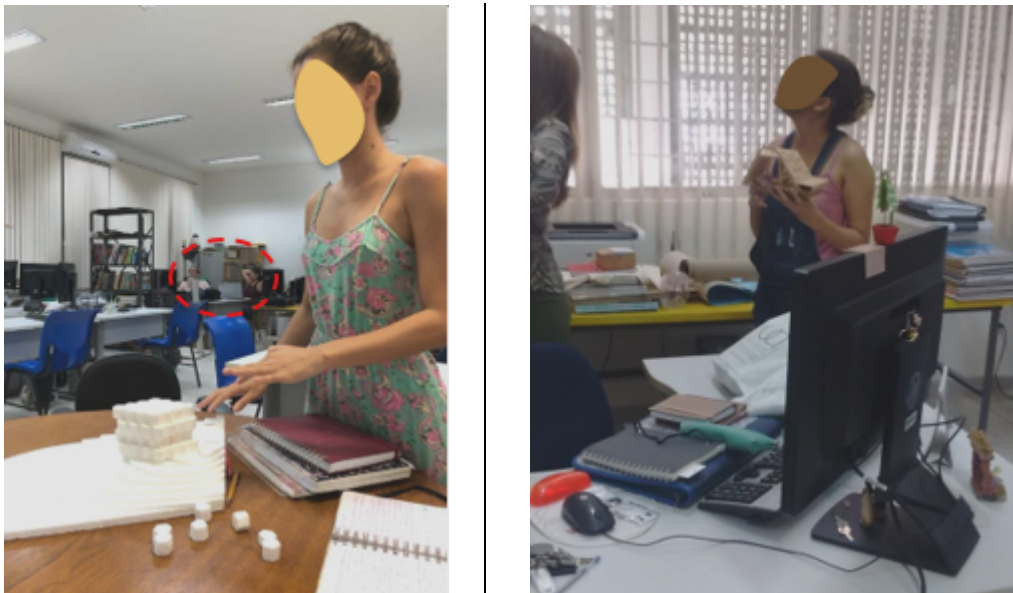

Figure 6: Examples of supervision meetings in professor's offices (researcher's photos).

At the pre-exam board (Figure 7), contact with other professors and students help participants to prepare for the final evaluation, enhancing the creative process as a consequence of the feedback. Most of the interview responses express positive perceptions of this activity, for instance: "feedback from other professors helped to resolved previously unresolved issues in the best way" (Student 1); "other students' work inspired my design" (Student 4).

But still, a few answers were negative, depending on what the students heard from the professors: "there were more questions than I was prepared to answer at the time. In general, it contributed very little to my design" (Student 3); "personally, it was not very useful to me because the feedback was below my expectations. It was not very constructive and, in a way, it seemed like a waste of time" (Student 10).


Figure 7: Examples of pre-exam boards (researcher's photos)

To conclude this topic, I highlight the main aspect that point to the coexistence of order and disorder in the collective microenvironment – the Architecture Labs. In the atriums, there is a greater presence of chaotic elements, such as: constant movement and spatial transformations. The professors' offices, despite being spatially organized, have a variety of visual stimuli (models and books); furthermore, the fact that these are shared spaces makes it impossible to predict the number of people and the noise level, adding factors of randomness. Finally, the pre-exam boards were in controlled places (regulation of access, time and number of people) and with low complexity, but the unexpected comments provoked both positive and negative perceptions in the students.

The individual workspace (at home)

When asked about the place where they frequently work on their FGWs, most students said that they stay in their bedrooms or home-offices, as these quotes show: "my room is where I spend most of the time working in my project" (Student 1); "the study table in my room is where I worked most of the time to draw, design and search for references" (Student 15); "for the idea conception, I work at UFRN or at home. For development and detailing of the design, I'd rather be in my room" (Student 5).
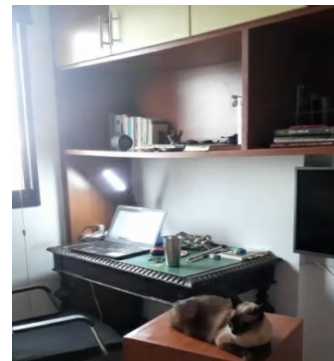
For this paper, six pictures illustrate the participants' spaces, each one captured from their own point of view (Figure 8).
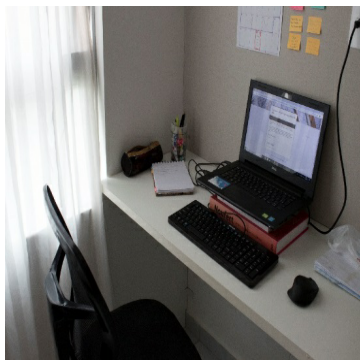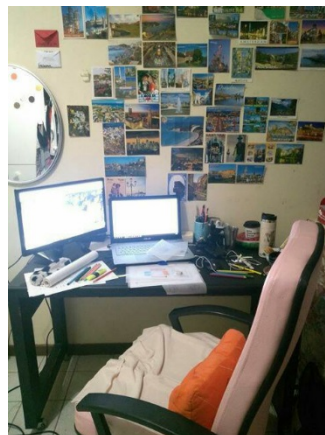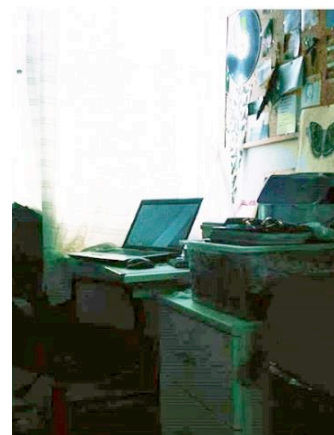

| Student 2 | Student 9 | Student 8 |

| Student 18 | Student 4 | Student 13 |

Figure 8: Examples of workspaces with low (top) and high (bottom) complexity (participants' photos).

To emphasize order/disorder, the photos were divided in two groups, considering levels of visual complexity (number and variety of objects, details, materials, colours, light, furniture and resources), according to the previous bibliography (Scott, 1993; Oliva et al., 2004; McCoy and Evans, 2002; Ceylan, Dul and Aytac, 2008). The three photos on the top show spaces with less visual complexity as compared to the three on the bottom.

The three photos on the top seem more ordered or organized because they have low visual complexity, particularly the wall in front of the desks. The furniture looks organized and have neutral colours (black, brown and white). The proximity to a window brings natural light and ventilation, but also, they have curtains to regulate brightness and privacy. The materials that they have nearby are for doing work-related activities (laptop, books, office supplies, like post-it and calendars).

On the other hand, the three photos on the bottom look chaotic because of the high visual complexity on the walls and over the desks. They are more colourful, and the furniture looks adapted to the circumstances of the activity and not planned in advance. These photos also show the presence of a second and bigger screen that functions as an additional support material. Likewise, these spaces have more office supplies on the table.

Despite of the fact that each photo looks different, even the ones that have low visual complexity do not seem organized according to the students' perceptions. The participants highlighted aspects of the place that could be improved in order to stimulate their creativity. However, they also feel that they can continue working in that way. As these participants – the owners of the first, third, fourth and fifth spaces – explain:

> It doesn't seem very organized because I had to adapt for my own comfort (for instance, books supporting the computer to have a better height) and because it always has many wires. I think that if the space was more organized it would stimulate me more. However, as it is now, it doesn't get in the way (Student 2).

I have privacy, my cats are here, and it's more comfortable. Despite the unpredictable actions of the pets that distracted me and sometimes messed up the objects, I did readings and the design without major problems (Student 8).

My table seems very chaotic, but I like the encouraging phrases on the wall, as well as photos and travel memories, because these are elements that bring me comfort and happiness […] I consider that I have freedom in this environment to make creative choices (Student 18).

I collect postcards and love to travel. So, this wall behind my desk shows my world. They are my inspiration to keep working. The positive aspects of the space are that it is quiet and that I personalized it in my own way. Negatives are: the chair is not that comfortable and the table is always messy, because I'm not very organized (Student 4).

As it is possible to see in the photos and quotes, the students arranged their workspace to transform it into a creative environment, even though some maintained a certain level of chaos (mess, high visual complexity, and uncontrolled situations). The main adjustments of the participants are related to: ergonomic regulation, control of the ambient conditions (light and ventilation) and the need to have supportive materials nearby. Personalizing the environment was also a good way to bring in personal identity to the space and create visual complexity, helping to focus on the work, as well as facilitating travel along memories and creativity. The absence of people in these photos, plants and exterior views shows less social contact and relationship with nature, only the presence of pets added some vivacity to the spaces.

Conclusion

The mixed methods used in this research were an appropriate way of investigating the microenvironment of senior architecture students. Despite the low number of participants (20 in the questionnaire and 10 in the interview), the results support the qualitative case study. Both content analysis of photographs and answers to the interview elucidated the

microenvironmental components, especially because they reveal that order and chaos are subjective aspects that cannot be seen as right or wrong, but coexistent.

Although the sense of complexity varies according to the field of study, the analysis of the results considering levels of visual complexity allowed to associate the behaviour of senior architecture students within the same spectrum of dynamic behaviours studied by Langton (1990) when he located computer science in a transition phase within the 'edge of chaos'. Thus, the divergences between the analysis of the research photos and the participants' interviews about the order and disorder of their individual workspaces, happened because "complexity increases with randomness only up to a point – a phase transition – after which complexity decreases with further increases in randomness, so that total disorder is just as 'simple', in a sense, as total order" (Langton, 1990, pp. 31-32).

The space 'in-between' is a reference to the students' constant route between the Architecture Labs and their workspace at home, where ordered and chaotic aspects coexist (with varying levels of visual complexity, different degrees of spatial arrangements, programmed and unprompted discussions of ideas). The spaces of the collective building (atriums, professors' offices and pre-exam board) seem to be good examples of a 'liquid network', where people can recall the relationship between order and chaos, in an atmosphere of respect and freedom.

According to Johnson (2010, p. 62) "the quickest way to freeze a liquid network is to stuff people into private offices behind closed doors". So, the collective space allows a behavioural information system that emerges, transmits and maintains ideas in a dynamical way. Despite the geographical differences, this advantage can also be seen in the documentary 'Archiculture', produced by David Krantz and Ian Harris (Arbuckle Industries, 2014), which discusses the architecture studio and the architectural educational and profession systems.

The need to carry out creative tasks in the transition between collective and individual spaces also promotes reflection on the importance of social interactions for designers – especially in the current context of social isolation caused by the Coronavirus pandemic, that requires working mostly at home and reduces access to the benefits of spontaneous and unexpected discussions of ideas in collective buildings.

Overall, the outcomes reveal that the participants of this study have experienced many features that enhance their creativity: a familiar and vivid building in the university campus; scheduled and spontaneous contact with people that add new viewpoints on their design; and a flexible arrangement and personalization of their workspace. However, this methodology has its limitations. One is the fact that some aspects of the research question remain open; for example, the relationship between the stages of the creative process and the spaces where they take place remain unclear. Nevertheless, the results point out that, in the early conceptual phase of design, the students had the opportunity to create and develop their ideas in both collective and individual spaces.

The exploratory design of this study could be extended in future research, with case studies that analyse other populations and characteristics of microenvironments. The results also highlight the need for creating a standard instrument for comparative analysis that reflects the object of study. For that, it could be interesting to associate – in addition to visual complexity –, other elements of environmental perception of photographs, such as contrast, as presented by Oliveira et al. (2020) and symbolic values, as discussed by Duarte et al. (2006). The findings could also contribute towards the design or construction of offices and study spaces planned for creative activities.

Acknowledgements

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