

CREATIVE NETWORKS: TOWARD MAPPING CREATIVITY IN A DESIGN CLASSROOM

Lama Abdulrahman Harkan

Dissertation Prepared for the Degree of

DOCTOR OF PHILOSOPHY

UNIVERSITY OF NORTH TEXAS

December 2019

APPROVED:

Tyson Lewis, Major Professor

Michael Gibson, Co-major Professor

Laura Evans, Committee Member

Denise Baxter, Department Chair Department of
Art Education and Art History

Greg Watts, Dean of College of Visual Arts and
Design

Victor Prybutok, Dean of the Toulouse Graduate
School

Harkan, Lama Abdulrahman. *Creative Networks: Toward Mapping Creativity in a Design Classroom*. Doctor of Philosophy (Art Education), December 2019, 174 pp., 3 tables, 40 figures, 6 appendices, references, 199 titles.

This study developed new mapping techniques and methodologies for understanding creativity in terms of connectivity and interaction between human and non-human actors in a design classroom. The researcher applied qualitative methods of data collection combining both observation of classroom activities and focus group interviews in order to map a creativity network. The findings indicate that creativity is a complex weather-like system (or what I call “creative climate”) composed of many sub-networks and diffused networks. Four interactions emerged from the study: (a) the creative climate is composed of the circulation of bodies and objects forming networks and sub-networks, (b) centers and corners/edges are a measure of connectivity and interaction in classroom space design, (c) roundness is a measure of classroom style and the space of connectivity usage, and (d) plugs-in creativity is a measure of technology consolidation. This study attempted to fill the gap in the literature on creativity and classroom design by explaining the role of non-human actors in shaping the creative climate in the classroom, especially the role of the classroom space itself as an actor. The implication of this study in art education opens a new opportunity for research in designing innovative classrooms. Also, it will allow future investigation of the phenomenon of creativity as a climate system based on the interaction between human and non-human actors.

Copyright 2019

by

Lama Abdulrahman Harkan

ACKNOWLEDGMENTS

I would like to extend my sincere thanks and deep appreciation to my committee members. I thank them for working with me throughout this journey and for their patience, motivation, and immense knowledge. Dr. Tyson Lewis, these bright ideas came out with your guidance and advice; you are a godfather to me. Thank you for your supporting and patience, and all your efforts with me. Also, I would like to express great thanks to Dr. Michael Gibson for facilitating the sources that encouraged me to complete this work; you were the inspiring teacher and supporter, thank you very much for everything. Dr. Laura Evens, you are the first one who took my hands on this journey and taught me to believe in myself no matter what the difficulties, thank you very much.

Thank you all for your belief in creative thinking and continued support in refining this study. I have put my work in your hands with confidence and gratitude for what I have learned from you in the last five years. Thank you for your faith in me and my work.

My sincere thanks go to my parents, my father: Abdulrahman Al Harkan, and my mother: Fatimah Al Yaish, the most caring and supportive of parents. I thank them for their constant encouragement in my intellectual pursuits. I would not have completed this journey without your blessing. Also, deep thanks to my family, my brothers, and sister for supporting me spiritually throughout my writing of this dissertation and taking care of my kids. My work would not have been possible without my dear husband: Mishaal Al Kaishan, who offered his endless love and support. My Lulu and Talal, I appreciate your patience to make this dream become real, thanks for waiting for me all these years to finally celebrate this moment.

Also, great thanks to my colleagues Kate Wurtzel, Lucy Bartholomee, and Shoshana McIntosh, for supporting me on this journey. Thank you for advising and for all of your valuable critiques. You have been part of this success. Last but not least, I would also like to express the deepest appreciation to Patrick Durkee who was a part of this achievement, and spent much time editing my work and enhancing my writing. Finally, my gratitude and appreciation go to all those who encouraged me and provided me with advice and suggestions that have moved my thinking about ways to conduct this study.

TABLE OF CONTENTS

	Page
ACKNOWLEDGMENTS.....	iii
LIST OF TABLES.....	viii
LIST OF FIGURES.....	ix
CHAPTER 1. INTRODUCTION TOWARD MAPPING THIS STUDY	1
Research Question	3
The Concept of Thing Power.....	3
Why ANT in Educational Research?.....	7
Study Terminology	7
CHAPTER 2. REVIEW OF THE LITERATURE	10
Actor-Network Theory	10
ANT in Educational Studies.....	16
Classroom and Creativity	22
Classroom Space and Creativity.....	24
Technology Fostering Creativity in the Classroom	25
Designing Learning Environment for Designers	27
Creative Climate as a Weather System in a Design Classroom	33
Creative Climate in the Classroom.....	36
Creative Climate for Practicing Design	44
Creative Climate Model	46
Summary	50
CHAPTER 3. NETWORKS METHODOLOGY.....	52
Research Design	53
Mapping and Interaction	56
Using Data-cum-Information-cum-Understandings Derived from Focus Groups	59
Focus Group as a Tool for Designers	61
Mapping Creative Focus Groups.....	66

Mapping the Research Methods	68
Participants	69
Focus Group Criteria	69
Mapping Tools.....	70
Data Analysis.....	72
Credibility	72
Summary	74
 CHAPTER 4. MAPPING THE ACTORS' RESULTS	 75
Introduction	75
Arranging Data Analysis	75
Maps Analysis.....	78
Actor Maps.....	78
Findings from the First Week of Observation.....	81
Findings from the Second Week of Observation	91
Findings from the Fourth Interview Question: Where in the Classroom Do You Feel Most Creative?	99
Final Findings from the Observation Maps Analysis.....	101
Findings from the Third Interview Question: How Would You Redesign the Classroom so that It More Effectively Promotes Creativity?.....	107
Summary	124
 CHAPTER 5. LET THE NETWORKS TALK!	 125
Introduction	125
Discussion and Interpretation of Findings	125
Discussion of Findings in Relation to Creative Climate.....	127
Discussion of Findings in Relation to Center vs. Corners.....	128
Discussion of Findings in Relation to Roundness.....	132
Discussion of Findings in Relation to Connectivity and Plug-in Creativity.....	135
Limitations.....	137
Recommendations for Future Research	138
Conclusion.....	139

APPENDIX A. IRB APPROVAL LETTER..... 142

APPENDIX B. INTERVIEW PROTOCOL..... 148

APPENDIX C. INDIVIDUAL OBSERVATION SHEET 151

APPENDIX D. GROUP OBSERVATION SHEET 153

APPENDIX E. A DESIGN SHEET OF PINNING CREATIVITY 155

APPENDIX F. A DESIGN SHEET OF DRAWING PINNING CREATIVITY 157

REFERENCES 159

LIST OF TABLES

	Page
Table 2.1: Creative Climate Questionnaire.....	39
Table 4.1: The networks components that the human actor used in building the creative networks.	106
Table 4.2: Results of the classroom arrangements designed by the participants.....	106

LIST OF FIGURES

	Page
Figure 2.1: Different styles of arranging classroom seating (adopted from Webster University, n.d.).	28
Figure 2.2: A conceptual model underlying assessment of perceptions of the work environment for creativity (Amabile, Conti, Coon, Lazenby, & Herron, 1996).	41
Figure 2.3: The study model of creative climate in a design classroom.....	48
Figure 3.1: Diagram of the methodical framework. This diagram explains the methods used in mapping creative networks in the design classroom.	53
Figure 3.2: A design project: pinning on the wall.	66
Figure 4.1: A layout shows the arrangement of a design classroom, where the study conducted.	77
Figure 4.2: A diagram outlines the method of data division. This diagram illustrates the process of analyzing data based on the result of the observations.	79
Figure 4.3: Actor movements layout shows the results obtained from the preliminary analysis of week 14 on Monday.	81
Figure 4.4: The actor movement layout shows the results obtained from the preliminary analysis of week 14 on Wednesday.....	86
Figure 4.5: Actor movements layout shows the results obtained from the preliminary analysis of week 15 on Monday.	91
Figure 4.6: Actor movements layout shows the results obtained from the preliminary analysis of week 15 on Wednesday.....	95
Figure 4.7: The final results of pinning creativity from the focus group interview activity.	100
Figure 4.8: Creative climate map: the final finding from both actors movement and pinning creativity map.	102
Figure 4.9: Chart of findings shows the classroom arrangements chosen by the participants.	107
Figure 4.10: U-Shape style from the focus group interview results.	108
Figure 4.11: U-Shape style from the focus group interview results.	109
Figure 4.12: U-Shape style from the focus group interview results.	109

Figure 4.13: Shape style from the focus group interview results.....	110
Figure 4.14: U-Shape style from the focus group interview results.	110
Figure 4.15: Classroom style from the focus group interview results.....	111
Figure 4.16: A rectangle style represents an extracted style from the original cluster style results.....	112
Figure 4.17: A rectangle style represents an extracted style from the original cluster style results.....	112
Figure 4.18: A different style of classroom arrangement that includes the cluster style.	113
Figure 4.19: Clusters style represents the design of workgroup stations without details.	114
Figure 4.20: Clusters style represents the design of workgroup stations without details.	114
Figure 4.21: A rounded style from the focus group interview results.....	115
Figure 4.22: A rounded style from the focus group interview results.....	116
Figure 4.23: A rounded style from the focus group interview results.....	116
Figure 4.24: A different type of round shape from cluster style results.	117
Figure 4.25: A different type of round shape from cluster style results.	118
Figure 4.26: Conference style from the focus group interview results.	118
Figure 4.27: Conference style from the focus group interview results.	119
Figure 4.28: Conference style from the focus group interview results.	119
Figure 4.29: A double arrangement style from the focus group interview results.	120
Figure 4.30: Square style from the focus group interview results.	121
Figure 4.31: Square style from the focus group interview results.	122
Figure 4.32: Square style from the focus group interview results.	122
Figure 5.1: A result showing the classroom center as a central network in the classroom.....	129
Figure 5.2: A study model distills the findings of the pinning creativity activity.....	131
Figure 5.3: A schematic reflects the percentage of connected form selections in the classroom arrangement.	133

CHAPTER 1

INTRODUCTION TOWARD MAPPING THIS STUDY

Why study the connections between classrooms, students, and creativity? Over the course of my doctoral studies, I have continually compared various classrooms and the functions of each. During this process, I became interested in how distinct classrooms seemed to generate diverse kinds of relationships between students and various modes of creative expression. These observations generated a desire to map these interactions between students and classroom arrangements, especially in the last course I took with design students. In this course, I acted like a researcher who wanted to catch a glimpse of a phenomenon, particularly how design students embodied creative approaches to design work. Through my observations, I became increasingly aware that the *things, equipment, and space* in classrooms affect students' creative cognition. I realized that some *spots and objects* around the students in the class worked together in seemingly invisible networks that, at times, produced a powerful learning environment. However, these networks, at other times, could slow down creative activity and create a mood of boredom.

To explore my impressions more systematically, I drew some maps of the classroom layout that included the objects, students, and instructor, considering all active agents. My goal was to see how these factors enabled one another to produce creative activity. By tracking human and non-human *actors* in the design classroom, I began to see how classroom design might affect the overall creativity of participants. The result was the beginning question of this dissertation: How can the design of classrooms increase the creative networks between students and things? Or, in other words, how can we create an environment where creativity is

not a skill or disposition human actors have, but rather a product of a network?

These questions have led me to actor-network theory and to new materialism, both of which emphasize the active agency of things. The *things* surrounding us have a *thingly* power all their own (Bennett, 2009; Shaviro, 2014). *Thing power* affects the condition of human bodies through invisible interaction in the form of networks. Latour (2005) emphasizes a broad conception of action and actors in his network theory. For Latour, actors are not simply human, and actions are not simply the result of human intentions. Rather, actors exist because of networks they belong to.

To clarify with an educational example, in classrooms there usually are essential materials that determine what the class looks like: tables, chairs, walls, equipment, and space, all non-human *things*. Normally, these are not considered actors, but rather passive materials used by humans. Regarding *thing power* in the classroom, Fenwick and Edwards (2010) examine how the material aspect of the classroom reveals distinct patterns of knowledge that place students, objects, teaching identities, and space within various possible positions and roles. The authors highlight the agency of things to create certain kinds of networks that may be invisible to the human participants yet highly effective. Considering that education is already shaped by material things such as classrooms, curriculum making, technological tools, and learning space, it is evident that they alter human actions. Thus, a change in the network of *things* in a classroom will radically affect the kinds of learning that are possible, or, in my hypothesis, the kinds of creativity that may emerge. Therefore, distributive agencies in the classroom develop a network that entails associated possible modes of work with actors. In relation to *thing power*, for instance, the interaction with *things* in the design classroom helps to generate invisible

networks to produce creative outcomes. Observing the design classroom allowed me to consider the *power of things* and the interactions between *us* (learners) and the influences of *matter* in creativity. How might classrooms enhance creativity for design students? How can the design of classes increase the creative networks between students and things?

Research Question

In relation to spaces, creativity, classrooms, objects, and interaction among them, the research main question will consider:

- How do things, spaces, and atmospheres affect the kinds of creativity that are possible in a design classroom?
- How can we map the networks of cooperation between students and objects in a design classroom visually to better understand how creativity is relational and emergent?
- Following this cooperation over time, what lessons can we learn about classroom design that can enhance creative production?

To pursue such interrogations, I will first have to draw on a variety of discourses and fields such as design creativity in the classroom, design creativity more broadly, and actor-network theory. Together, these will help me analyze how creativity appears between actors in a design classroom. Second, I will outline a methodology allowing me to map a pattern of creativity between the human (design students) and non-human (things) as they interact, and how this pattern might change over time.

The Concept of Thing Power

One of the significant influences of actor network theory (ANT) has been to inspire a *new materialism*, the recent turn to *things* and *thing-power*. First of all, *new materialism* tends to think of *matter* as productive and primary rather than secondary. In classical philosophy,

matter is passive and inert without agency. Thinking through matter and its power was proposed as early as 1677 by Benedict Spinoza in his *Ethics*. As indicated by Van der Tuin and Dolphijn (2010), Spinoza asserts that "the mind is the notion of the body," making the body as much mind as the brain. In this sense, the psyche and the body are similar things (p. 94). Famously, Spinoza argued, "we do not even know what a body can do." Similarly, Deleuze (1988b) agreed with Spinoza by declaring that the mind will not act without the body being acted upon (p. 18). Therefore, Deleuze states,

To capture the power of the body beyond the given conditions of our knowledge, and to capture the power of the mind beyond the given conditions of our consciousness. One seeks to acquire a knowledge of the powers of the body in order to discover, in a parallel fashion, the powers of the mind that elude consciousness, and thus to be able to compare the powers. (Deleuze, 1988b, p. 18)

These concepts inform new materialism by suggesting that mind is not the specific quality of human beings alone, but rather mind extends outward to include bodies and that these bodies are active and have agency. Mind is not separate from body, but rather part of body. Thus body—matter—is capable of acting and is not simply passive.

My focus is on Latour's idea of new materialism, or what he called the "collective," referring to both humans and non-humans. Van der Tuin and Dolphijn (2010) note that Latour proposes a cultural theory that thoroughly reconsiders dualisms, facilitating a postmodern consideration of how restrictions amongst nature and culture, mind and matter, human and non-human are created within life itself (p. 93). More specifically, In *Politics of Nature: How to Bring the Sciences into Democracy*, Latour (2009) intends to distinguish the notion of a collective, giving a clear explanation of why he established this term. Latour (2009) avers that the expansion of the collective makes conceivable an introduction of human and non-humans

wherein human and non-human can unite power without requiring their partners on the opposite side to disappear. Therefore, when we consider non-humans as objects, we empower them to join the collective network as new entities, and we can acknowledge them as actors.

In relation to materialism and the fundamental idea of thing power, Latour (2007) defines materialism as a sort of agency and an arrangement of substances and powers that enable experts to clarify, reject, or differentiate kinds of agencies beyond the human. Materialism, in short, focuses on matter and how matter has agency (p. 138). Accordingly, he suggests that objects are equally genuine, but not identically powerful, because some objects have stronger or weaker connections with various bodies within networks. Matter, as Latour describes it, has two very surprising sorts of developments that have been conflated: first, the way we advance learning to get to things that are far away or generally blocked off, and, second, the way things move to keep themselves present and active (Latour, 2007, p. 139).

The concept of materiality in this study draws from Latour but also Jane Bennett's notion of thing-power. According to Bennett (2004), *thing-power* is the vitality that appears within things. Thing-power functions in groups or networks that include humans and other beings all receptive to and influencing one another. In addition, thing-power materialism underlines the concept of closeness and the familiarity between human and non-humans, with each contributing to an environmental ethos (p. 365). Bennett (2009) also notices that objects emerge within assemblages that may or may not involve human agency or intention. These assemblages of objects cannot be reduced to situations defined by humans, and their meaning or function cannot be exhausted semiotically (according to human ways of understanding or finding meaning). Similarly, Coole and Frost (2010) argue that material items move with power

or force in alignment with specific circumstances and end results that might be beyond human agency. Therefore, their change and development will be based on the forces that engage with them.

Consequently, *thing* in my study is a word that refers to the active, agentic materials that occupy space and are usually used in classrooms, including walls, windows, furniture, devices, boards, and lights. These are things that are, as generally defined in *Merriam-Webster's Collegiate Dictionary*, "material[s] that may be perceived by the senses." The concept of thing-power emphasizes how things exist in networks of cooperation. Thus, researchers aligned with ANT emphasize the idea of thing-power from various angles, making central the power of things within productive networks of relationships, both inside and outside human worlds. As such, we can consider power an effect of diverse productive practices engendering engagement with others in certain power formations (Latour, 1984; Foucault, 1977; Law, 1986).

The conception of *power* has various interpretations in ANT. First, power in Foucault's understanding refers to concrete practices. Thus, the general view of *Discipline and Punish* surveys the relationship between power and knowledge. On the other hand, Law (1986) indicates that power might be viewed as an impact of the production of networks, strong yet tractable operators that have been transported across groups (p. 34). Similarly, many scholars acknowledge the influence of the material on knowledge and examine how an invisible network of interactions produces a phenomenon that can be studied. Based on this scholarship, I will explain in the second part of this chapter the role of such networks and power in relation to ANT. I will also chart their influence in the classroom from the point of view of educators, which entails the impact of *thing-power* on creativity.

Why ANT in Educational Research?

The significance of this study is that it indicates the connection between the agency of the classroom and that of students to co-create creative potentialities. This will expand our understanding of creativity, and in turn, assist future classroom design to maximize creative potentials. Recent studies have focused on creativity trends; I aim to interpret the *circumstances* that make creativity possible. My contribution in this study will enrich research that locates design within an educational perspective, employing ANT as a methodology; ANT will assist me to map the cooperation of actors by understanding their performance and interaction in the classroom. ANT is suited for this work because of its interest in human and non-human interactions as well as its unique approach to data visualization through mapping networks of relations.

In this study, I will discover patterns of interaction that are important for the emergence of creativity—or the failure of creativity to appear—by concentrating on the primary axis of things, students, and their mutual relationships within the overall design of the classroom. Both art education and design education concentrate on creativity, and my study hopes to provide new insight into the location and intensity of interactions that are important creativity markers. The ultimate goal will be to help define the parameters of an “ideal creative place” that takes into consideration classroom space, tools, technology, resources, and conditions, gauging how these factors optimally enhance students' creative thinking and design artwork.

Study Terminology

- Actor movements. Actor movement represents how human actors interact with classroom objects and use space.

- Cold spots. A term representing dead zones with no interaction between the actors in the classroom.

- Creative classroom. The learning environment and the ways creativity is facilitated by the class condition. As the literature (Amabile, 2011, p. 3; Bartholomee, 2017; Alhussain, Loudon, and Wilgeroth, 2016; Zimmerman, 2009) indicates, there are many definitions of creativity. As I work toward defining a creative classroom through my study, I will draw upon these definitions but also remain open to what my data will reveal. In particular, I will pay attention to several dimensions of creativity in classrooms, including interactions between a multiplicity of actors, practices that center around things and thing-power, and hot-spots that maximize the potential of a network to foster creativity.

- Creative maps. Maps devised to extend the identification of creative climate. Creative maps consider network interactions as weather systems that foster creativity and trace the effect of weather on actors.

- Design classroom. A description of particular classrooms where design subjects are often taught and practiced.

- Hot spots. A term indicating areas where significant actors gather in moments of great activity.

- Interactive maps. A term employed designing maps for outlining the values of qualitative variables by colors or shapes (Andrienko & Andrienko, 1999).

- Mapping networks. A term developed to apply a method that tracing the interactions between actors to come up with visual maps.

- Medium spots. A term describing common areas where all actors can communicate and interact.

- Non-human. A term to identify the objects and things in the classroom. This study “is intended to signal dissatisfaction with the philosophical tradition in which an object is automatically placed opposite a subject, and the two are treated as radically different” (Sayes, 2014, p. 136). In addition, Langstrand and Elg (2012) identify non-humans as actors in organizational transformation (p. 854). Moreover, “a non-human actor can through these inscriptions, influence behavior, and thereby contribute to reinforce the associated action program” (Langstrand & Elg, 2012, p. 855).

- Warm spots. A term referring to an area where some actors have a moderately high interaction.

CHAPTER 2

REVIEW OF THE LITERATURE

To begin mapping creativity in a design classroom, I would like to group the literature review into three sections. The first division highlights actor-network theory with a focus on educational studies to grasp the phenomenon of creativity in design classrooms. Actor-network theory will illuminate networks and how interactions among various actors in a classroom help to generate the cooperative power that fosters creativity. The second division focuses on creativity, design, and some ecological studies relating to classroom environments. This section will consider the role of creativity in a learning environment and how it might facilitate a better understanding of creativity in the design classroom. The third division examines the central idea this study develops, creative climate in the classroom. This final section brings together studies of actor-network theory, learning environment, and classroom creativity as a phenomenon of a particular place. The resulting synthesis is manifested as creative climate, the “weather system” in a design classroom.

Integrating these divisions will contribute to mapping the creative network in the design classroom as it emerges between humans, their environments, and the things in these environments. Together, these discourses will help answer the following questions: How can we consider things in a classroom environment as a matter that impacts creativity? And how can we design objects to improve such impacts?

Actor-Network Theory

Actor-network theory has served as an analytical tool to shape and understand the development of scientific and technical communities by providing new ways of interpreting

how humans and non-humans have associations that develop, collapse, connect, and disconnect based on their acting in networks (Callon, 1987; Latour, 1987, 1992; Law, 1987; Roth, 1996). Actor-Network Theory (ANT) developed in the 1980s in sociology, focuses on the power of human and non-human bodies as they work together and act in productive networks that facilitate both intellectual and material phenomena. While many authors wrote under the banner of actor-network theory, including John Law and Michel Callon, perhaps the most important figure in ANT is Bruno Latour.

Latour one of the foremost scholars who developed ANT, notes how the material world pushes back on individuals due to its physical structure and form. Such a material world is not simply passive, but rather exerts agency over humans. Moreover, ANT scholars also propose the fascinating contention that objects play a dynamic part of their own in network relationships with their human counterparts. Although it is not the case that machines are like human subjects, choosing how they will act (Latour, 1992), ANT nevertheless uses the term "actants" for both the human and non-human, and the term "network" captures the mutual agency of the actants—all of which conceptions ultimately inform the term *actor-networks* (Latour, 1996).

In addition, "actor" in ANT has a distinct semiotic definition: an actant is that which acts or is granted activity by others. Such a view implies no special motivation of human individual actors, nor of humans generally. An actant in ANT implies no particular motivations or cognitive functioning as in human actors. An actant can be anything designated as a source of an activity (Latour, 1992, p. 177). John Law, one of the authors writing under the banner of Actor Network Theory, considered ANT a group of dissimilar material-semiotic apparatuses, sensibilities, and

methods of inquiry that negotiate everything inside the social and physical universes (Law, 2009, p.141). Moreover, Law (1999) considers ANT a term that embodies a force that is purposefully oxymoronic, encompassing a pressure which lies between the focused 'actor' from one position and the decentered 'network' from the other (p. 5). According to Law (1999), ANT articulates the entities that take specific form and shape as a consequence of their relationships with other entities. Stated differently, Law, like Latour, believes that actors do not preexist their networks but rather emerge out of them. Based on the system of things, entities have no essential features and cannot be divided into dualisms, such as truth and falsehood, large and small, agency and structure, human and non-human, before and after, knowledge and power, context and content, materiality and sociality, or activity and passivity. Therefore, all these dualisms have to be replaced by a network where all actors simultaneously act and are being acted upon (p. 3).

Law & Singleton (2014) have examined the historical development of ANT. They note briefly that material semiotics and ANT both offer comprehensive tools for contemplating politics and policy. Hence, employing ANT as a critical tool, we must first underscore the primary position staked in the 1980s by proponents of ANT that the world is heterogeneous and that secondly, it is social. In the 1990s, ANT inquiry began to speak plainly about ontological variety. The contention that the world is ontologically different — that it isn't intelligent — sits uneasily for some. Presently, contemporary successors to ANT and feminist material semiotics further this line of inquiry by focusing on ontological performativity and how such performativity produces conceivable outcomes and difficulties. Finally, they return straightforwardly to the issue of the procedures underlying arrangement-making. If the world is

ontologically various/diverse, then what it means to make, to battle with, and to 'exchange' begins to change (Law & Singleton, 2014).

The concept of the actor-network was influenced foremost by Michel Foucault, based on his realization of power and how it related to community of practice, particularly how this power can spread an active, resistive or reactive force (Fox, 2000). Foucault defined power as a relation between forces that produce a power relation (Deleuze, 1988a). Moreover, Foucault's understanding of power split into two portions; a) power does not take any sort of shape or form, and b) force only exists in relationship with other forces; therefore, force must have a relation with force, rather than objects or subjects (Deleuze, 1988a). For instance, power only passes through forces, not through forms, while knowledge formulates matters and shapes practices (Deleuze, 1988a). Critical to ANT's development is this idea of power as relational, networked, and somehow above or below the intentions of humans (who are rather minor actors within a much larger set of power relations).

Drawing on sociology, ecology, and philosophy, ANT does not classify or focus on specific disciplines, rather it is intentionally hybrid with many diverse applications beyond human-centric social analysis. Accordingly, ANT is not reducible to social interpretations, and their examinations of class, state power, gender, relations of production, globalization, neoliberalism or democratic deficits (Law & Singleton, 2014, p. 384). Paget, Dimanche and Mounet (2010) stated that ANT clarifies the collective actions between human and non-human entities and the translations performed between these distinctive actors, which ultimately become networked (p. 830). Thus, based on such connections between actors—human and non-human—we can examine where *translation* happens and why it happens there. We can

also point out the appearance and disappearance of creative spots chosen by human actors. Translation highlights where creativity might emerge between networks, as an actor links him or herself through networks or through interactions with other bodies, assigning interests and developing roles to play. *Translation* in this context is, moreover, illuminated by ANT, which addresses the way things change, connect, and disconnect from their entities (Latour, 1987). Likewise, translation is perhaps the most documented feature of ANT in innovation and creativity studies (Boerboom & Ferretti, 2014; Mclean & Hassard, 2004). Furthermore, to determine its meaning in ANT, Burgess, Clark, & Harrison (2000) explain translation extensively:

The concept of translation recognizes that the content of texts, conversations, objects and so forth is not simply transferred unchanged between actors, but may be transformed as things pass from hand to hand (Latour, 1987). In building its network, the actor translates the other entities, by giving each 'an identity, interests, a role to play, a course of action to follow, and projects to carry out' (Callon, 1986a). The actor decides their attributes, links them together, and draws up the scenarios in which they take part. Translation is thus about attempting to gain rights of representation, to speak for others and to impose particular definitions and roles on them. To achieve success, other actors' worlds must be colonized. Actors become powerful through their abilities to enroll others in a network and to extend their network over greater distances. (p. 123)

From Latour's (2005) point of view, to define ANT first we should understand the connection between entities, as the identity of any given actor is dependent on its position at any given time within a network (p. 64, 65). Latour (1992) asserts that actor-networks associate, and by interfacing with each other, clarify themselves, thereby illuminating the connections among an arrangement of practices controlled or intervened in by another ANT. This clarification is more grounded or more ground-breaking than giving associations among disconnected components or demonstrating how one part holds numerous others. In this manner, each system develops "bonds" expressing the assets around it, and it is highly unlikely

that such bonds between networks can be disengaged from further development.

Consequently, it is essential to introduce ANT in this study because ANT can focus on understanding how human and non-human entities integrate together in art classes, primarily in design classroom where human and non-human systems can bond in surprising ways to form complex networks.

ANT shows how different types of objects in the classroom may affect students' achievement. Everyday objects that include thoughts, intentions, technology, materials, and bodies are involved in and perform in relations, and consequently, these things can apply force and engage each other (Fenwick, 2010a). This sharing can lead to the development of practice and knowledge that create an invisible hotspot in specific space in the classroom, which, in turn, determines how environmental variables can affect academic development. Such processes are important in the design classroom, a technology education environment distinguished by the presence of a lab that promotes and stimulates creative practice (Warner & Myers, 2009). Subjects like design usually require distinct skills like high concentration, problem-solving and creativity, and thus, teaching this kind of subject requires a particular learning environment. Therefore, many researchers are focusing on studying the creative classroom, particularly uses of lighting, color, decorations, walls, furniture, resources, sensitive variables, technology equipment, space, and class size because they develop student behavior, increasing the influence of creativity and learning progress (Barrett, Davies, Zhang & Barrett, 2017; Warner & Myers, 2009). At the same time, ANT focuses on associations between agents, especially in their participation, and how they manipulate and influence the design of the network linked through their relationships (Dwiartama & Rosin, 2014). Therefore, ANT in this

manner will help to consider how creativity might be mapped and promoted in the design classroom by illustrating how *things*, which include classroom space and objects, can affect students' achievement.

ANT in Educational Studies

Regarding matter, power, and things, Diana Coole and Samantha Frost in *Introducing the New Materialisms* ask about the role of *things* in our everyday practice. In my study of thing power, I consider their question in relation to education. Coole and Frost (2010) examine the importance of the material, and why we disregard its power in some theories, asking, "*how could we ignore the power of matter and the ways it materializes in our ordinary experiences or fail to acknowledge the primacy of matter in our theories?*" This observation about matter, or to be specific, particular *things* around us, facilitates and guides our perceptions and knowledge. One of the most important implications of Coole and Frost's analysis is the pedagogical point of view on the role of the *thing* in the *classroom* and how objects can affect students' knowledge and work.

Considering this question within an actor-network framework, some directions in scholarly literature helpfully designate the role of objects in the classroom and the utility of ANT to analyze them. Indeed, actor-network theory has been applied in numerous academic disciplines, including art history, education, art education, museum studies, sociology, psychology, anthropology, business, and medicine (Law & Hassard, 1999; Fenwick, 2010a; Fenwick & Edwards, 2012; Blair, 2015; Tillander, 2008; Latour, 2005). Tara Fenwick wrote many studies employing ANT as a method to research educational practices. Fenwick, Edwards, and Sawchuk (2011), stated that ANT allows us to investigate how education is built as a

network of practices, exploring how various aspects might be connected together as temporary changeable stabilizations in its process of the multiple overlapping worlds in its networks. Further, ANT provides a language and theoretical sources with which to comprehend troublesome ambivalence, disordered objects, and apparent logical inconsistencies that are inherent in many educational matters, including educational policy, curriculum, implementation, and school reform (p. 95). Additionally, ANT is critical in education research, fostering a focus on how we can reform education. Fenwick (2010a) explains that ANT sheds light on several network methodologies through which this potential change may be accomplished. This theory continually concentrates on the tiny everyday transformations of the disorderly materials and human actions that make an educational life. Moreover, Fenwick (2010a) continues that actor-network theory proposes approaches that illuminate the flow of educational reform, although education is frequently left aside by more socially-focused analyses—including how actors appear amid the development of various linkages among human and non-human. Further, Fenwick (2010a) shows the diversity of actors whose performances are highlighted in such links, and thus, ANT illuminates network representations to conceive forms of change, including teacher development and student learning, amid the work of network connections. Consequently, Fenwick (2010a) emphasizes that the greater a networks' expansion, the more substances move toward becoming 'joined' into its connections and 'translated,' or changed in ways that improve its work, and consequently, the more likely the network is to continue over time and spread its reach. Fox (2005) declares that actor-network theory supplies a specific understanding of social and material phenomena, which can

enable us to comprehend the place of education more extensively within the academic community in higher education (p. 9).

Jan Nesper is one of the first educational scholars to apply ANT-associated network readings in order to analyze education methods and reforms. I found Nesper's research within ANT on schools' development and practice very important to my approach. In fact, Nesper argues that as educators we should recognize and understand how "building changes" shape practice:

The point is that we need to understand "school change" as at least partly about the ways school practices are made mobile, and what and how they connect as they move. What are the structures of connections or linkages? What materials are they made of? How do things change as they move? How do connections change with this movement? (Nesper, 2002, p. 368)

Nesper (2002) suggests employing education from social networks by assembling various entities such as written curriculum, videos, human actions, and buildings that can move educational practices across space and time. Accordingly, entities in education change as they are associated with or registered in various competing networks (p. 369). Indeed, I think that as knowledge changes and develops, it exhibits patterns that we can follow to study its impact, especially in art education and design classrooms, since these fields require extensive equipment and tools that help to improve networks and create a model of productivity. The alternative modes of knowledge that accrue in art classes in general start with our perceptions, which involve the networks of things around us. In fact, some educational scholars have made the point that our attentiveness is a result of the call of things or forms because the *things* assemble up simultaneously.

Others have even suggested that the things in classrooms have their own autonomous life and energy that is not reducible to the call which they send out to human actors. For instance, Hood & Kraehe (2017) state thing-power is not tied to doling out human attributes to non-human things. Perhaps it is about the tricky idea of materiality, and how in a moment, we sense that an object is part of our human world, while simultaneously recognizing that things have parts of their being that are beyond human recognition (p. 34). In any case, these theorists suggest that we correct the assumption that agency is something over and beyond the non-human actant. Things in education are complex and networked, and they are just beginning to gain primacy in art educational discourses (Fenwick & Landri, 2012; Lewis, 2018). In educational studies, such a perspective on things, shaped by an ANT approach, can enable an investigation of ways that human and non-human materiality join to fulfill specific purposes and create specific impacts on education. Such an analysis can investigate the messy surfaces woven through various types of networks, and the subsequent indecisions that cross in pedagogical procedures. Therefore, most phenomena are comprehended to be heterogeneous assemblages of materials, thoughts, images, desires, bodies, natural powers, and so forth, and they are always dynamic, continually reconstituting themselves (Fenwick & Landri, 2012).

The question is then, why is actor-network theory important and how can it make a significant, particular impact on education practice? Fenwick (2010b) has maintained that “ANT’s theoretical resources might offer an analysis of educational standards and studies of educational policy more broadly,” noting that

actor-network theory traces the ways in which human and non-human elements are enacted as they become assembled into collectives of activity. These complexes, interwoven ‘networks’ can spread across space and time, and produce policies, knowledge and practices. ANT-inspired studies trace the micro-interactions through

which diverse elements or 'actants' are performed into being: how they come together - and manage to hold together - in 'networks' that can act. These networks produce force and other effects: knowledge, identities, rules, routines, behaviours, new technologies and instruments, regulatory regimes, reforms, illnesses and so forth. No anterior distinctions such as 'human being' or social 'structure' are recognized – everything is performed into existence. (Fenwick, 2010b, p. 120)

Moreover, in *Actor-Network Theory in Education*, Fenwick and Edwards (2010) assert that what might appear to be a teacher's agency is an impact of various powers, including activities, desires, abilities, and associations stimulated through her, and in addition, the powers applied by the texts and technologies in all educational encounters. However, while networks and distinct currents circulate through the educator's practices, her own particular activities or desires are not dictated by the network, yet emerge through the myriad interpretations that are encountered among each of the developments, instances of talk, materials, feelings, and discourses making up the classroom's everyday encounters (p. 21).

Waters (2014), proposes that another way ANT can be helpful in educational research is its capability to identify the impacts of connections that appear between material things in networks, which, in turn, subjectify actors (educators and students) as part of a curriculum that can be enacted (p. 18). For instance, Nesper (2011) studies two cases of device-mediated educational change by applying ANT. In one case, he includes a PC-supported interactive video module that gave a half-hour of guidelines for a college course; the other case is an assistive communication instrument that lent a supposedly developmentally disabled, pre-school child to his own, unique form of intelligence that might otherwise had been missed (p. 15).

Accordingly, Nesper (2011) states that devices in education can be utilized to rearrange agency itself in core organizational activities, since it shifts and changes location. They can also shift participants from one actor category to another, or further, produce new kinds of agents

(p. 16). Fenwick (2010b) states that ANT helps to interpret the various heterogeneous conceivable outcomes inserted inside any formal iteration of educational standards (p. 8), such as inserting components into practices of standards that either can be restricted socially or collaborate with other forms of standards to develop at any field of educational practice. Koyama (2012) adds that an ANT point of view considers the agency of policy actors inside educational, societal, and political structures that expand the manner by which the theory is "intentionally oxymoronic" (p. 887). Koyama's formulation is based on Law's (1999) explication of the term "intentionally oxymoronic"—because actor-network is a term that represents the tension between the centered actor and the decentered network. Thus, what distinguishes between agency and structure is always contingent upon the activity and context (p. 5).

Several scholars have begun to recognize and examine networks in educational studies (e.g., Cibulka, 2001; Kirst et al., 1984; McDaniel, 2001; Mintrom & Vergari, 1998; Song & Miskel, 2005; Young, 2005; Young & Miskel, 2002; Young, Wang, & Lewis 2016). Therefore, comprehending the issue of networks in education practice is crucial. Young, Wang, and Lewis (2016) emphasize that because connections are the schemes through which actors in an issue network share specialized data, change resources, access policymakers, and get received data about the approach procedure, understanding the hidden patterns of connections that include issue networks is fundamental to our comprehension of them (p. 801).

To conclude, there are many studies and theories within educational research that suggest the importance of thing-power and networks. My proposed study will extend this line of inquiry by focusing specifically on the impact of design classroom networks on creativity. As I will illustrate below, discussions of classroom creativity have yet to fully take advantage of ANT

theory and research to better understand how creativity might function, and in turn, how it might function better.

Classroom and Creativity

This section examines creativity as a phenomenon within the learning environment in a classroom. In this section, I will address some studies on the relationship between objects and students in various circumstances, particularly in the design classroom.

There are, of course, numerous definitions of creativity, the factors of creativity, and its influence on the creative process. From one point of view, “creativity is the production of a novel and appropriate response, product, or solution to an open-ended task” (Amabile, 2011, p. 3). Also, “creativity [is] described as the degree to which outstandingly creative individuals feel influenced by social and environmental factors” (Amabile 1983, p. 357). Magyari-Beck (1998) states that most creativity scholars have found enough evidence to study aspects of creativity (p. 84). For example, the interactions among individuals and objects in the classroom generate a particular type of creativity, and this “creativity [we] could consider as a lived experience” (Bartholomee, 2017).

In previous studies in ANT and education, it is evident that the objects in the classroom participate during the learning and teaching process. The physical environment of the classroom, which include lighting, technology, space, equipment, walls/windows, chairs/tables, clocks, and air conditioning all function to create a learning environment. More importantly, the literature indicates that the physical environment in the classroom shapes students' creativity and the interaction among students and teachers (Granito & Santana, 2016; Davies, et al., 2013). In particular, Barrett, Davies, Zhang, and Barrett (2017) address some significant aspects

of the physical environment of the classroom, focusing on the space, lighting, and classroom window view, and how these might impact creativity. In addition, Alhussain, Loudon, and Wilgeroth (2016) state that many recent researchers in the creativity field analyze factors that can stimulate the creativity level in individuals and animate them to think more creatively, including the social and physical environment. Zimmerman (2009) defines creativity as an individual phenomenon, as a person responds within one or more systems, within a specific condition. Thus, many contemporary psychologists and educators agree that creativity is a complex process that can be seen as an interactive structure in which connections among people, procedures, objects, and social settings are of active significance.

Luna, Ernst, DeLuca, and Kelly (2018) state that a creative environment supports individualized learning and assists students to think openly and productively (p. 26). In other studies, it is clear that a creative classroom can promote students' achievements, considering creativity as a variable influence that can be established through the learning classroom. Jindal-Snape, et, al. (2013) review a few studies that recommend considering the effects of creative learning environments on students' academic accomplishment, which can include developing confidence and resilience; improving motivation and engagement; increasing social, emotional and thinking skills; and enhancing school participation. Further, studying some principal factors in the classroom such as space, including creative space, can increase the potential of creativity.

These studies all indicate that the environment plays a significant role in learning and creativity, thus indicating the importance of ANT research in relation to creative classroom design.

Classroom Space and Creativity

In the classroom, ANT utilizes several kinds of spaces, where objects/relations are bunched inside limits and where distances amongst components and connections are thought of as changing or leaking (Harrison, 2018, p. 19). Moreover, Triantafyllaki & Burnard (2010) identify creative spaces' power to inspire, including physical spaces, defined by how they create new directions and openings to compose networks (p. 10). In a study of the role of space and place in facilitating creativity, Warner and Myers (2009) clarify that technology education has recognized the qualities of classroom and lab facilities that support creativity. Likewise, the essential design of the space has its own impact on the creative environment of the classroom or lab. Moreover, Davies et al., (2013) consider that the space inside a classroom or workshop ought to be fit for adaptability to advance students' creativity. Also, making associations between such casual spaces within the school environment extends engagement and inspiration and, thus, creative results.

Regarding classroom space and creativity, Thoring, Desmet, and Badke-Schaub (2018) distinguish five types of creative spaces with five related spatial qualities: the personal space, the collaboration space, the presentation space, the making space, and the intermission space. They further state that the flexibility of the classroom space or its furniture is vital in understanding different creative activities (p. 69). Accordingly, Martens (2008) highlights the significance of precise definitions and illustrates the meaning of layout, color, light, and space in relation to creativity. He states the physical workplace may contribute various approaches to creativity, one of which outlines dedicated spaces that sustain the number of users and the required disturbance level (enclosed/open), as well as stimulating the senses (relaxed or

activated, motivated, and inspired). Therefore, it is significant to consider *classroom space* as a principal concern to design a creative classroom. Creative space—as a thing with its own power—is critical for producing creativity.

Jankowska and Atlay (2008) investigate the impact that teaching in an extraordinarily creative learning space has on students' commitment to the learning procedure, their inspiration to study, and their involvement. Luna, Ernst, DeLuca, and Kelly (2018) state that it is useful for an educator to comprehend and characterize creativity by keeping in mind the end goal to actualize a classroom that cultivates creativity (p. 27). Brandt, et al. (2013) explore an environmental framework that considers the surface structures and pedagogical methods in the studio and how these components are associated with the development of design knowledge. They underline how the studio is grounded in the systematic knowledge of the shared relationship among design, the human environment, and social practice. Additionally, Barrett, Zhang, Moffat, and Kobbacy (2013) analyze the effect of the constructed environment on students' learning improvement, emphasizing the significance of this perspective for policymakers and designers, along with users' experience, developing ten outline parameters within a structure of three design principles: naturalness, individualization, and stimulation. Accordingly, Zaugg and Warr (2018) discuss the advantages of makerspaces that provide the materials and an area for individuals to work collaboratively, encouraging creativity and innovation. In this way, the authors stress how useful space may become creative (p. 173).

Technology Fostering Creativity in the Classroom

About the role of technology and creativity in classrooms, Latour states that "we might call technology the moment when social assemblages gain stability by aligning actors and

observers” (Latour, 1990, p. 129). Biagioli, Grimaldi, and Ali (2018) conclude that based on the innovation and tech revolution, design becomes a creative discipline and the designer a creative actor (p. 6). Indeed, technological devices are essential in the classroom, especially since teaching design depends on learning how to build student knowledge through applying the design process. Such technology may also be considered a classroom learning environment tool that improves creativity: "Technology as an enabler of new learning environments" (Sinfield & Cochrane, 2018, p. 5). In addition, “students demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology” (Davis, 2017, p. 41). Runco (2008) states that the creativity in our practice employs the creative possibilities that are given by new technologies, including computers (p. 4).

From this perspective, teaching design in the classroom always requires having the technology to practice the design of a course. For instance, this type of technology usually includes laptops, a projector, a smart-board, tablets, and computers. Amiel and Reeves (2008) investigate the role of tools and techniques in the classroom, stating that researchers are intrigued to adapt the educational environment to a new technique or device for creative use (p. 33). Moreover, the comprehension of technology as a procedure increases the complexity of the integration of devices into educational environments. Likewise, integrating technologies into the classroom prompts considerable changes in social association, student-teacher relationships, and some variables that can't be examined effectively by predictive research (Amiel and Reeves, 2008). Accordingly, Hye, Park, Yoo, and Kim (2016) state that educators and researchers have indicated that combining technology in the classroom can improve various types of drawing projects within several academic areas by developing the communicability and

representational purposes of final illustrations (p. 209).

Thus, an essential view of the potential of technology emerges from literature on creativity in the classroom: innovative uses of classroom technology stem from creating problem solving, and at the same time, creative uses of technology stimulate new modes of thinking, thereby forging a productive synthesis with the potential for continual creative renewal. Therefore, the importance of technology in the design classroom, as McLellan and Nicholl (2013) emphasize, is that in design and technology, students synthesize functional and technological skills with creative thinking to design and make products and systems that meet human needs (p. 166). Therefore, I assume that technological devices in the classroom, particularly in the design classroom, are essential to the formation of networks of actors that create a mood of creativity.

Designing Learning Environment for Designers

In this framework, design classrooms for teaching design courses may be considered places of extensive interaction and assemblage between actors in different networks. The design of these environments clearly affects learners' decision processes in design. ANT in design illustrates the significance of creating experimental zones where design is about learning and developing over time (Storni, Binder, Linde, & Stuedahl, 2015). Yaneva (2009) states that ANT reveals how each particular technical feature of an object accounts for a social, psychological, and economic world (p. 276). Hence, "the innovative feature of ANT is the ability to study boundary objects with an agency not only from a human-centered perspective but also being open to alliances among non-humans" (Fleischmann, 2006, p. 84) such as the relationship between designing classroom space and designing the classroom equipment. Thus, ANT makes

a strong case for investigating and understanding the creative climate in a design classroom, in order to underline the interaction between objects and actors. Moreover, “ANT support[s] understanding of design as well as the adoption process in current planning practices” (Boerboom & Ferretti, 2014 p. 94).

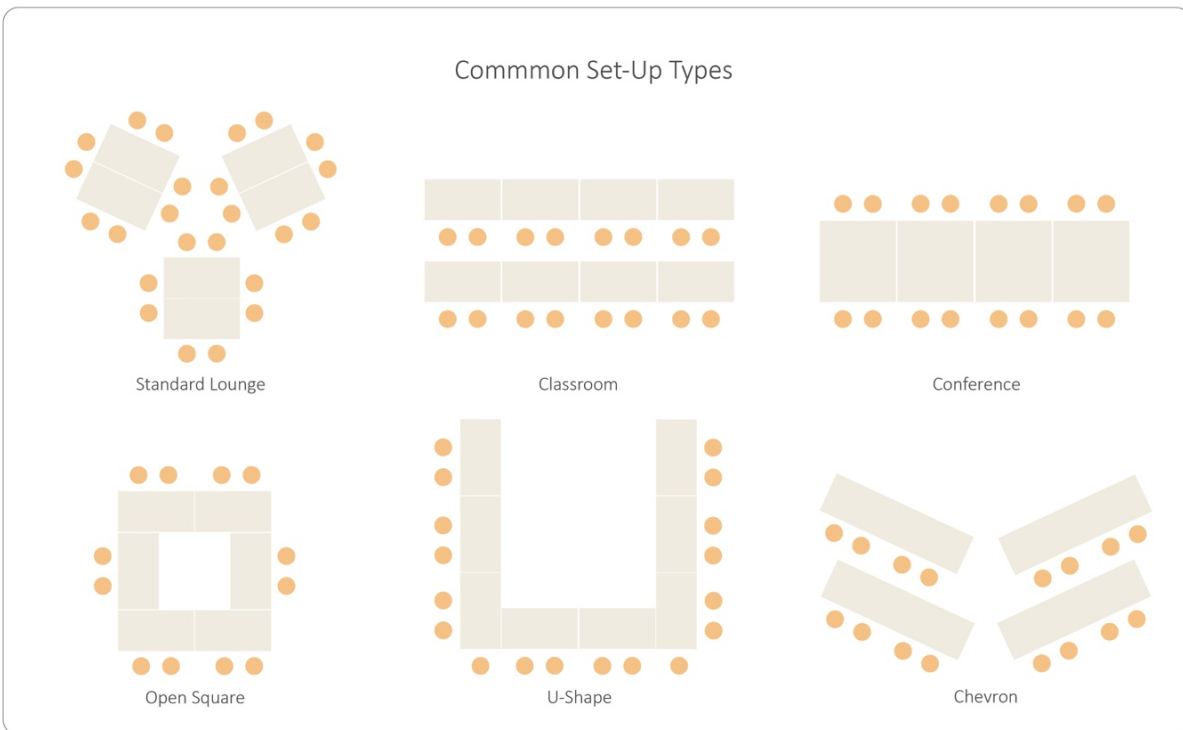


Figure 2.1: Different styles of arranging classroom seating (adopted from Webster University, n.d.).

In a design classroom, there are diverse factors that affect behavior between learners. For instance, the location of the windows and the light, the design of the tables and chairs, and the design of the space are significant because they impact learners’ interactions and their achievements (Figure 2.1). Also, the physical settings—the arrangement of the classroom—can either encourage or constrain the teaching and learning process. Therefore, the design of a classroom may aim to increase the impact on learning through autonomous learning spaces and the design of compatible productive components that serve collaborative education (Beery, Shell, Gillespie, & Werdman, 2013; Sommer & Olsen, 1980). Nancy Van Note Chism explains

that the arrangement of classroom desks or tables in ways that make it easy for students to pair off or work together in small groups not only supports active learning more readily—it also encourages this very behavior among students (n.d.). Moreover, Van Note Chism and Bickford (2002) claim that universities and colleges need to reconsider the construction and renewal of learning spaces to allow the impact of such important factors as technology to support learning patterns amid projected future use of such spaces.

Classroom design shapes the way students (designers) think, move, act and connect with different objects, and how they interact in the design classroom. The interaction is not only material. Rather, it may be any sort of interaction among different bodies that is experienced, perceived, and understood (Edmonds, 2007, p. 141). For instance, a designer works in particular situations to make a final product (Schön, 1983), so a relationship between the materials and non-materials arises through the design process. Such interactions develop because the designer at work lives under the influence of the idea, including the emotional and intellectual impact of interacting with material components of creative work. Such considerations can ultimately illuminate the reasons interactions between humans and non-human actors emerge in particular spots. Consequently, the interactions between individuals in a design classroom as a learning community rely on activity, everyday practice, and context (Brandt, Cennamo, Douglas, Vernon, McGrath & Reimer, 2013; Brown, Collins & Duguid, 1989). Victor Papanek has emphasized associated ways to design an environment for learners and how this affects their interactions. He states that change in learning occurs because education is a process of interactivity that also relates to the environment (Papanek, 1984). Specifically, when the learning environment cannot engage the learner to be interactive, the environment must

deliver appropriate feedback that meets with a learner's needs so the learner can respond to the environment (Papanek, 1984).-The classroom studio requires light, windows, and technology to be designed in advance for an ideal classroom. In other words, design is concerned with how things function, how they are controlled, and how collaboration unfolds among individuals and technology (Norman, 2013). Equally important, the way the layout of the design classroom is structured can help track where creativity might appear as a phenomenon, as well as how creativity might be improved as a set of skills. All of this is part of what I will refer to as the creativity climate of the classroom.

At the same time, the aim of design is to understand the process of designing objects and their environments for better uses because "design must become an innovative, highly creative, cross disciplinary tool to the true needs of men" (Papanek, 1984, p. x). The goal of the design classroom is to acculturate students into specific practices, habits, experiences, and skills of professional design practices (McDonald, Rich & Gubler, 2018). Elisa Navarro Morales and Londoño (2018) describe traditional design studios by discussing the goal of practice. They state that throughout practice, the design studio exists to fulfill the objectives established in a type of relationship, named by Donald Schön (1983) a "reflection in action," which develops skills as a result of the exchange between thinking and making. Schön notes that when a practitioner reflects in and on his practice, the conceivable objects of reflection change according to the phenomena before the practitioner and the systems of knowing-in-practice, which he or she brings to them. Thus, reflection shapes the adoption of a particular course of action. It is, therefore, crucial to contemplate the work environment of the practitioner because it will ultimately be reflected in practice and interaction with design work.

In this context, it is fundamental to underline good design for design classrooms by realizing the importance of *experience design* and *interaction design*. Norman (2013) notes that experience design focuses on the process of designing products, including the enjoyment of the whole experience, while interaction design is centered on how individuals interact with technology. Moreover, interaction design involves principles of psychology, design, art, and emotion in order to ensure entertaining, positive experiences (p. 5). Don Norman has developed a conception of “affordances” from a design perspective that emphasizes interaction with the design of things. In particular, affordances capture the relationship between physical object and individual. For instance, the presence of an affordance is simultaneously determined by attributes of the object and the capabilities of the agency with which it interacts (2013, p. 11). This conception entails design based on a human-centered perspective, encompassing relationships with surrounding things.

In my study, I consider affordance a part of understanding the relationship between actors in a design room. The concept of affordance relates to how we can design a creative place for a design practitioner. Maier, Fadel, and Battisto (2009) assert that affordances can be used as tools to examine the relationship between intentions of design and artifact use, leading to archived knowledge, as well as the potential for avoiding common design failures (p. 393). Also, Xenakis and Arnellos (2013) state that interaction aesthetics plays a critical role in design by improving the ability to identify the action possibilities affordances reveal, in order to anticipate effective interactions (p. 59). Moreover, Bilda, Edmonds, and Candy (2008) explain the engagement of individuals in materialistic interaction modes, which illustrate a transformative dialogue between designers and art systems during the interactive art

experience. Accordingly, Thoring, Desmet, and Badke-Schaub (2018) find that designing a creative space facilitates creative working and learning processes for designers, developed through a typology of creative spaces that is (a) comprehensive, (b) addressed to design education and practice, (c) based on empirical data, (d) a source of tangible examples of spaces, and (e) validated through an additional study. Based on affordances, we can understand the impact of the environment for creative design in education and practice, which can encourage designers and educators to enhance the design of their work environments.

As Latour states, "an actant can literally be anything provided it is granted to be the source of an action" (1990c, p. 373), so that all actors (human and non-human) have the same source of power as affordances. Thus, applying the notion of affordances entails that we consider non-humans as significant as humans when contemplating how actors create networks that gather other entities. For instance, the heterogeneous non-human assemblage of the design classroom involves students' desks and chairs, technology, and class equipment. In turn, the assemblage (objects) intersects with other assemblages (things) such as design curriculum and tools to develop a connection woven over time among networks. Accordingly, "designers who consider the non-human might find themselves reorganizing entire social and environmental systems" (Forlano, 2016, p. 50). Applying ANT to examine affordances in a design classroom should decenter the human and consider the agency of the non-human. Accordingly, connections among such design fundamentals suggest how the design classroom should be designed, accounting for environmental models that generate interactions between the actors within the design classroom.

Ultimately, many of the studies reviewed thus far see creativity as a network located

between human and non-human actors. I agree with this line of inquiry but feel that it can be pushed even further. Here I would like to introduce my idea of embodied creativity as a weather condition within a design classroom. I hypothesize that there is a variable climate between actors in various zones around the classroom, such as spots for group projects requiring collaboration or places where particular project parameters lead students to work independently from others. Creative climate will be a metaphor to clarify where creativity might be located and analyzed, thereby supporting the re-conception of design classrooms as containing multiple, dynamic, interactive elements that can cause “storms.”

Creative Climate as a Weather System in a Design Classroom

This section synthesizes an ANT framework with a focus on classroom design and learning environment, which ultimately illuminates creative climate as a “weather system” in the design classroom. It also explores the relationship between ANT and creative climate, particularly examining effects on the decision-making of the design student. There is precedence for the idea of creativity as a kind of weather system. For instance, Ekvall (1996) considers climate a reflection of the interpretations, perceptions, comprehensions, emotions, and practices that represent life in an organization. Bearing this in mind, I will define the idea of creative climate, and I consider how creativity appears and functions as a “weather system” in a design classroom by using “creative climate” as a metaphor to support analysis of how actors interact.

Therefore, I argue that such interactions create a particular climate, which consists of identifiable creative practice spots in the classroom. This notion is important to fill in a gap in the existing literature. As outlined above, there are many studies focusing on the impact of

things, spaces, and technologies on student creativity. These are important studies, but there is a pretty consistent idea of creativity that it is something humans have or do. Technology, for instance, can shape creativity, but creativity is a human capacity. The idea of creative climate emphasizes how creativity emerges through a network, and thus is not purely human. It also emphasizes how creativity is a dynamic, intangible pattern that emerges through complex interactions. Therefore, I will try to fill a gap in the literature to contemplate the role of interaction in generating creativity. In this framework, the design classroom is a place with unique features that nurture a creativity climate between actors, which spawns distinct modes of interaction that generate creative networks. Therefore, my hypothesis within this framework seeks to grasp the connection between the design classroom layout, arranged as a learning environment based on actors' interactions, and creative climate as a weather system that encourages actors' interaction during project critique or design practice.

As such, it is important to highlight the relationship between the human (students) and the non-human (classroom things) from an ANT perspective to understand the production of creative spots. Such spots generate potential interaction between actors at points where creative weather might be storming in a design classroom. According to Law (1999), ANT articulates the entities that take specific form and shape as a consequence of their relationships with other entities. Unlike a human actor, an actant (actor) in ANT connotes no particular motivation or cognitive functioning. An actant can be anything designated as a source of an activity (Latour, 1996, p. 157). ANT was developed with the ambition of discovering and then critically examining explicit or implicit dynamics of power (Alcadipani & Hassard, 2010), and creative climate may be considered a power that emerges from interaction between actors that

generates special connections with classroom objects. Also, ANT makes a strong case for investigating and understanding the creative climate in a design classroom, in order to underline the interaction between objects and actors.

ANT describes the creativity emerging from such interactions and collaborations in different spots in a design classroom. My explanation is that creativity is “the process of creativity involves the interaction between heterogeneous groups of participants” (Bown, 2015, p. 17). Consequently, ANT and creativity meet at the same point of interaction between actors that fosters new patterns of creative networks. ANT views things according to what they do, rather than as instruments of the work of a group (Georg, 2015). ANT explains the non-human as “an effect of stable patterns of relations” (Sayes, 2014), and the same characteristic applies to design classroom things. For example, a student might choose a specific seat that feels comfortable or use particular tools or objects for practicing design. In addition, things—material and visual artifacts—are powerful because they have performative effects.

Employing ANT to conceptualize creativity as a weather system shaped by interactions as variable factors in a classroom, I consider that the geography of the classroom (the classroom layout) is formed to promote an *interactive climate* between actors. Interactive climate occurs in classrooms that encourage participants to interact with classroom objects in innovative ways that promote new connections between students (human actors) and objects (non-human actors). However, the climate can also discourage, neglect, or confuse connections between actors, which defuses interaction. Hence, the interactive climate can disappear from the classroom. Building on this conception, I also ask how creative weather events like humidity, fog, or brainstorming around spots of creativity might affect on the decision-making of

design students. As such, I have devolved terms in using creative climate model *Figure 2.3*, referring to the weather in the design classroom, to accurately describe the state of actors in the network while evaluating creative climate map.

Creative Climate in the Classroom

My review of such literature on creative climate examines how creative climate is created in pedagogy or organizations that are interested in shaping creativity. In turn, I use this literature to formulate a distinctive perspective shaped by actor-network theory. The conception of creative climate I draw upon throughout my work stems in part from studies of the phenomenon in organizational and business environments. I have, however, rethought the concept to fit the design classroom as a work environment producing creative ideas. Creative climate studies explore individuals' perceptions of their work environment with regard to support and independence (Mathisen & Einarsen, 2004; Hunter, Bedell, & Mumford, 2007; Péter-Szarka, 2012). "Climate is defined as the recurring patterns of behavior, attitudes, and feelings that characterize life in the organization" (Isaksen, Lauer, Ekvall, & Britz, 2001, p. 172). Moreover, James and Sells (1981) define climate as individuals' cognitive representations of environments (p. 276). Also, "climate may be viewed as a more concrete and tangible way to measure elements of culture in terms of specific behaviors and characteristics" (McLean, 2005, p. 241). In addition, the concept of climate may encompass individuals' productive representations or cognitive schema of their work environments, through efforts to reveal individuals' sense-making of their work environment (Ashforth, 1985; James & Jones, 1974; James & Sells, 1981; Schneider & Reichers, 1983; Anderson & West, 1998).

Several studies employing a concept of creative climate focus on collaborative learning

between peers and project-organized groups. The concept of creative climate is defined by Göran Ekvall as “an attribute of the organization, a conglomerate of attitudes, feelings, and behaviors which characterize the organizational life” (Ekvall, 1996, p. 105), as well as an individual’s action within groups. Ekvall and Ryhammar (1999) emphasize that creative climate transforms the organizational realities members experience around structures, policies, tasks, goals, strategies, leadership, resources, workload, technology, and staff characteristics (p. 303). Moreover, creative climate may be seen as the work climate or organizational environment that promotes or discourages the production of ideas and innovation in practice (Gisbert-López, Verdú-Jover, & Gómez-Gras, 2014; Schumpeter 1934).

Building on such uses of the term *organization*, I employ the word in my study to refer to the learning environment of the design classroom as a creative place, where creativity emerges as a result of interaction between all actors as it is developed within various networks. In this light, the conception of creative climate illuminates implications for sustainable pedagogy, since pedagogy adapted to a creative atmosphere promotes creative climate and encourages the learner to be more productive. Lin (2011) states that a supportive climate for developing creative abilities and qualities is created through the interaction between creative and effective teaching by the creative facilitator, as well as creative learning by the active learner (pp.151-52). In addition, this definition of creative climate includes practices, attitudes, and emotions inherent to a group or an association, which supports the shaping role of the situational environment around creative ideas in working groups (Zhou, 2018).

Several studies have examined creative climates in working spaces (Amabile & Conti, 1999; Ekvall & Tangeberg-Anderson 1986; Isaksen & Ekvall, 2010; Mohamed & Rickards, 1996;

Hong, Chang, & Chai, 2014). Woodman, Sawyer, and Griffin (1993) state that organizational creativity is the conception of a valuable, useful new product, service, idea, or process by individuals working together in a complicated social system (p. 293). McLean (2005) emphasizes that while environmental factors within organizational culture and climate impact individuals' behavior, a primary focus on the individual's creative climate remains essential. Moreover, Amabile (1998) asserts that individual creativity is the most significant component of organizational innovation, but it is not, by itself, adequate if creativity-relevant skills are lacking. Thus, based on the componential model of creativity and innovation in organizations, five environmental elements affect creativity: encouragement of creativity, autonomy or freedom, resources, pressures, and organizational impediments to creativity (Amabile, 1988, 1997; Amabile, Conti, Coon, Lazenby, & Herron, 1996; Amabile & Conti, 1999). Also, as long as resources are available, they will allow individuals to grasp ideas that arise from a creative climate (Hunter, Bedell, & Mumford, 2007, p. 83). Correspondingly, it is clear that previous studies consider the creative climate concept part of organizational creativity and innovation.

Furthermore, a useful tool has been developed by Göran Ekvall (1996) to assess and measure creative climate in organizations, known as the Creative Climate Questionnaire (CCQ). *Table 2.1.* This technique is used to measure how individuals in the workplace frequently act, and it might help to illuminate how creative climate emerges in a design classroom. "CCQ concept is a general measure of the creative climate, of the attitudes, behavior, and feelings that are common in the organization, not an indication how some individuals or groups of people behave" (Ekvall, 1996, p. 118). Ekvall (1996) states that the creative climate is related to ten dimensions that promote the work environment: challenge, freedom, idea support, trust/

openness, dynamism/liveliness, playfulness/ humor, debates, conflict, risk-taking, and idea time (Table 2.1). Classroom behaviors may be distinguished by their improvement of creativity with regard to Ekvall's dimensions, some of which are: a) idea-time that allows time for ideas and creative thinking, challenges that fulfill creative ideas and products; b) risk-taking that encourages tangible risks , acknowledges mistakes, imagines other viewpoints, or questions assumptions; and c) debate that explores the environment, finding interest and problems, generating multiple hypotheses, focusing on broad ideas rather than specific facts, and thinking about the thinking processes (Fleith, 2000; Péter-Szarka, 2012).

Table 2.1: Creative Climate Questionnaire

DIMENSION	DESCRIPTION	DIMENSION	DESCRIPTION
Challenge	The emotional involvement of the members of the organization in its operations and goals.	Playfulness/ humor	The spontaneity and ease that is displayed. A relaxed atmosphere with jokes and laughter characterizes the organization in which this dimension is prevalent.
Freedom	The independence in behavior exerted by the people in the organization.	Debates	The occurrence of encounters and clashes between viewpoints, ideas, and differing experiences and knowledge. In debate in the organization, many voices are heard, and people are keen on putting forward their ideas.
Idea Support	The ways new ideas are treated. In a supportive climate, ideas and suggestions are received in an attentive and supportive way by bosses and workmates.	Conflict	The presence of personal and emotional tensions (in contrast to conflicts between ideas) in the organization.
Trust/ Openness	The emotional safety in relationships. When there is a strong level of trust, everyone in the organization dares to put forward ideas and opinions.	Risk-taking	The tolerance of uncertainty in the organization. In high risk-taking cases, decisions and actions are prompt and rapid, while arising opportunities are taken and concrete experimentation is preferred to detailed investigation and analysis.
Dynamism/ Liveliness	The eventfulness of life in the organization. In the highly dynamic situation, new things are happening all the time and alterations between ways of thinking about and handling issues often occur.	Idea time	The amount of time people can use (and do use) for elaborating new ideas.

Source: (CCQ) (Ekvall, 1996)

Ekvall (1996) emphasizes that the climate exerts a directing force because its impacts

influence organizational processes such as problem-solving, decision-making, communications, co-ordination, control, and psychological processes of learning, creation, motivation, commitment, and responsibility (p. 106). Moreover, Amabile (1996) has measured climate for creativity with the assessment survey instrument *KEYS*, and she also explains that components divide into two general sections: a) stimulants to creativity described by scales assessing organizational and supervisory encouragement, workgroup support, sufficient resources, and challenging work, and b) obstacles to creativity illustrated by scales assessing organizational impediments and workload pressure.

Also, Amabile et al. (1996) develop a conceptual model underlying assessment of perceptions of the work environment for creativity that include conceptual categories of work environment factors hypothesized to influence creativity, scales for assessing perceptions of the work environment (key environment scales) and assessed outcome of the work (Figure 2.2). Also, Anderson and West (1998) describe the development of a measure of proximal work group climate created to capture team members' perceptions of climatic dimensions, hypothesized to relate to one phase of group output and workgroup innovation. Particularly, it is clear that creative climate is influenced by several factors both in the organization and in the classroom.

Naturally, the relationship of creative climate to design classes is strong because interdependent variables arise between objects and individuals due to direct and indirect interaction. In this case, my interest in developing this perspective is part of understanding the impact of the creative climate on the student-designers who are subjected to brainstorming, moments of intellectual laziness, or inability to design and engage with work in a group.

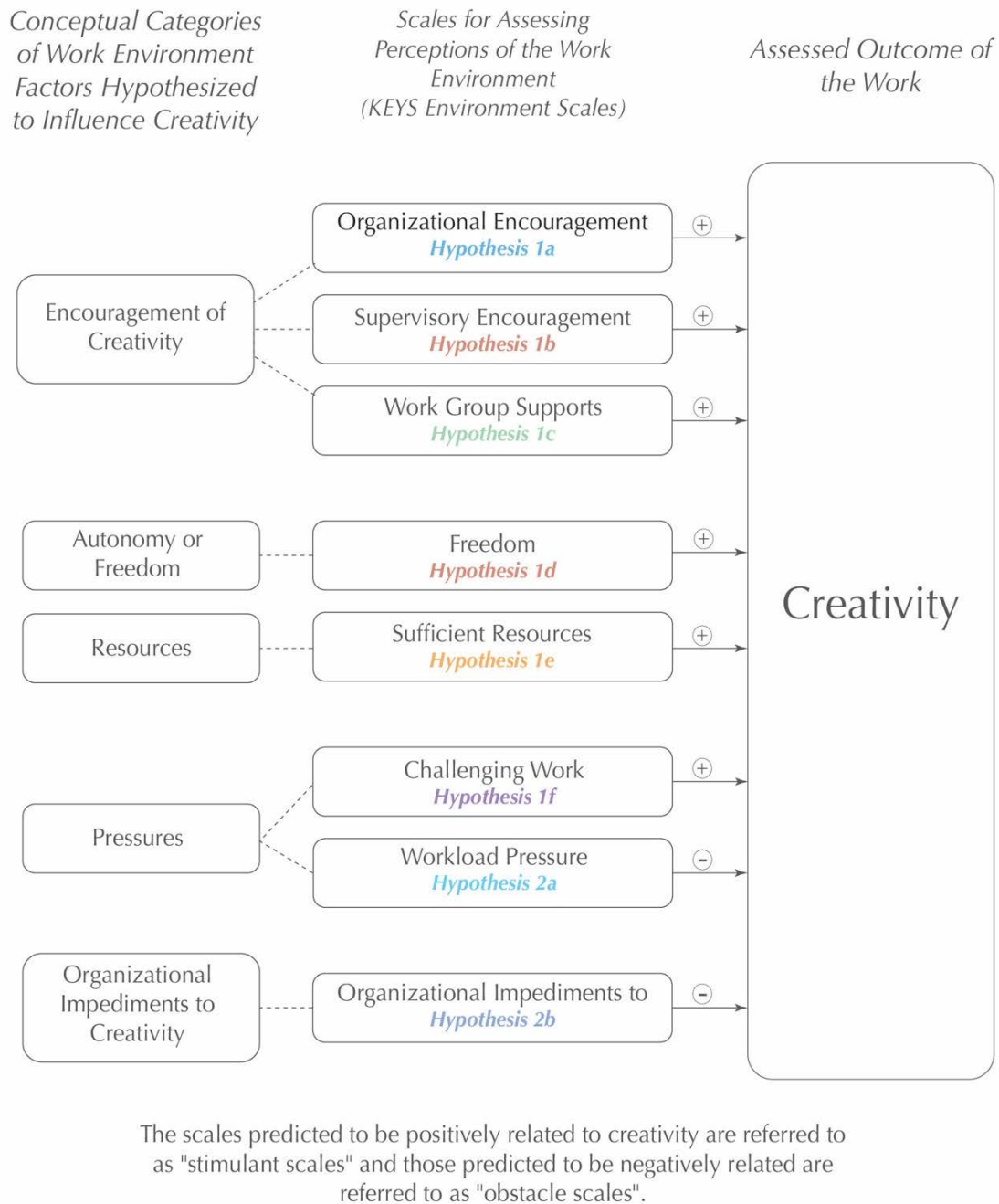


Figure 2.2: A conceptual model underlying assessment of perceptions of the work environment for creativity (Amabile, Conti, Coon, Lazenby, & Herron, 1996).

Organizational climate features are intimately connected with problem-solving and learning styles, which also explains their function in the classroom (Péter-Szarka, 2012, Treffinger, Isaksen & Dorval, 1996; Argona, 2001). In *Interaction Design and Creative Practice*, Candy and

Costello (2008) express that interaction design techniques are brought into a creative process through a comprehension of the lived experiences of participants (p. 522). The design process and creativity are an integral part of the creative process, as design thinking contains stages that include problem-solving to devise creative solutions to be applied to objects and projects. In other words, "A designer is a thinker, whose job is to move from thought to action" (Friedman, 2001, p. 37). Similarly, creativity is a thinking process that addresses different phases to achieve creative ideas. Although many studies on creative climate in organizational environments do not address design and art education subjects directly, such literature provides valuable insights, such as the importance of creative climate to the redesign of creative workspaces—which undoubtedly includes classrooms—based on innovative networks. At the same time, however, in such scholarship on creative climate in organizational environments, there remains a lack of literature on the role of non-human things and objects.

Nevertheless, some important studies elucidate models of creative climate that may encompass the role of the non-human. For example, Gisbert-López, Verdú-Jover, & Gómez-Gras propose that the "creative climate emerges from different forces interacting in a way that can be stimulated or inhibited" (2014, p. 47). Therefore, the capacity of resources related to innovation and creativity interact with climate by enabling associations to follow and act on the ideas flowing from a creative climate (Nystrom, Ramamurthy, & Wilson, 2002; Hunter, Bedell, & Mumford, 2007). Consequently, in my reading, this power may certainly encompass the relationship between actors that create the forces of interaction between entities, human and non-human.

Previous studies address the climate of creativity to enhance skills in work environments

and organizations, while in my study, climate as a metaphor of creativity is distinguished by the individuals' presence in a design classroom based on their interactions with non-human actors in the classroom. As such, it is important that I develop my own definition to expand this hypothesis of creativity as a weather system. For example, although Amabile's model illustrates the organizational impediments to creativity such as formal management restrictions, this model does not consider that the design of the place and its contents are essential components to stimulate creativity among individuals, work environments, and classrooms. However, I found that Andrea Rae Gammon develops a term to describe the climate as assemblage by referring to the importance of non-human objects in interaction:

Climate-as-assemblage brings to light numerous and diverse non-human forces, or actants, and taking these seriously requires a reconceptualization of agency that can be broadly disseminated across these instead of restricted to human subjects only. (2013, p. ii)

Also, Jonathan Daly discussed the role of the non-human affecting human actors by observing objects in Superkilen's Green Park; he confirms that the "some non-human actors had the agency to repel human actors" (2019, p.11). Daly's perspective influences me to think about a different dimension that can be mapped by applying ANT within creative climate studies.

In sum, creative climate literature reflects a common understanding of the human motivation to create a creative environment, but it does not fully appreciate the non-human elements that help to manufacture creative motivations and skills. The lack of literature evaluating non-human assemblages in creative climate has strengthened my commitment to investigating the role of non-human assemblages in enhancing creative climate in the classroom. Creative climate may be effectively applied to redesign a design classroom because the organization of space shapes students' perceptions and interactions, which encompass

relationships among instructor, students, and classroom facilities. As such, my study has addressed the conspicuous neglect of the power of things in such environments, developing a model of creative climate informed by actor-network theory and encompassing the non-human.

Creative Climate for Practicing Design

Since design education is associated with the design environment, there are several studies that highlight the relationship between design education and creative environment. Design education considers the learning environment for the students and how it builds their knowledge through practicing design. At the same time, design education teaches how to practice design and visual language to communicate with design tools to produce subjects for various purposes (Nae, 2017). Moreover, in design education, the design provides a framework for much of design practice and is, thus, crucial for practicing designers (Easterday, Gerber, & Rees Lewis, 2018). Moreover, “flexibility in course design and workload also require[s] students to take responsibility for their learning and challenge themselves at a level that promote[s] personal knowledge growth (Zaugg & Warr, 2018, p. 12)”. Also, Bjögvinsson, Ehn, and Hillgren (2012) describe design as a potential to certify that existing skills could be made a resource in the design process (p. 103). Accordingly, Zaugg and Warr (2018) highlight that design courses purposefully promote design thinking within a context of a learning experience that focuses on preparing student skills for future employment (p. 14). By explicating some elements of these studies, I would like to suggest that creativity conceptualized as a creative climate affects the decision-making process and the development of skills by the student.

The educational environment in design education is realized through creativity as a key

factor affecting individuals during learning. Thus, creativity lies in the availability of factors such as classroom design, availability of resources and devices, cash, work methods, and teaching methods. In relation to creative space in design education, Walter (2012) suggests employing a theoretical framework for designing a workspace that increases creativity in both learning and office environments as a creative space for practicing design. Zakirova and Purik (2016) state that having a creative environment helps develop students' creative abilities, enhancing the quality of their artworks, knowledge, expression, and comprehension of artistic skills. Creativity never functions by an individual alone, but rather is the result of the connection of a stable social interaction that will guarantee the generation of creative ideas (Lewis, 2005; Csikszentmihalyi, 1988).

Accordingly, the creative climate of the design classroom enhances the design thinking that in turn promotes decision-making through a design process. Schön (1983) explains that our practice of problem-solving encompasses the process by which we determine the decision to be made, the ends to be accomplished, and the means which may be chosen in our practice (p. 40). "Decision-making is then a field of study that is constantly addressed in all domain knowledge areas being as a main driver of those studies the cognitive assessment of how decision-making occurs" (Christiaans & Almendra, 2010, p. 642). Ford and Gioia (2000) confirm that decision-making is significant in its own right, and it also might be fundamental to understanding creativity in other areas of organization (p. 706). Indeed, decision-making and design are so interlaced that the whole of decision-making may be viewed as a design (Simon, 1969; Christiaans & Almendra, 2010). Moreover, decision-making improves by "design moves" that include creating choices, selecting among them, concretizing choices, and evaluating the

choices and the design results, which, in turn, shape decision-making to be more understandable in the design process (Schön, 1995; Hendriks, Huybrechts, Slegers & Wilkinson, 2018). Also, Keeney (1994) states that “decision makers usually think of decision situations as problems to solve, not as opportunities to take advantage of” (p. 39). Considering the design process, I assume that the relationship between decision-making and creative climate is connected when we have a creative environment because it works as a motivation to promote more creative ideas.

Moreover, Hasirci and Demirkan consider the interaction between the creative individual, creative process, and creative product within a creative environment during a design process (2003; 2007). Accordingly, Hasirci and Demirkan (2007) demonstrate that productive interaction between students is effective in developing their ideas. (p. 269). Also, working within a larger group of individuals on different levels facilitates the interaction of creative ideas as a result of working with classmates and predecessors in the field. (Simonton, 2003; Hasirci & Demirkan, 2007). In sum, clearly, the creative climate in a design classroom impacts students’ skill and promotes their decision-making through a design process.

Creative Climate Model

“Creativity is a multi-dimensional and complex phenomenon. It is difficult to measure and one of the most difficult psychological concepts to define” (Toivanen, Halkilahti & Ruismäki, 2013, p. 1169). However, based on previous literature on ANT, creativity, creative climate, and design education, I conclude with a model that might represent the concept of creative climate in a design classroom. To construct this model, I consider two significant points:

1. Location of a creative climate → How creativity as a climate affects decision-making and the mood of a student (designer)
2. Design of a creative climate → How we can design a creative environment to develop the student's (designer's) skills.

Drawing on both Ekvall's (1996) dimensions of organizational conditions that stimulate or hamper creativity and innovation, along with Amabile, Conti, Coon, Lazenby, and Herron's (1996) model of environment for creativity, I apply both studies' frameworks to designing classroom climate. In my approach to terminology, I apply various expressions to outline concepts in this essay. For example, I am using general definitions, all of which have several sub-terms, such as *geography of the classroom*, which refers to the classroom architecture. Creativity knowledge will be represented in *creative clouds* where actors develop and use their knowledge for both skills and decision-making. *Classroom climate* captures where such circumstances appear in a studio classroom. Consequently, as an example of mapping a creative climate, I have created a model that combines ANT, the creative climate, creativity, design education, and dimensions of creative organizations in the Ekvall model to highlight three main elements that impact and promote creative climate: a) climate in the classroom, b) brainstorming areas, and c) creative clouds (Figure 2.3). These features have several axes, which are:

A) *Climate in Classroom*, which represents two models that describe factors essential to the creative climate in a design classroom. Each factor is divided into categories representing the creative climate; for instance:

- a. The "practices of creativity" category explains the implications of practices of creativity, divided into positive effects (supportive) that increase creativity, and negative impacts (obstacles) that reduce creativity. This idea derives from Amabile, Conti, Coon, Lazenby, and Herron's (1996) model that underlines the assessment of perceptions of the work environment for creativity (Figure 2.2).

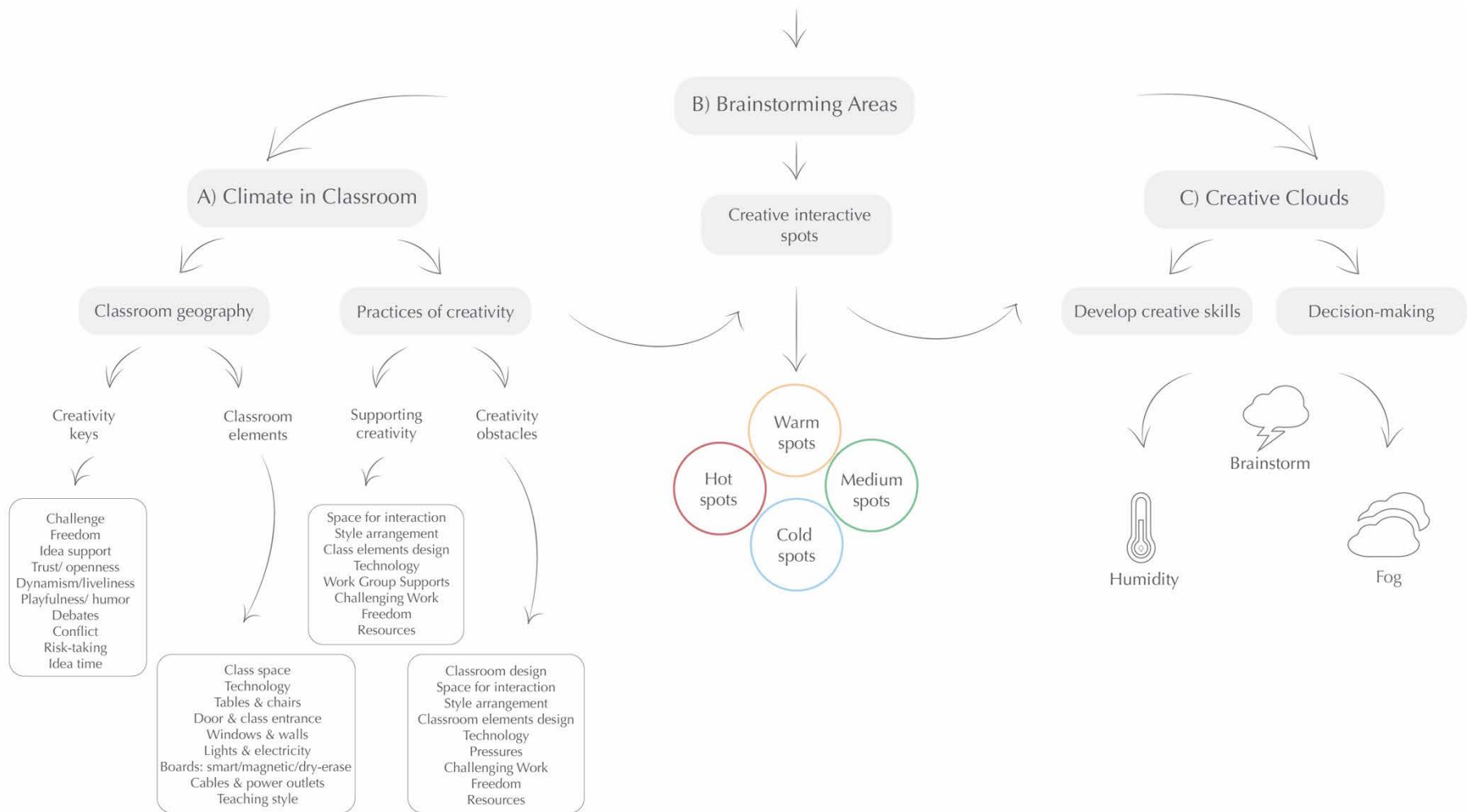


Figure 2.3: The study model of creative climate in a design classroom.

b. "Classroom geography" describes space, tools, technology, and teaching method, which are also expressed in Ekvall's model of ten dimensions of creative organizations (Table 2.1).

B) *Brain Storming Areas* represent the assemblage and interaction among actors in the classroom network, including creative interactive spaces, which, in turn, represent the creative patterns and changes in the classroom. Also, this portion could be useful in designing creative interactive maps, which indicate and emphasize interaction spots among actors. For instance, medium spots will be common areas where all actors can communicate and interact, in contrast to the cold spots that will represent dead zones with no interaction between the actors in the classroom. The hot spots will underline where significant actors gather in moments of high activity, while the warm spots will highlight where some actors gather in cooperative moments of activity. *Figure 2.3.*

C) *Creative Clouds*, which are the actions the designer pursues in the design process, related to the development of creative and critical skills. This aspect contains:

- a. Decision-making
- b. Creative skills development

These two elements are affected by the interactive spots, which, thus, relate to the designer's performance during the design process. Moreover, considering the relationship between decision-making and design that affects the development of creative skills, I apply weather language as a key to articulate phases of growing, dulling, and disappearing creativity. In my model, I use the brainstorms key to refer to the periods when actors have moments of creativity, and I apply the humidity key to define where actors have a moment of passion lost to

complete design work. The fog key describes the moment when actors disconnect from creative ideas and lose their decision-making power in design work. *Figure 2.3*.

This model demonstrates an important potential for understanding how many features affect the creative climate of a design classroom at any given moment. The model is based on actor network theory, design and education, decision theory, creativity, and creative climate organization, and it focused on interaction and experience in the learning environment.

Summary

In this first part of my literature review, I have worked to clarify the utility of some research related to actor-network theory to find an appropriate way to investigate my major question. Beginning by clarifying the conceptual framework of actor-network theory, I have then examined the application of this theory in education. In the second part of the review of literature, I illuminate the relationship of the learning environment and creativity within the scope of design classroom in order to determine the factors that cause the inspiration of creativity.

While the literature on learning environments and technology highlight the role of these factors in promoting creativity, ANT, as a theoretical perspective, furthers this inquiry by placing emphasis on the creativity of things and their powers within networks. ANT proposes that creativity is not merely human but is rather the outcome of a host of creative agents working together within an assemblage. Viewing the classrooms as an assemblage of actors is essential to this dissertation project. Likewise, ANT has failed to produce studies focused on specific kinds of classrooms (such as design classrooms) that foster creativity. Thus, the two bodies of literature ought to be brought together.

Finally, the third section of my discussion explores creativity as a weather system in a design classroom toward understanding the interaction between designers and things in a particular place. I argue that a design classroom, where design courses are pursued, has a distinctive system of interaction that promotes different patterns of creative climate, which, in turn, bring on special weather that affects creativity as a skill or the process of decision-making for the design student. Also, I have established a critique of creative climate theory in its exclusive focus on human action and neglect of the impact of non-human things.

Consequently, under the concept of creative climate, I develop a climate metaphor based on the interaction between human and non-human in a classroom to enhance design education that apprehends the design environment for learners. Also, I examine the design classroom's layout as comprised of factors that foster the weather system. That analysis is based especially on design theory that explores conditions forcing students in a classroom to either make decisions or develop their creativity.

CHAPTER 3

NETWORKS METHODOLOGY

This chapter presents the methods and procedures followed to generate, collect, and analyze data to answer this study's research questions and to report on the findings. The chapter includes: (a) research design; (b) mapping the method, including research setting and participants; (c) data analysis; (d) credibility; and (e) summary. I chose to apply a qualitative method to assemble and analyze data. My qualitative approach, associated ultimately with ANT, included observation and a focus group method, wherein detailed observation tracked actors to understand the various roles that human and non-humans play in a "creative network." The data was collected through observing students and objects in a design classroom during the Spring 2019 semester and applying focus group interviews. This investigation focused on:

- The interaction between the students and objects and how creative climate affected their design practices.
- Recording observations of students with observation sheets and noting how often they interacted with things to create their network.
- Producing multiple maps of the actor-network movement that changed over time between students and materials.

Since no specific research methods are provided by ANT, I found that an ANT approach did not limit its investigation to the structure of objects; rather, it demonstrated how each specific object is a part of the social, psychological and economic world (Yaneva, 2009). Therefore, my goal was to explore the potential of using the classroom layout and pinning creativity to trace a creative network by highlighting class spots where students (human) gathered and interacted with classroom objects (non-human).

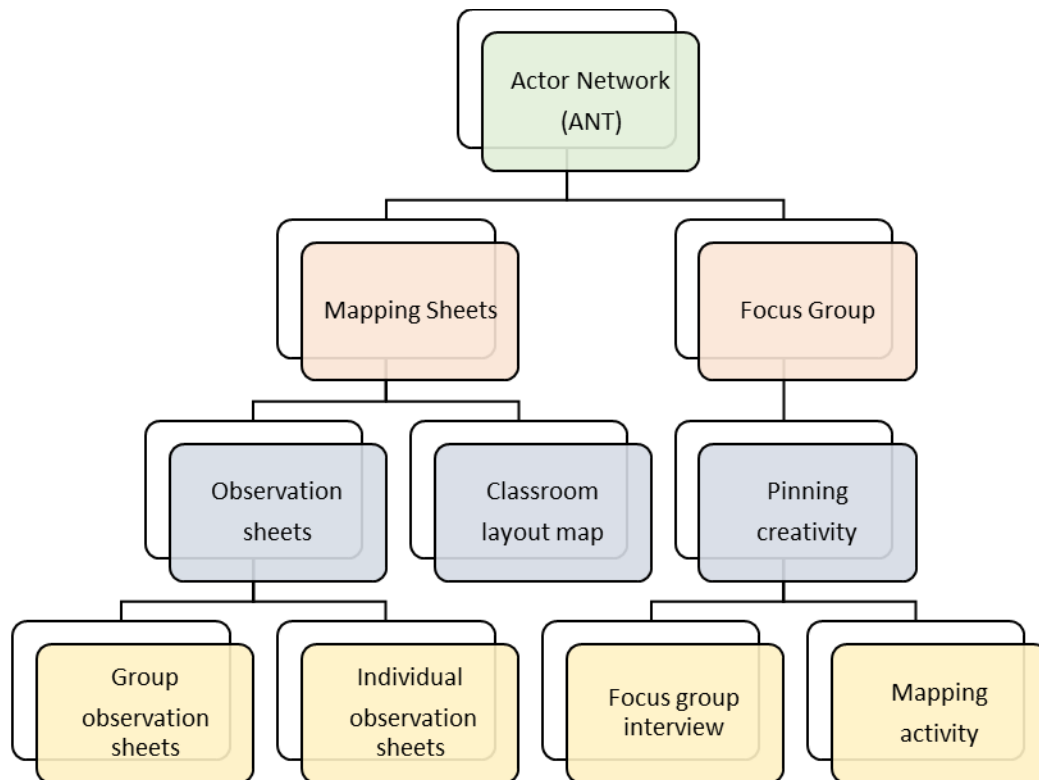


Figure 3.1: Diagram of the methodical framework. This diagram explains the methods used in mapping creative networks in the design classroom.

Research Design

As a methodological choice, actor-network theory provides a microscope for conceptualizing data as arranged procedures (Tillander, 2008). I employed ANT as a general methodology essential to structure an accurate analysis, as well as a comprehensive theory to illustrate the role of objects, actors, and networks. Moreover, since focusing on the human and non-human relationships in the classroom is an essential part of this study, I assumed that ANT would help to analyze such interactions and expand our understanding of the importance of the classroom as a network of actors, rather than as a set of isolated variables. Research indicates that connections and discourses between networks can at one minute seem to work on a fantastic scale, and, at another point in time, disintegrate or fall (Callon & Latour, 1981; Law,

1992; Waters, 2014). Therefore, employing actor-network theory as an approach allowed this study to follow the translation that develops because of the interaction between the human (students as designers) and non-human (class things). This approach is a notable contribution to the analysis of actor networks because ANT scholars have not applied actor-network theory to design and designing classrooms. Rather, they simply have investigated widely the appearance of objects and how they work and act (Yaneva, 2009, p.276).

This study focuses on employing ANT to look at a design classroom, where technology is an integral part of teaching and learning the design course. O'Byrne et al. (2018) state that in relation to integrating technology in the classroom, effects on learner creativity should be evaluated for any potential change, either positive or negative (p. 184). Nottingham (2017) finds that ANT enables us to analyze how the materiality of learning environments is involved in the development of design students (p. 43). Similarly, Yaneva (2009) expresses that an ANT approach to design would consist in examining the culture and the practices of designers, rather than their theories and their beliefs, to understand what designers and users do in their everyday activities (p. 282). In this context, tracing creativity in the design classroom is an effective mode of data collection, following the emergence of creativity among students (designers) and things.

ANT has been used as a methodological framework in several studies in order to understand various education issues in different locations. Roth (1996) creates his methodology by applying ANT to “understand a living classroom community to follow the emergence of shared knowledge in the form of resources and tool-related and concept-related practices” (p. 186). Roth recorded students in the classroom on videotape to “find out how an increasing

number of students in the classroom used particular knowledge and recognized this knowledge as shared” (p. 193). Therefore, his study raised new, significant questions about student-centered pedagogy in general and technology in particular. Roth (1996) concludes that ANT improved his study by offering a new understanding of learning, and of how the classroom changes. Although interviewing participants is not common in ANT, Roth (1996) has applied this method to have a comprehensive understanding of student interactions (p. 191). Also, Pierre, Johnson, Ballie, Thorup, and Brooks (2017) apply ANT as a methodology to study two cases of design artefacts. By developing a visual design method from ANT, they represent design artefacts within the complex network of individuals and things in the design situation, contributing an expanding notion of design artefacts and how they perform as boundary objects (p. 221). The authors find that ANT provides a way to bring to life the knowledge produced through design artefacts at complex boundaries. Moreover, Nottingham (2017) takes an assemblage analytic approach towards investigating the human and non-human data, examining how impacts might be assembled in design learning places, and exploring the pedagogical implications therein.

The present study worked toward utilizing actors’ interactions within a physical classroom for a design course and discovering the relationship between human and non-human active bodies. It used a classroom layout to map the emergence of creative networks. My conceptualization of mapping defined a particular approach to the relationship between students and objects, with particular interest in how maps might be constructed to highlight where and why creativity emerges in a classroom. Therefore, I considered implementing a creative-map approach that would highlight students' interactions to determine spots of

intense networking, followed by interviews and pinning activities to find correlations with creativity. This approach was envisioned to enhance and promote creative spots in a design classroom, as well as identify what makes a “spot” in a classroom “creative.”

I applied the focus group to extend the accuracy of my evaluation of the ways creativity is located in a design classroom. My goal was to determine a method to explore and trace the student interactions that fostered creative networks in a particular design classroom space. In the following methodological framework, I review the background of the idea of mapping in actor-network theory and its relationship with focus groups. Then, I discuss focus group literature and how it applies to the design discipline as an analytical tool. Finally, I address creating a unique approach to implement the focus group viewpoint on collectively generated creativity in a design classroom.

Mapping and Interaction

Maps in general are “graphical instruments or tools for organizing and representing information, and they are used in many disciplines to construct new knowledge” (Novak & Cañas, 2008). They are also used to implement or clarify actions or ideas. Mapping describes the process of selecting and considering information spatially, which implies a way of looking beyond the completed artifact (Hall, 2012). Maps have different forms of usage to direct or track a phenomenon in a particular site in order to distinguish changes that emerge because of particular factors. To illustrate, maps include mental or cognitive maps, interactive maps, climate maps, road maps, political maps, economic maps, process maps, interaction maps, or creative maps etc. In particular, the focus of this investigation explores the concept of maps on measuring the interaction. Therefore, interactive maps a definition employed designing maps

for outlining the values of qualitative variables by colors or shapes (Andrienko, G. & Andrienko, N., 1999). Hall (2012) discusses mapping on a broad scale regarding design; she distinguishes mapping as recognizing and visualizing networks of activity, showing their potential to create and allowing them to grow. Also, she explains that the structure of mapping must be purposively established to indicate the distinctions between perspectives and levels of detail.

Most significant in this study is a focus on forging creative maps and recognizing the potentials of mapping as a conceptual idea, especially in relation to data collection based on focus group interaction in a design classroom. In this research, I apply the concept of the *creative map* to trace the relationship between the students and objects in a design classroom, to see if there are correlations between such spots and creativity. The notion of tracing and understanding the relationship between bodies comes from actor-network theory (ANT), allowing the exploration of the appearance of materials in a specific circumstance. In this way, creative maps might help identify creative climate, considering network interactions as a weather system producing creativity, and tracing its effects on actors. ANT provides a methodology for accurate analysis through mapping of the places creativity emerges in a design classroom.

Mapping in this context follows Bruno Latour in *Reassembling the Social: An Introduction to Actor-Network Theory*, which addresses the interaction between actors (human and non-human bodies). Latour found that mapping actors helps to illuminate the effects of replacing or changing actors in the network:

ANT . . . pictures a world made of *concatenations of mediators* where each point can be said to fully act. Thus, the key question for a social science is to decide whether it tries to deduce from a few causes as many of the effects that were there 'in potentia', or

whether it tries to replace as many causes as possible by a series of actors—such is the technical meaning that the word ‘network’ will later take. (2005, p. 59)

Callon (1987) mentions using a general map to understand different resistances met by actors.

Actor-network theory also can expand connections between collective cognitive practices in socio-ecological movements and educational environments (Pierce, 2015). Besides interaction among individuals, ANT's idea of mapping is to chart the process by which actors define and distribute functions and assemble or develop others to act roles (Law and Callon 1988; Cressman, 2009). Furthermore, the concept of mapping networks was developed by Pierre, Johnson, Ballie, Thorup, and Brooks (2017). Mapping networks in my study will entail studying classroom layout to come up with visual maps, the design of which will be based on the data collection. I construct them based on the actors’ (students) interactions with objects and spaces in the classroom. These maps not only will designate spots of assembly, but also places where the networks spread around different spots.

From various angles, ANT as a methodology in the design discipline has contemplated interactions, as well as how networks assemble, connect, disconnect, and collapse among actors. Design researchers have found ANT an essential approach to solve and study design issues, applying ANT as a method to consider collaborative design practices towards a design democracy (Storni, Binder, Linde, & Stuedahl, 2015). Design focuses on the interaction between creative ideas and practices, as creative design underpins many processes of thinking. Andersen et al. (2015) note that ANT problematizes participation as a concept and practice while also empowering practice design as network performance. They also focus on the practice of design as an interaction that gives a voice to participants through interaction with prototypes during project testing. Moreover, design, as Yaneva (2009) asserts, is a mode of association that

cannot be explained by other economic, social, or political means, possessing its own modes of growth, objectivity, and solidity (p. 281). In addition to contemplating ANT and design, the application of focus group methods is a companion tool in my study to explore how design students interact to create places that generate creativity in the classroom.

Moreover, using the focus group interview approach helps students share their ideas about classroom design and areas where they find comfort in their work, and the method also generates ideas that help me generate creative maps. This method is especially helpful to study interaction among actors and networks—to comprehend the actors is to see how they interact with other actors.

Using Data-cum-Information-cum-Understandings Derived from Focus Groups

The focus group supports ANT methodology because both illuminate participant interaction. Tatnall and Burgess (2002) note that focus groups and interviews allow the researcher to examine the structure and development of networks built through interaction (p. 182). Moreover, they find that focus groups involving actors selected on the basis of their previous interest in similar projects and demonstrated interest in the selected themes leads to discussion within the focus groups (Arnaboldi & Spiller, 2011). Accordingly, the extent to which different knowledges, experiences, and actions can be brought together depends on the abilities of the different actors to accommodate and make sense of each other's worlds (Burgess, Clark, & Harrison, 2000). ANT analysts tend to work through detailed, specific, situated case studies because these allow the close observation of the processes of building networks (Burgess, Clark, and Harrison, 2000). Thus, I think the focus group method dovetails

with ANT to observe interaction and record the emerging results stemming from discussion among practitioners.

Krueger (1988) describes focus group discussion as an effective method affording information about the way people think, feel, or do. Furthermore, focus groups can recognize examples of behavior that are not particular to a single individual, but rather, are exhibited, to a greater or lesser degree, by groups of participants who experience common things (Barbour & Morgan, 2017). Initially, the focus group method was called “focused interviews,” and this approach was widely used as a research tool that included ethnographic participant observation and the projective method, among other methodologies (Stewart, Shamdasani, & Rook, 2007). The focus group interview derives from the selection of groups “focused” on given subjects (Lederman, 1990). Also, focus group interviews have been applied in market research in which the technique was utilized in reaction to the limitations in the use of large sample polling techniques (Adler, 1979; Bohner, Goety, Richter & Serdil, 1978; Calder, 1977; Cox, Higginbotham, & Burton, 1976; Reynolds & Johnson, 1978; Szybillo & Berger, 1979; Lederman, 1990).

The focus group is also defined as an interview style designed for small groups, and the goal of applying a focus group is to collect data from several people simultaneously through interactions among the participants (Berg, 2007). The technique of the focus group is constructed upon the idea that group interaction encourages respondents to explore and clarify individual and shared perspectives (Tong, Sainsbury, & Craig, 2007). The focus group has distinctive characteristics; it consists of a group of participants who work under the direction of a *moderator*, and the moderator’s task is to observe, manage the interview, and write notes of

what occurs during the discussion. Lederman (1990) clarifies that focus group interviews differ from individual interviews in the depth with which they attempt to investigate responses and reactions. The group members are usually asked by the moderator to provide specific, personal, subjective responses, and the responses from the participants are examined to explain more about the inner workings of the minds of the group members in response.

Further, one of the main goals of the focus group is to study the interaction between members. Accordingly, Kitzinger (1995) notes that group interviews are often employed simply as a fast and comfortable way to collect data from several individuals simultaneously, and focus groups explicitly apply group interaction as part of the method. That is what Morgan and Krueger call *the group effect*. The advantages of focus groups for examining complex responses and motivations are direct results of the interaction in focus groups (Morgan, 1996).

Additionally, the focus group approach has advantages such as extracting and collecting the data directly from the participants and gathering different insights about the study. Regarding results, one powerful feature of the focus group is providing more distinctive results than other methods. Morgan (1996) asserts that focus groups are the most useful procedures because they produce new results that would not be possible with standard methods in a particular field. Consequently, my focus is observing the creative interaction between human and non-human actors, especially the acts of human actors based on space and classroom elements, a procedure that will highlight where creativity emerges in a design classroom.

Focus Group as a Tool for Designers

The focus group approach in design is unique. It targets the design of everyday things and critically interrogates their uses by various users. Focus group interviews are a qualitative

data collection method that has become prevalent in recent years because it can provide results quickly (Liamputtong, 2011; Kroll et al. 2007). Also, focus groups interviews provided a structured set of options that designers can act upon to guide their design decision-making processes. Cooper, Reimann, Cronin, & Noessel, (2014) explain that collecting data via focus group in design is a standard technique because the designer can gather reactions and give valuable opinions that are useful for measuring initial responses to a product's form—its visual appearance or industrial design (p.57).

A focus group approach is compatible with ANT because both methods focus on the interactions that emerge simultaneously among participants and a moderator, or among participants, objects, and creative activities. Markovà et al. (2007) demonstrate that interactions in focus groups appear on three levels: 1) the interaction between subjects and researchers, which creates a web of sensemaking interdependent with previous and possible emergent contributions; 2) the interaction between concepts, ideas, and arguments; and 3) the interaction with socio-cultural traditions, including traditions of discussing the issue (p. 133). The focus group may be used in design “to the specific requirements of designers and the creative design process and explain its function in aiding user-centered design” (O'Brien, 2003, p. 62). The focus group in design helps participants to draw on their experiences as designers and support moving to a solution space, rather than exploring only the opinions and perceptions of participants. Also, it is designed to evoke deeper insights into the participant's perception and use of design for behavior change (Niedderer et al., 2016).

Studies have applied knowledge and understandings gleaned from focus groups in diverse ways. For example, the study of McDonagh-Philip and Denton (1999) addressed the use

of focus groups to support a designer in the evaluation of existing products by assisting the designer in gathering data. The aim of this case study was a) collecting useful design-related data directly from users, b) supporting the designer's understanding and empathy for users from diverse socio-economic groups, and c) exploring the advantage of employing a designer as moderator of a focus group discussion. This study involved 60 participants (30 women and 30 men) in groups of six to eight participants, and they were video- and audio-recorded. The most interesting outcome of this study shows different interactions in terms of gender. McDonagh-Philip and Denton (1999) found divergent responses when the designer-moderator was female and the eight sessions comprised single gender groups, while the male groups may have responded differently when the moderator was male. Also, females found this exercise easy and simple, but males had much difficulty engaging with this practice. Therefore, McDonagh-Philip and Denton conclude that focus groups provide feedback on initial opinions and support more precise directions in diverse ways.

In a different approach, Wong, Lam, and Chan (2009) proposed a study that considers optimizing design objectives using the Balanced Scorecard approach by applying a focus group to facilitating communication between clients and design professionals. This study: (a) collected information from a group of individuals in a comparatively shorter time than individual interviews would have taken; (b) investigated and clarified the participants' comments with each other; and (c) encouraged the expression of views, insights, and creative opinions about the subjects within an interactive discussion. Wong, Lam, and Chan (2009) encourage participants to provide their views and ideas using the Balanced Scorecard approach as a tool for effective design management. The focus group in this study includes six members of

experienced practitioners, in their abilities as customer, advisor, temporary worker, government officer, and educator. Their perspectives along these lines mirror a complete picture of various gatherings associated with the local construction industry. The result of this investigation shows that the Balanced Scorecard helps designers realize their overall design aims in an explicit, systematic, and structured practice. Hence, a consideration of a set of interactions' goals can optimize designers' efforts.

On the other hand, Cho and Youn-Kyung (2012) explore the results of web interface designs on a consumer's behavioral intention in the context of online retailing. This study investigates the specific elements of online store design. The goal of this study is to examine how designers and design managers can expand their capacities by understanding the interaction between emotional reactions and cognitive evaluations to increase the chances for an online business to succeed. This study used two focus group interviews to determine a final set of four websites, and each focus group involved eight female participants whose ages ranged from 20 to 40. As a result, Cho & Youn-Kyung (2012) found that focus group interviews designated an initial self-congruity judgment, which was likely to be based on visual ambiance and the overall visual design of the Internet storefront. The study indicates that in terms of web design, visual design is primary, followed by information/navigation design, for an online store.

In "Visual Culture Learning Communities: How and What Students Come to Know in Informal Art Groups," a focus group is applied to a large sample to measure interests in the production and use of a form of visual culture. This research examines an international focus group interview in different sites, including Amsterdam, Budapest, Chicago, Helsinki, and Hong Kong. The study examined 10 groups, and the total of the members was 102 participants of

varying ages, such as one high school group and one college undergraduate group. The research questions for this study focused on: a) conditions of visual culture communities, b) group practices in visual culture communities, c) individuals in a visual culture community, and d) peer teaching and learning processes. Two themes emerged from the data: social networking through shared interests and a desire to learn about art/visual culture that tends to be missing from the school curriculum. To collect the data, this study used voice-recorded, front-end interviews conducted with members of each of the ten groups. Also, focus group interview transcripts and creative products were then subjected to qualitative analyses utilizing familiar-pharse and close-reading thematic content analyses of the transcripts. The results of this study showed that visual culture groups act as powerful student communities for auto-didactic and peer-initiated learning (Freedman et al., 2013).

In another study, Senbel et al. (2013) focused on presenting digital design cases studies and explore new circumstances that digital design cases might offer to contemporary design education. They proposed a web-based urban design reference database called *elementsdb* as a knowledge source for design students. They employed three focus groups with 19 design students by using 3D digital models to review, replicate, improve, and recreate elements of urban design in an environment of accelerated learning. Senbel et al. (2013) noted that students developed their knowledge by examining 3D spaces and designs buildings:

Students generally moved from virtual explorations of 3-D space to using building cases as density and population accounting references, to revising cases to match specific site needs, transforming buildings to achieve different density and population targets, and ultimately designing their buildings. (p. 75)

The authors applied the outcome of their findings to urban design pedagogy and consider some general challenges and prospects for web-based digital reference tools.

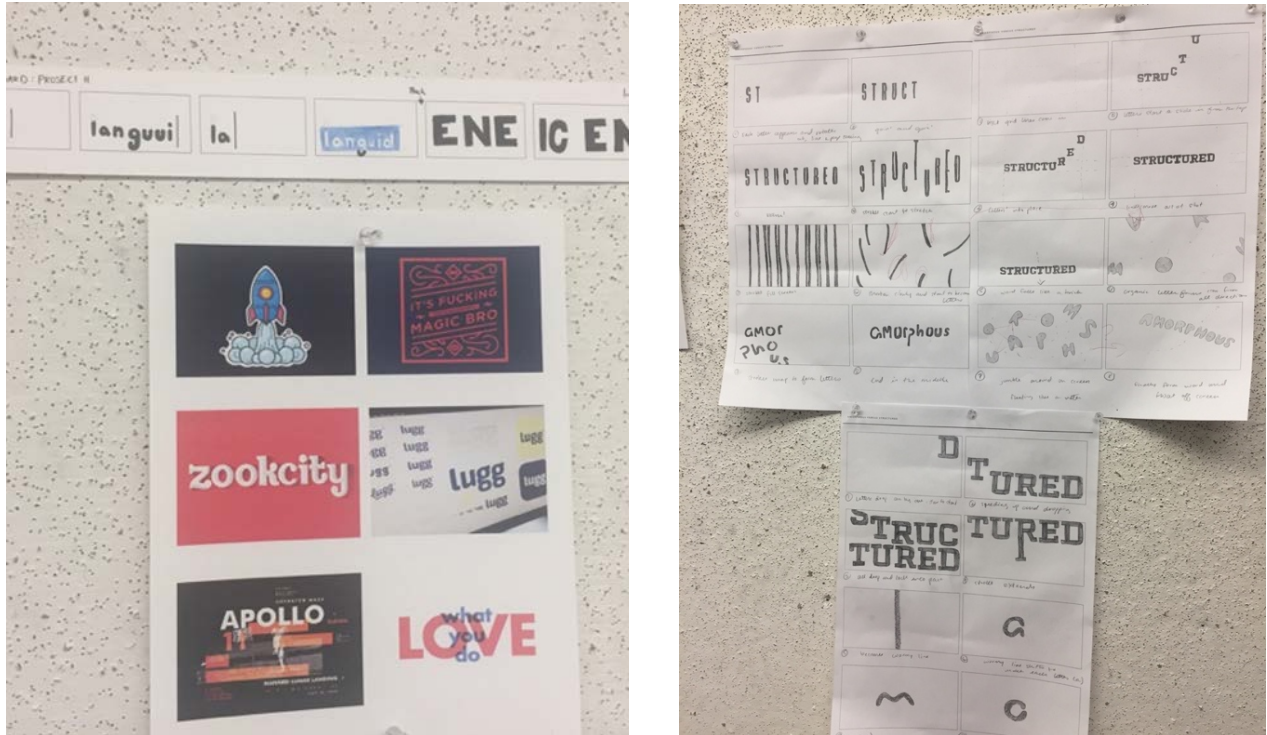


Figure 3.2: A design project: pinning on the wall.

In the review above, I surveyed the use of focus groups that helped me to structure my research method. Each study employs a distinct procedure and illustrates how the use of a larger group increases the amount of data on the study topic. However, the distinctive aspect of my study is to explore how design students define the concept of creativity as a place and a practice, envisioning its impact on their future performances as designers. Thinking from a student perspective facilitates the articulation of the conditions a student-designer needs in a creative classroom to practice creativity.

Mapping Creative Focus Groups

My study employed ANT as a methodological framework to examine design classroom actors' interactions wherein technology is an integral part of teaching and learning in the design course. As such, the fundamental purpose of applying focus groups was to help determine the

ideal creative place, taking into consideration classroom space, tools, technology, resources, and conditions, along with how they optimally enhance students' creative thinking and design artwork. Therefore, I structured a unique approach incorporated within the focus group method, which I call *pinning creativity*, designed to illuminate and critically examine the creative weather systems in a classroom. The focus group interview was an integral part of the general research approach that supports observation sheets for collecting data about the creative climate in the classroom.

Pinning creativity is a concept influenced by Google Maps pins, which help to locate a place and generate information from a location. *Pin*, in the Merriam Webster dictionary, is defined as “a piece of solid material (such as wood or metal) used especially for fastening things together or as a support by which one thing may be suspended from another.” Moreover, pins are normally used in a design studio classroom to hang projects and artworks either on drywalls or cork wall (*Figure 3.1*). In this study, the pin helped to distinguish where creativity might be located in a design classroom, based on the participant's choices of place, or the way he or she interprets creativity as a location of certain design practices.

Belzile and Öberg (2012) focus on the importance of clarifying the role of participant interaction, which coincides with my aim to highlight the role of the interaction between participants in pinning their creative places in a design classroom. I agree with their assertion that the use of participant interaction should be an explicit part of the decision-making process in the research design phase, matching the complexity of the analysis to the appropriate purpose and skill sets of the researchers. From this perspective, I see also the importance of focusing on decision-making in selecting creative spots, through which participants may

improve the design of creative maps to illuminate the circumstances of interaction between actors.

Mapping the Research Methods

This study took place in one of the design classrooms in a public university located in the southwestern United States that is classified as a Tier 1 Research University according to the Carnegie Classification of Institutions of Higher Education. In this study, I gathered the data in two phases, using two different methods. To determine which design classroom to study, I considered its form and function, as well as the classroom activities it usually housed. I concentrated not only on the distribution of technological devices around the room, but my zone of observation also consisted of the classroom space, walls, lightings, chairs, and tables. In addition, I focused on specific activities to create my maps, particularly the interaction between students within the design classroom. For instance, I looked at the rhythm of the interplay between the human and non-human actors, the connections between students and their devices. Also, I tracked the relationships between two human actors within the classroom network in order to identify the interaction points of the classroom space. Then, I examined how connections between actors led to notable moments of creativity, reflecting on students' actions, productions, and interactions informed by attraction and dissonance.

I observed one design classroom twice a week for two weeks; each class took three hours of observation. I traced the changes exhibited by *actors* and *things* for three hours per day. Accordingly, based on the observations, I completed multiple visual maps from the data, which ultimately became animated maps showing students' movements as well as variations in

their interactions with classroom objects. The data was shaped into maps locating the spots of greater and lesser interaction.

Participants

Because the data was gathered from tracking human subject interactions, and from the interview questions, Institutional Review Board (IRB) approval was an important step to pursue this study. I used a focus group interview technique as a tool to question the participants. The study participants were junior-year design students, chosen because they have a high level of design knowledge and are more professional than less experienced students. Any student who agreed to participate signed the IRB consent form that clarified the purpose of applying this method, explained how it would proceed, and specified how long the observation would take. See Appendix A. To create the focus groups, I used in the study, in the initial stages of observation, I created maps that indicated significant interactions among students.

Focus Group Criteria

This study was conducted with seven focus groups made up of 23 participants. Five groups included three members; the other two included four members. Criteria for selecting the subjects included familiarity, flexibility, and comfort with the interview process because these components were essential to conducting the interview. The topics discussed during the interview were related to the students' experiences in design classrooms, which meant that there was no need for students to have had prior knowledge of each other. The participants were expected to be open to sharing their ideas and responses to the interview questions. In addition, the participants were expected to be comfortable working with the study and open to

being observed. Finally, the participants were chosen because they were at the same academic level and had the time flexibility to interview without conflicts with other courses.

Mapping Tools

Observation Sheets

I developed sheets that indicated a participant's achievements during the observation weeks. These sheets were developed to distinguish students' levels of work and interaction in the classroom in order to have an accurate result of the sample of the study to, in turn, design the interactive maps. In particular, I developed two types of this form; the first one concerned individual interaction, and the second addressed the collective interaction of students. See Appendix B, C.

Pinning Creativity

This tool was based on the focus group method, and it included interview questions and mapping sheet activity. See Appendix D, E. The first component was the interviews, which were designed to collect insights about the students' perspectives on creativity in classrooms. The questions were useful for picking up words and phrases that were then formative for mapping creativity. The interview protocol (See Appendix F) was simple and depended on the needs of students in their learning positions:

1. What do you think creativity is?
2. Do you think this classroom encourages or discourages creativity?
3. How would you redesign the classroom so that it more effectively promotes creativity?
4. Where in the classroom do you feel most creative?

5. When you feel creative while working on a project, do you use tools you bring with you?
6. What things do you prefer to use when you feel most creative?
7. How do you use them?
8. Do you use things in relation to classroom technology equipment? If so, how do you use them?

The second part of the interview included an activity among the participants, using design classroom layout and pins. This approach was designed to collect location data that helped distinguish the creative places in the design classroom. To apply pinning creativity, I used two sheets of paper with a picture of the classroom layout. The first sheet was the pinning sheet, and it had the actual design classroom layout, including the class entrance, windows, lights, class space, desks, technological devices, and other objects. Participants used pins to mark the first sheet while they responded to interview questions. This *pinning sheet* indicated where students commonly sat, chose to interact with other students, and decided to think in a place where they felt most creative. The second sheet was used to draw creative places for design. It depicted only the space of the classroom, including the door and windows, but excluding all objects such as lights, desks, etc. Participants used this sheet to respond to the third and fourth interview questions while they debated what the creative classroom looked like. The importance of the focus groups was that they gave quick results, as opposed to individual interviews. This technique allowed me to observe and record participants' interactions simultaneously. Furthermore, using the two sheets to compare the participants' answers was advantageous to discover themes that helped define where creativity emerged. For the focus group, the interview protocol addressed:

- Highlighting interactions among participants and ways to improve the creative map designed as a final result of the focus group interview.
- Using coding for specific words and phrases, such as “feel most productive,” “most creative,” “I feel more comfortable working with this classmate”, “I focus more while working near the window,” “area of the classroom has a perfect light,” “this spot is cold,” “too near the board,” “chair not comfy,” etc. More phrases provided during the interview helped to form the creative map.

Data Analysis

Analysis of the maps identified visually the interaction between human and non-human actors in the design classroom, where both facilitated creativity. I analyzed interactions with non-human actors in the focus group by locating the places of objects that had connections with human actors, which affected their abilities to practice design. Thus, based on pinning creativity results, I designed the data through interactive maps to show where creative networks in the design classroom were located. I designed the maps to be readily manipulable in both Adobe Illustrator and Adobe Photoshop software. In addition, I analyzed the participants' activity sheets to define particular themes that helped to generate the findings. My contribution through these maps has been to show the interaction between human and non-human actors and how it facilitates concentrations of interactivity that might correlate to increases in creative climates.

Credibility

The criteria for judging the quality of a focus group is different than other research methods. Validity and reliability are for the most part not essential issues for qualitative researchers because they are not making speculations to more extensive studies (Mangioni & McKerchar, 2013). In spite of copious clearly established instructions and specific prerequisites

for conducting focus groups in literature on the subject, there exists little focus on methodological aspects of focus groups, due to the lack of works addressing validity and reliability (Chioncel, Wildemeersch, & Jarvis, 2003). Therefore, the study focused on the interaction between focus group members in ways that reveal how and why creativity within them is encouraged to emerge. The data collected from the focus group considered results supportive of the main findings of the observations. Also, the data-cum-information I gathered and analyzed demonstrated how the objects of study are altered by the sheer fact of being studied in the first place. The significance of this data-cum-information in this research it comes from the designer's perspective and therefore; a) helped to promote the concept of interaction between all actors, which in turn helps the human actor to build the creative network that affects creativity and making decisions.

Based on several sources of data collection, I have triangulated the findings from variable and visual impacts in order to create accurate maps that connect interaction—with humans and non-humans—and creativity. This approach helped to locate creativity as a weather system in a design classroom based on maximal and minimal forms interaction within networks. A focus group approach provided specific location data for cooperation, which, in turn, helped to design the concept of a creative map for university design classrooms. In addition, focus groups helped create a broader understanding of what students want in the classroom, particularly how creativity is enhanced as practice and as an inspiring place. Design practitioners need unique environments to help their ideas grow, and they can readily take advantage of the resources in them, so I think it is essential to appreciate students' needs as a critical point in building classrooms.

Summary

In this chapter, my goal has been to locate creativity in the ideal creative place by employing a focus group approach to examine the nature of creativity in a design classroom. I have reviewed previous studies regarding the focus group approach, particularly those that apply the focus group method in design studies, specifically, Niedderer et al.; Wong, Lam, and Chan; Cho and Youn-Kyung; and Freedman et al. I discovered important insights into using focus groups to collect data. Particularly, I found that formulating and observing these groups allowed me to notice that this operation became sensitive to the researcher's bias, so I learned to manage these groups to avoid affecting the participants' responses during the interview. This research has proposed an innovative way to collect data from design group participants, which, in turn, relates to determining the places of creativity in the design classroom. The pinning creativity process helped to pin information, along with knowledge and understanding of located creativity.

Investigation of mapping creative networks in a design classroom determined where, how, and why design students find places in which they feel the power of being creative to practice design. The pinning creativity process is powerful and unique because it focuses on human actor perception, but also on recapping and synthesizing where creativity might be found in a design classroom. Finally, applying a focus group to design students constituted an extended approach to the primary research by affording new perspectives to contemplate the redesign of design classrooms. Thus, the results of this approach completed the investigation of the relationship between human and non-human actors creating and improving the creative climate in a design classroom.

CHAPTER 4

MAPPING THE ACTORS' RESULTS

Introduction

This chapter details the findings of the observations and focus group interviews. The data collected for the research includes two models: (a) actor interaction maps, which provide a visualization of the actors' maps and the creative climate maps, and (b) pinning creativity maps, which describe the results of the focus group activity sheets.

This analysis is guided by two central questions: (a) How can we visually map the networks of cooperation between students and objects in a design classroom to better understand the relational and emergent nature of creativity? (b) What lessons can we learn about classroom design from constructing such maps that can enhance creative production? My assumption is that mapping actors helps to analyze forms of connection and disconnection within a network, and in turn, sheds light on how creativity is fostered in the classroom as a dynamic and interactive weather system.

Arranging Data Analysis

The process of data analysis included writing a detailed description to interpret the data from the observation sheets that used to observe the actors' interactions. In addition, the process involved examining the results from the pinning creativity tool employed in focus groups. The study used part of the results from focus group interviews and concentrated on investigating question three, *How would you redesign the classroom so that it more effectively promotes creativity?*, and question four, *Where in the classroom do you feel most creative?* In this analysis, I used the class description to illustrate the contents of the place where the study was conducted. In Figure 4.1, the layout of the classroom

represented the design of the class in which the study was conducted. The classroom layout contained seven portions:

- Southern wall: This section included a glass entrance, a teaching platform including two rectangular tables, and a mobile electronic platform containing a computer, a projector, and a set of controllers. There were also three magnetic whiteboards on the wall behind the teaching platform.

- Eastern wall: There were three long windows and curtains that prevented light from shining on the eastern wall, and two of them were separated by a concrete wall. There were also two magnetic whiteboards on the north side, three of which were located on the south side.

- Northern wall: There were three large windows and curtains that could block light in the north of the classroom, including electrical sockets along the wall under which there was a concrete seat.

- Western wall: This wall contained eight magnetic whiteboards, as well as an animated projector screen. I referred to it as the whiteboard area.

- Classroom ceiling: The ceiling contained extension cords with adapters that included electrical sockets used by students to charge their devices. There was also a projector directed at the western wall. In addition to electric lighting and air-conditioning vents, there were water sprays used in case of fire.

- Classroom center: The class center was divided into two groups of large tables so that each group contained five tables used by students during design. Additionally, there were approximately 28 student chairs, which the students used in various ways in the classroom. The

floor of the classroom included object-free spaces that determined the paths of motion for students in the classroom space.

- Classroom corners: In the classroom, almost every nook had objects that ultimately intersected with magnetic whiteboards. As shown in Figure 4.1, corner one was located between the south and west wall and contained the entrance to the room and part of the whiteboards. Corner 2 was situated between the north and west wall, which intersected with whiteboards and the windows in the north wall. Corner 3 was located in the teaching platform area between the south and east wall, which involved the concrete column corner and the whiteboards from both sides. Finally, corner 4 was situated between east and north wall, and it contained the concrete bench, part of the whiteboards, and one window in the corner.

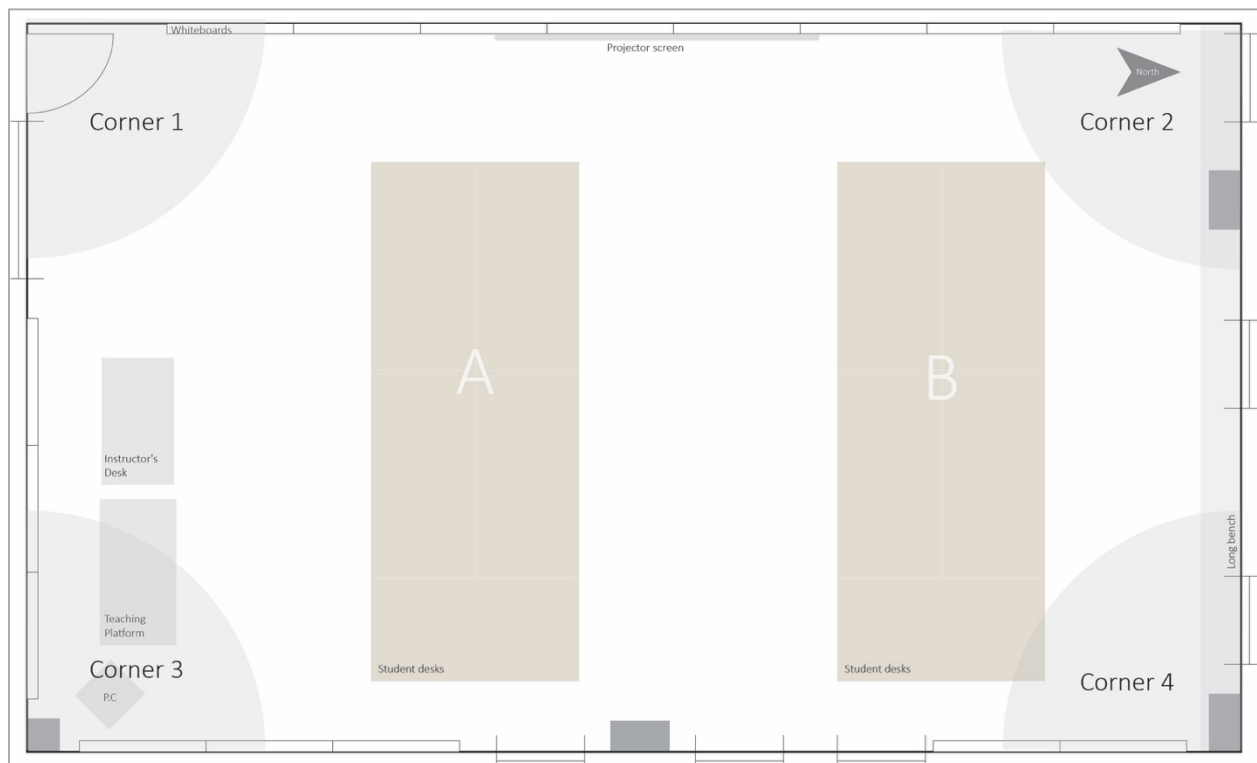


Figure 4.1: A layout shows the arrangement of a design classroom, where the study conducted.

Finally, in terms of using technology, all participants interacted with their own devices; almost all participants used laptops and tablets to build their projects. Since the observation time was during the final days of the students' second project, the participants used whiteboards to illustrate the phases of the work and the laptops to modify the comments after the critiques. In this project, as described in the class syllabus, students learned how to develop design elements in the "iterative, team-based design and execution of digital components, products, and systems that advocate for and provide information about a particular socially, politically, economically, environmentally or culturally motivated cause or issue."

Maps Analysis

The following analysis is divided into; a) actor maps, which focus on the dynamics of the actors as observed in the classroom; b) pinning creativity maps, which focused on the data from the focus group activity sheets that helped to pinpoint the most creative places in the classroom. Moreover, this analysis gives detailed results from spots identified by the human actor, which in turn, indicate the points where creativity is most prevalent in the classroom.

Actor Maps

This section following answers the first of the research questions, *How can we map the networks of cooperation between students and objects in a design classroom visually to better understand the relational and emergent nature of creativity?* I focus here on analyzing actors' actions and highlighting the locations in the classroom that were most occupied and most "busy." The results of this section are based on the observation sheet notes. The action of actors includes two subdivisions that describe actor movements use of objects, space, and

things, and finally connections between these movements and uses and creativity. The map key designated the seven groups of the study by color, based on how they were organized together in the classroom. These groups divided into Team P (four members), Team C (three members), Team D, (four members), Team T (four members), Team F (three members), Team X (three members), and Team G (three members).

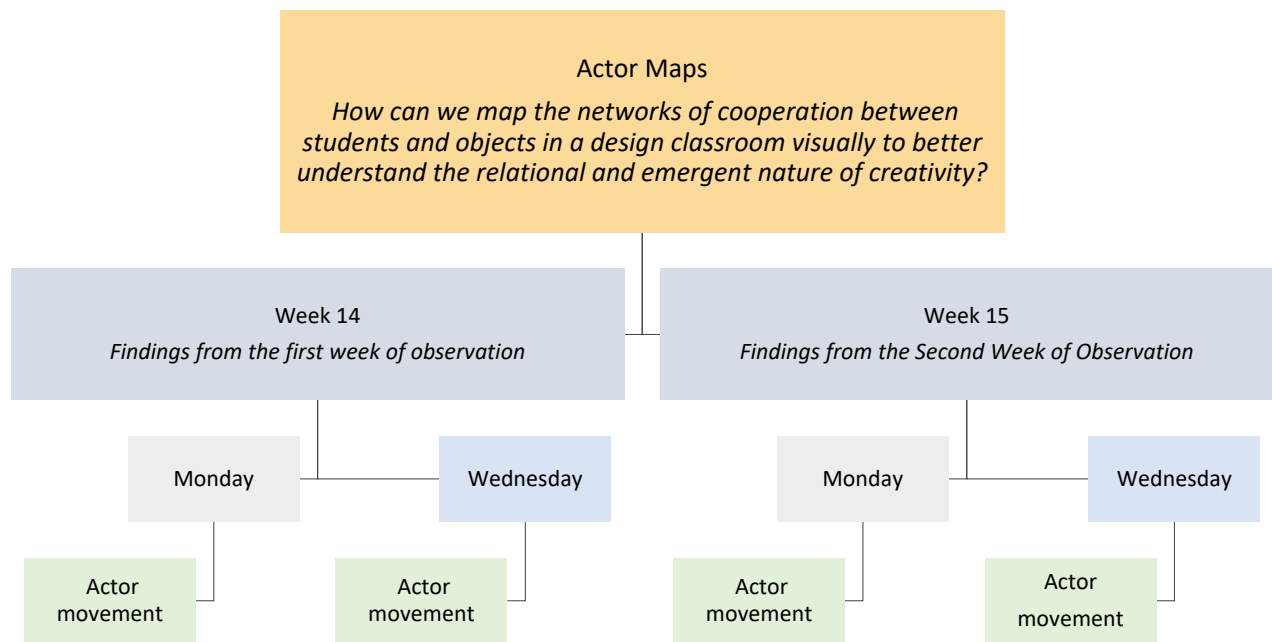


Figure 4.2: A diagram outlines the method of data division. This diagram illustrates the process of analyzing data based on the result of the observations.

The data for the actor maps was collected through the individual and collective observation sheets. I used this method to track the interaction of each human actor and the way he or she interacted with non-human actors (see Appendices A, B and C). During the observation, I focused on the movements of students and their choices of places to display their projects. The action began in the classroom based on project critiques, which involved students joining the group that presented its design idea. After that, the gradual transition from

group to group began until the lesson ended. In the meantime, many changes occurred throughout the observation of the research sample. These changes included students changing seating, shifting project presentation spaces, and interacting in certain areas of the classroom.

Moreover, from my observations, I have developed a network-based language to describe the actors' interaction. I use the terms connected and diffuse to describe the various states of interaction between actors in a network which is itself composed of several semi-autonomous sub-networks. In particular, connected in this context describes where the human actors in the sub-networks are close and interacting regularly, while, diffused refers to sub-networks where human actors are only loosely affiliated with each other. Disconnected, on the other hand, describes the vanishing and the absent status of an actor from the whole network (classroom) such that the actor did not exist in the network permanently.

The movement climate map was based on the diagram I discussed in Chapter 2. In this approach, I used Photoshop software in the implementation of climate maps by tracking the interaction of networks during the process of project critiques. The movement climate map revealed the thermal areas in which interactions occurred between non-human objects such as student tools and classroom objects, and between the human actors (design students). The data coded four areas of cooperation: hot spots, warm spots, medium spots, and cold spots. Afterward, I followed the spots over two weeks to visualize changes in location and intensity. These spots reflected the movement climate of the classroom and its patterns of change. Finally, the goal of the maps was to discover how each spot exposed patterns in the relationships among actors, revealing where creativity tended to appear and disappear over time. These changes are represented in the following results.

Findings from the First Week of Observation

Actor Movements on Monday

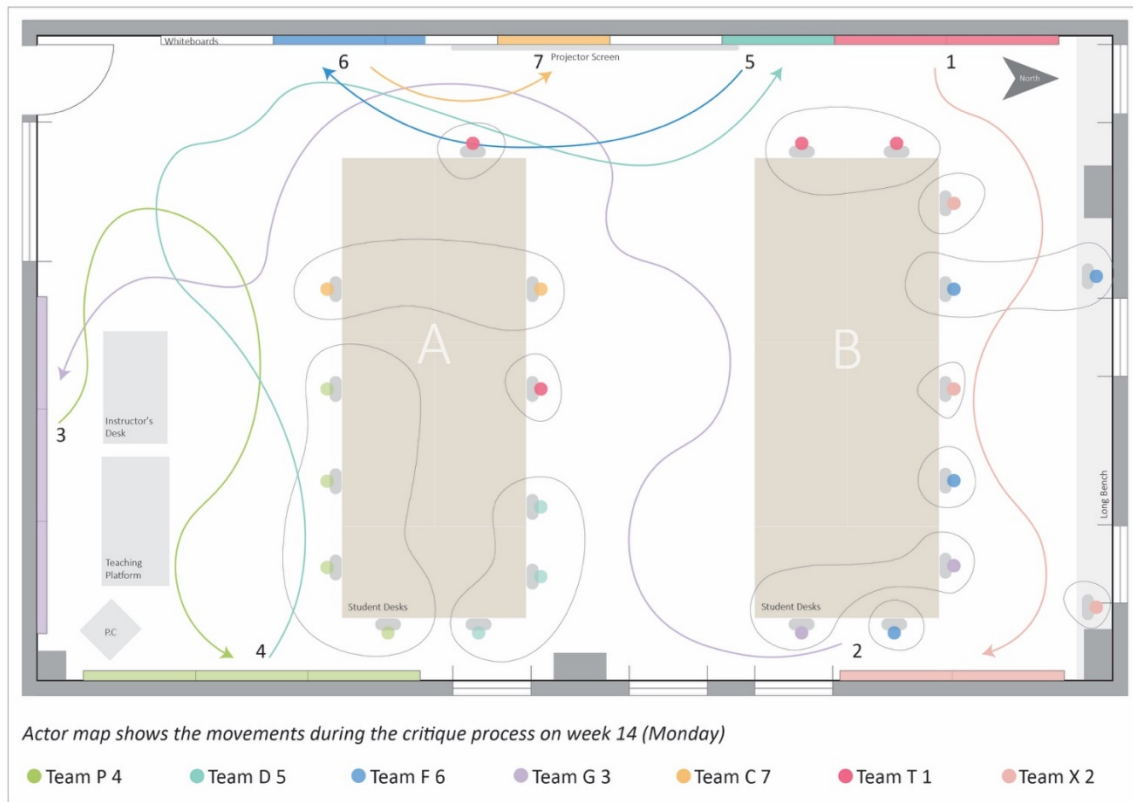


Figure 4.3: Actor movements layout shows the results obtained from the preliminary analysis of week 14 on Monday.

Figure 4.3 shows the general movement in the design classroom. The arrows reflect the human actors' movements during the critique process of the second project. The first movement began with Team T, which chose to affix the project to the whiteboard area at the corner of the west wall. This team used colored papers and sticky notes to explain the idea of the project. The actors in this group interacted with existing objects by choosing to sit near their project zone at desk B. The actors within the network of Team T resided in contrasting positions, in which two of them sat next to each other, and the other members chose to separate themselves and sit at desk A. In term of the using objects, members in the sub-

network assembled their network in desk B. One member used a laptop, phone, notebook, sketchbook, pen, charger, and jacket around his spot. The other used a laptop, phone, notebook, water, pen, and charger. In desk A, the diffused networks did not join the sub-network, but they made some correlation fusing and diffusion their connectivity within the sub-network. In these small networks, one actor used a laptop, phone, some papers, a soft drink, and a charger. Similarly, the other diffused actor on the other side of the desk used the same objects like a computer, phone, some papers, soft drink, and charger.

The second transition during project critique was made by Team X. Through space between the west and east wall, the actors moved simultaneously to interact with the other entities on the west wall. This team used markers to illustrate the details of the project, including affixing some of the project pictures taped some of the project pictures on the wall. Team X's work distributed its network in diffused form along the north wall; the actors preferred to work individually, as is represented on the map. Networks in this team were distributed as such, one member, who sat in the top of the desk B placed a laptop cover bag beyond the laptop, headphone, and soft drink. The other member in desk B used a laptop, laptop cover bag, water bottle, and charger. Although these two diffused members not seating next together, they were not used many objects in their network. In contrast, the other diffused network in corner 4, sat where the window, whiteboards, and the long bench were a quiet place to work. This actor liked to use the bench as a spot for settling his things and working near the project board. This member used many objects, such as the laptop, phone, drawing papers, pen, markers, and charger. Also, he distributed some personal things, such as the backpack, keychain, and a wallet. Therefore, these correlations between the actors generated a

climate of heat that reflected a high interaction in their spots.

The third movement was by Team G, in which they chose to present their project on the south wallboards. In this movement, the transition from the right-hand corner of the eastern wall by actors to the project on the northern wall led to the use of the class center to navigate. Particularly employed was the area of the center of the class, the area near the whiteboard area, and the classroom entrance area. In general, actors moved from a narrow area to a large area and then to a small space where there were a large number of non-human objects. This team used the colored palette, illustrated wireframes of their project, and affixed some printed papers including project information to the whiteboards. Two members of this team sat at the corner of desk B as a maximally connected network, while one of the members was absent and not disconnected in this network. One of the network team who sat in the edges of the desk used many objects, such as a tablet, mouse, notebook, drawing papers, pen, laptop cover bag, water bottle, charger, and some cables. The other member who sat on the other side of the desk used fewer objects such as a laptop and a headphone, and he put his bag on the counter. The interaction climate in this spot tends to be warm and stable between the actors.

The next movement was by Team P, in which they chose to present their project on the whiteboards on the left area of the west wall. Team P usually sat near the project site, next to the whiteboard and windows. The location of this team was strategic due to the proximity of many objects that facilitated the presentation of the project. Team P was an active network at this table, within which the actors sat with non-human counterparts continuously and permanently together. This team used storyboards and illustrations to explain their project.

This team engaged mostly with laptops, notebooks, sketchbooks, drawing papers, and separated many cables around the surface of the desk A. The members of this team were maximally connected to their objects, and their peers, this distinct interaction generated a high climate in the edges of this area in the classroom.

The other movement transitions were by Team D, then Team F, and finally Team C at the whiteboard area, where they shared the available spaces on whiteboards. This zone was an essential route for the navigation of human actors.

Team D used diagrams and printed pictures to explain their project. The team gathered and sat at desk A as an active network, yet they were far away from their display area. In team D, the members were maximally connected to their network in the edges of the desk, and they spread some objects such as sketchbooks, notebooks, and some devices like laptops and tablets. In particular, one of the members focused on drawing some illustrations, and he did not use a device, while the others were engaged in their devices to design the project more than using the sketches.

Similarly, Team F chose the whiteboard area to share their plan, also affixing design illustrations on paper, depicting their project process, on the whiteboard and they did it in the same way as previous teams had done. However, Team F sat separately at desk A, and each member was represented as a disconnected network. However, team F sat separately at desk B, and each member was represented as a diffused network. The member who sat in the head of desk B was moving his network between the bench next to the window, and back to desk B.

Also, this member used a laptop, notebook, sketchbook, headphone; including some personal things such as a keychain, bag, and wallet in the surface of his spot. The other two

members were seating at the end of the same desk, and they simultaneously moved from their spots to connect closely to other members in the team. These two members used their devices and notebooks more. This team also spread some familiar objects in their spots such, water bottles, wallets, drawing papers, colored pencils, sketchbooks, and their phones. The connectivity in this team had a form of fusion and diffusion within the network, which created interaction climate in their spots. The final transition was by Team C, in which they simply used one whiteboard and listed the process of their ideas. The members of this team sat at opposite sides of desk A, and one of the members was disconnected. Team C sat at desk A, and their status was a maximally connected network. Moreover, the members of this team mostly used tablets in drawings, yet they assembled some objects around them like colored pencils, wallet, keychain, their phones, and chargers. Also, this team created a hot interaction point in the middle of the classroom between the human and non-human actors, and this heat increased along the edges of the desk, which surprisingly became significant actors in their own right.

In short, the movement on this day was flexible, and the human actors were interacting with things around them. For example, some groups were attracted to places close to the screen and worked near them. Also, some movement reflected a narrow corridor that could not accommodate active participation, so some human actors preferred to stay in their seats and did not show involvement, especially in the whiteboard area, the north area, and the area between the south and east wall. Many forms of associated networks emerged as a maximal network in Teams P, G, C, and D. Also, there was one sub-network and some diffused networks who tended to separate from their network and maintain their own particular networks.

In general, this map shows intense interaction in both the northern wall area and its

corridor, an interaction along the eastern wall, a substantial interaction among the group at desk A, and interaction on the corners of desk B. There were areas reflect a warm interaction between networks where movement occurred amid the aggregation of the human actors and the use of objects that facilitated their mobility in space. This interaction was reflected in the area of the northern wall, where the windows and light and a long bench were located. On the other hand, the map shows areas where regular interaction between actors of the network was spontaneous. It was also interpreted to be a comfortable area to navigate in the classroom space.

Actor Movements on Wednesday

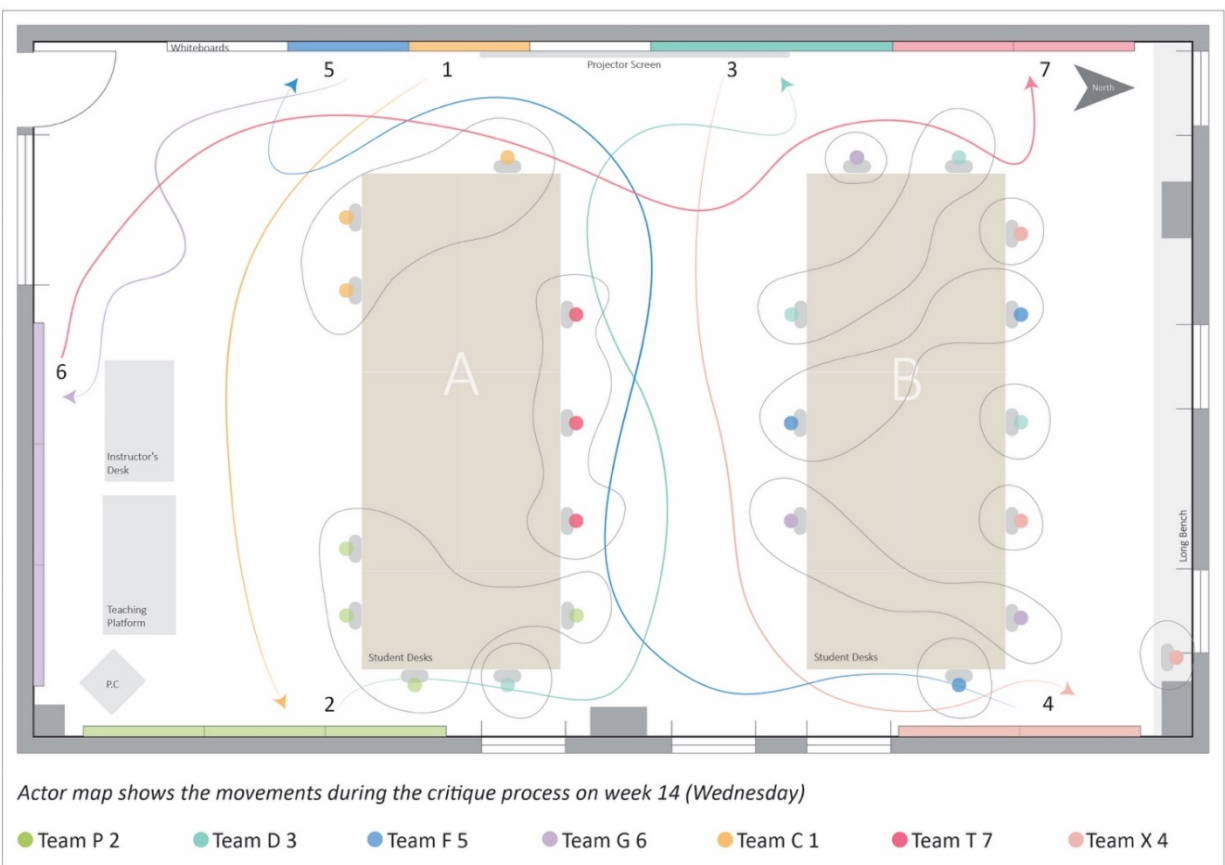


Figure 4.4: The actor movement layout shows the results obtained from the preliminary analysis of week 14 on Wednesday.

Figure 4.4 shows an overview of the interaction of actors different from the interactions of the previous day. The use of the space was semi-random, and the transitions were more varied. The first move was by Team C; this group moved the display of the project onto a different whiteboard. Two participants explained the idea of the project by using some papers on the board and markers to plan the concept, while the other member task was note-taking from the project critique. The members used a tablet and a laptop as an additional tool in presenting their project. Furthermore, the members used many objects to connect to their networks, such as electronic devices (laptops and tablets), colored pencils bag and soft drink cans, chargers; including some personal things such as wallets, keychains, and bags on the surface of the network. Also, the number of things diffused on team C area created a heat climate that also connected to their display area. As a group, they maximally connected to their network over the edges of desk A, and they included the display platform within this connection.

In contrast, the second transition took place on the left side of the east wall by Team P. This group kept its selection of the same project display site, and they used several papers placed on the whiteboards by magnets and also employed markers to illustrate what their design path would be. This team remained in the form of a harmonious group at desk A, and they worked cooperatively. As a maximally connected group, this team worked on the laptops, sketches, and settled some pens, markers, and chargers on the surface of the network. This relationship amongst objects and the choice of the place caused a hot interaction spot, which increased a high temperature of connectivity between the wall and desk.

The third transition happened as Team D used the center area of the classroom back to

the western wall to present. The difference was manifest as they enlarged the display area by using two of the whiteboards to approach the project. This group consisted of four members, and they used magnets to place some images of the project on the whiteboards and display a brief explanation of the concept of implementation. For the seating arrangement, this team chose different places to sit; and they had two types of connectivity. The map shows one of the actors sat away from the team at desk A, and his network only incorporated a laptop.

Differently, another actor determined as a diffused network in desk B, but this actor assembled many objects in his network, like as a laptop, tablet, phone, sketchbook, colored pencils, and a soft drink can. On the other hand, the rest of the team sat as sub-network in the top of desk B. This sub-network was connected to their devices and spread some objects such as sketchbooks, drawing papers, water bottles, and some food. The interaction temperature of this team tends to be between warm and hot stream in the areas where they sat.

The movement proceeded from the west wall to the right corner of the east wall, where Team X presented its project. The team's presentation evinced prior planning as they affixed papers to the wall to display the developed ideas of their project. Team X used the corner next to the window and whiteboards extensively, and members of this team occupied many locations as diffused and fused networks in the classroom. To clarify, this team kept its tools in the seating areas of desk B, while they preferred to use the bench and floor space to sit and discuss the design process. However, this team simultaneously showed different types of interaction by increasing and decreasing the connectivity of the team network, using two spots. One spot represented the tools (non-human actors), which remained distant afterward and were left in the corner, while the other place represented where the human actors sat on the

ground. The diffusion of these networks created a warm temperature on the corner, the whiteboards, and the ground, while the high interaction energy occurred in actors' spots and the edges of desk B.

Again, the networks moved from the right corner of the eastern wall to the left corner and returned to the western wall, where Team F presented the project. The second intersection of actor movements occurred in the area of the class center, while the space on the right side of the class was ignored. The team used a small space for the presentation, and they employed a number of project papers affixed to the whiteboard and a cardboard prototype to explain how their idea was developed. In addition, this team sat at desk B and their connectivity form divided into two sections. One of the members sat separately in the end corner of desk B; this diffused network usually extended its connection within her place to the place of the sub-network. Also, this diffused network had adopted some of the things inside its network such as sketchbook, pens, charger, and mainly focused on using the laptop. Likewise, the sub-network commonly used the same objects that the diffused network applied to create the connection within the place, which fostered a high temperature of interaction between actors in this spot.

The next transition was fast due to the short distance between the viewing area of Team F and team G. Team G used the same project area of the whiteboards at the south wall, where they explained the changes in the project using illustrations on paper affixed and sticky notes to the whiteboard to explain the briefs of the next phase of implementation. Members of this team preferred to sit at the edges of desk B while working, and they also divided into two networks. The actor in the diffuse network sat in the top of desk B and associated with some objects like as a laptop, water bottle, and phone to assemble a network. At the same time, the

rest of the group sat at the end of desk B, and they represented as a sub-network from two members. As a sub-network, the actors interacted with multiple things that built cooperation within a connected network like a tablet, laptop, colored pencils, drawing papers, charges, including some personal material, such as putting the backpacks on the top of the desk. Also, this activity between actors in the same spot affected the temperature in the zone of corner 4, which made a high climate of interaction in that area.

Finally, the last transition between the actors was by Team T, in which they stayed in the same place to present the project from the previous day. This team chose the location of the presentation in the corner, and they used a large number of papers affixed to the wall, on which the project was detailed. This team was a maximally connected network to desk A, but far from where the project was displayed. In term of using things, two members individually worked at sketching the illustrations of the project, and they used sketchbooks and some colored pens. The other was highly engaged working in the laptop, and his place showed the same objects used by other members in this network. Although the movements of this day were irregular, they made the transition in the classroom space dynamic, refreshing, active, and perhaps *energetic*. However, no activity seemed to exist along the northern wall, but it changed to a hot spot approaching the corner. The left part of the corner of desk B was connected with inactive areas at the center of the eastern wall that held the windows. The map shows a poor interaction spot that appeared on the left part of desk A. Consequently, this place was not only free of interaction but also absent of nonhuman objects; likewise, the entrance and the small spot on the teaching platform were also free of interactions and nonhuman objects. Otherwise, the hot zones fostered an intense stream of interaction that appeared in many areas. These

areas included edges of both desks A and B, the whiteboard area at the south wall, and both corner areas, which included whiteboards on the eastern wall and whiteboards in the western wall zone.

Findings from the Second Week of Observation

Actor Movements on Monday

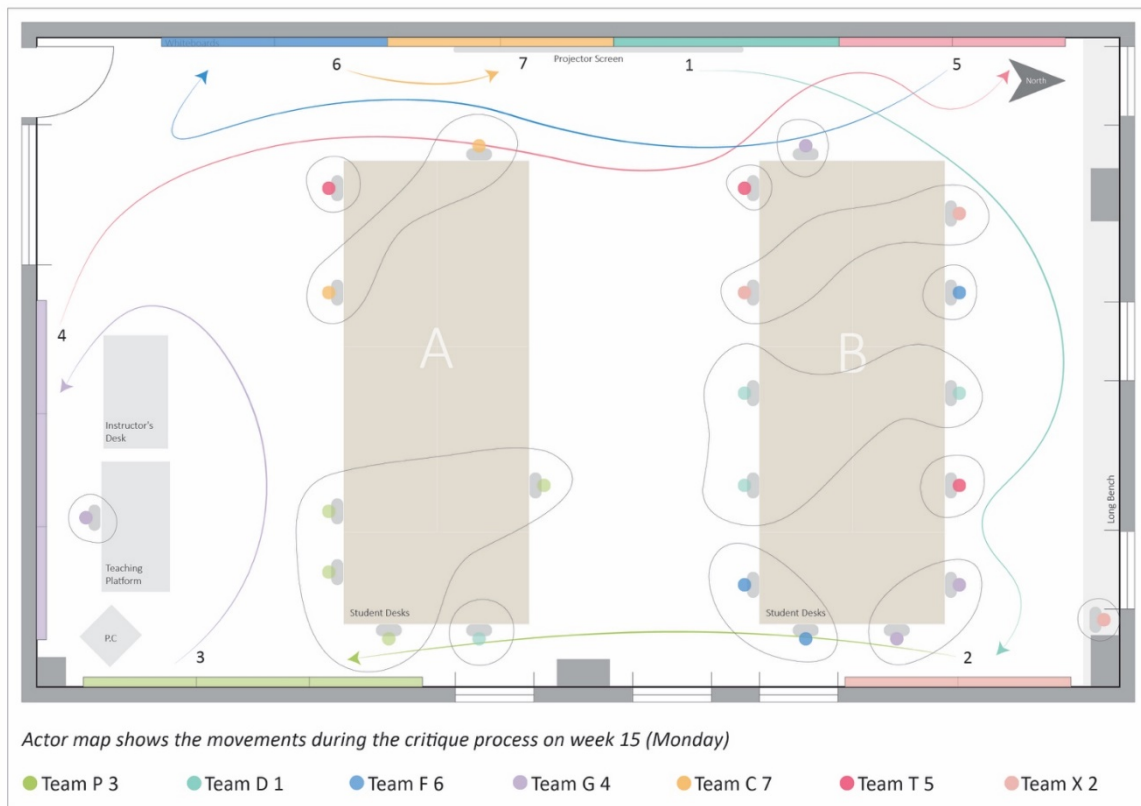


Figure 4.5: Actor movements layout shows the results obtained from the preliminary analysis of week 15 on Monday.

In Figure 4.5, the interactions among actors are described sequentially and are flexible around the space of the classroom. Indeed, the difference in this map is that the classroom center space was not used much during the critique process. The actors preferred using flexible paths, moving from the west wall to the display areas on the east wall, then moving to the south wall, and finally settling again along the west wall. At that time, there had been no

change in the project's display areas for groups, yet all whiteboards had been used to spread out the details of the design phases.

Team D started presenting the project by expanding more details about the design process in the whiteboard area. This team used magnets to place printed papers on the whiteboards and drew some instructions on the board with markers. The team members worked together as a sub-network in the middle of desk B, this sub-team shared common non-human objects on the desk such as laptops, one tablet, phones, chargers, sketchbooks, pens, food, soft drinks, and water bottles; they placed lunch bags, and backpack on the table. However, one of the team members preferred to separate himself as a diffused network and work at the corner of desk A, and he assembled electronic objects in his spot; the actor mainly focused on working on the laptop. These connections between both actors in the team had developed fusion energy that indicated a climate of high interaction in these spots.

The second transition took place with group X, in which the display location had not changed from the last time. This team worked in a sub-network and diffused network, and they were a connected network during critique and discussion time. This group used many affixed papers and sticky notes for the project on the board to give more details about their design decisions. As noted, the diffused network preferred to sit and work in the corner separately, and spread sketchbook, blank papers, pens, and water bottle, on the bench and focused on using a laptop. The rest of the sub-team network was sat in the head of desk B, and they also spread some objects such as laptops, mouse, phone, chargers, sketchbook, pens, water bottles, and personal things like a wallet and headphone. Between these two spots, there was interaction energy occurred in desk B, which was active in the edges of the actors' spot seats and corner 4.

Later, the next transition took place smoothly for Team P, in which members of this team sat in tandem and next to the project venue. This team performed like other groups in the presentation of papers and in giving extensive details about the project. This network used laptops, phones, chargers, sketchbook, drawing papers, pens, water bottles, and some personal things like a jacket and keychain on the top of the desk. This connectivity amongst all actors in this area had affected the climate at the end edges of desk A and corner 3, which increased the temperature of interaction and tended to be warm to hot in the whiteboards places. The unique aspect of this team was their connectivity and continuous togetherness for the duration of the observation, and they represented as a maximally connected network.

From team P's project to the critique of team G's project, the actors' interaction took place across a narrow floor space while joining the other team. This team displayed illustrations and drawings across a wide space to emphasize to emphasize project details. They used a prototype object to explain how the project would develop. The members of this team sat in the beginning on the edges of desk B and worked. Later, one member changed his spot from desk B to the teaching platform to sit near the project's whiteboards. This shift had to change the network state, and the form of connectivity to be a diffused network. Hence, there was a shifting in joining the sub-network and fusing from the same network synchronously. The actor in the diffused network adopted a few objects, and he only used a sketchbook and pen in his network. On the other hand, the other members stayed at the same spot in the edges of desk B corners, and they shared some objects that created the sub-team network. The tablet, and sketchbook, and pens were the essential object in the group project. Their interaction behavior tended to be warm and stable in the spot near to corner 4.

Afterward, the next team jumped from far left to far right, as the actors used the whiteboard area. This transition took place with Team T, where the project was presented on the corner of the whiteboard. This team used posters, sticky notes, and diagrams to interpret the next stage of the project's concept. The team's spots represented a warm climate of interaction, and their connectivity within a network expanded to sub-network, later it shifted to be fused connections based on the movements of the actors in the same network.

In sum, data from this week showed stable interactions within various sub-networks existing side-by-side within the classroom as a whole. The movement this week was decentralized, and there was less interaction in the center area. The members used other ways around the classroom to move around, and they more associated with the edges of the classroom than the center. Most of the group members were connected during and after the critique time, and the maximally connected networks sat at the same tables. However, some members of Groups T, F, and D showed some separation from their groups and chose places discrete from the groups, as shown in Figure 4.6. This situation emerged as diffuse connections from the assemblage circles and the network, and those actors created private networks in the edges of the classroom. In the case of the actors who were absent or did not present, their situation is referred to as a disconnected network because they did not exist. Such was the case with Teams T and C.

Overall, the movement climate shows high interactions around the desk area B, producing a powerful stream of energy between actors. This thermal current interacted with display areas of the whiteboards, some edges of table A, and the whiteboards on the south wall. Moreover, the reaction appeared less dense, turning into warm areas where the

cooperation between actors was at a stable level. There was medium stability of use around the areas of the north wall corridor, the middle of the classroom, and the entrance area of the classroom. Cold spots appeared in the middle of desk A, representing no interaction between actors at these spots. No interactions were revealed between actors near the entrance and the area of the windows on the north wall between actors, which was similar to the results of the previous movement maps.

Actor Movement on Wednesday



Figure 4.6: Actor movements layout shows the results obtained from the preliminary analysis of week 15 on Wednesday.

The movement in Figure 4.6 appears both arranged and malleable. There was no intersection in the center area of the classroom, and the area of the east wall corridor was not used to move between group project areas. The first transition started in the whiteboard area,

where Group C began to critique the project in the same place as the previous project. This time the group used a single whiteboard, which indicated the design of the project was nearing completion. This team sat in the same place at desk A, and two of them sat opposite each other, representing a sub-network. The other team member sat at the corner of desk A in a situation of diffused network, but he was near the network team. The actors in the same team used network components such as computers, tablets, chargers, headphones, phones, colored pencils, and put their items on the table, which included backpacks. The interaction in the edges of the team's spots was high, and the interconnections between the two networks were maximally connected through working in the project. Also, there was a high temperature of connectivity increased from team T, who shared the corresponding edges of team C, which produced a high power in the head of desk A.

The second step was taken by team G, as the movement shifted from the whiteboard area to the south wall area around the teaching platform. This team used all the whiteboards available to it, reviewing their final steps to complete the project. This team usually sat at desk B, which was located a distance away from the project area. The members of this team were diffused networks, both sitting at the edges of the desk, which formed three separate networks. Members in these diffused networks were consistently used many the same tools from the previous time, except one member who only correlated to his computer. The spots of this team were producing a high active interaction and tend to be warm in the center of desk B.

Later, the movement proceeded to the eastern wall, where Group P, showing the last stages of the work with many clarifications, used the space entirely. All members of this team sat as a maximally connected network and near their project site, so they represented one

united network. The team in this network focused on working in their devices, and there were some objects such as last time spread on the desk that had configured their network configuration.

The movement then shifted from the eastern wall to the western wall, where Team F presented their project. This team used a single whiteboard, which meant reducing the amount of detail covered by the project and discussing the most critical points of the final design. At desk B, two of the team members sat on the edge of the right side of the desk and represented a connected sub-network. Both of the members in this sub-team used computers, and they spread fewer objects such, phones, a wallet, headphones, and chargers. However, the other member of the team sat individually on the same side but represented a diffused networks from the group. This member used his laptop and assembled some objects such, umbrella, phone, some blank papers, soft drink, water bottle, and keychain. This team used objects that correlation to joining its networks, that generated levels of hot to warm interactions in their places. Afterward, the movement then shifted flexibly to Group T, as the change occurred at the project area. Usually, Team T used the right corner of the whiteboard area to present the project, but this time there was an exchange of location between Team T and Team D.

Team T used two whiteboards to display the final details of the design and presented some detailed drawings to give more explanations about the design process. Two members of this group sat at desk A, making it a connected sub-network, and they worked on their laptops. However, the objects were unknown to whom it belonged to because this sub-network was crossing within team C network. The other member sat close, at desk B, and created a private or diffused network, and there were not more objects in his network except the laptop. Also,

one of the members of this group was not present, so he was disconnected from the network.

The next transition occurred between a small space in the whiteboard area, where Team D presented some details of the design process. This team displayed their work on one whiteboard by using sticky notes and markers to give more explanations about what they did. This team looked incomplete, as two of the group members did not appear in the network, while the rest were sitting unevenly at desk B as diffused networks. As one member preferred to sit near the project, and used only a laptop and charger in his place. The other sat in front of the windows of the north wall as a private network, and he used a tablet and spread a phone, lunch bag, and water bottle in his spot.

The final movement was by Team X, in which they presented at the same whiteboard in the corner of the east wall. This group used printed illustrations and some sketches to clarify the design process. As usual, one of the group members liked to work near the project area as a diffused network, while the other worked as sub-network in the head of desk A. The number of things found in the sub-network spot was more than last time; one member had emptied everything in his bag in place which generated the high interactivity in their spots.

The condition of the classroom was quiet, and the movements of this day were flexible in the classroom space. There were two sub-networks and seven diffused networks connected at desk B, except one diffused network sat on the long bench next to the window. The other networks at desk A functioned as united working groups and sub-networks, maximally connected. The actors worked intensively and focused on completing the project by using their laptops and notes from the critiques.

The general findings from the actor maps indicate the diversity of the language of

communication among actors in the classroom networks. The findings show that both Team P and Team C's networks maintained a constant rate of continuous communication throughout the observation period. The actors (human and non-human) in these networks were maximally connected, which was demonstrated by their choice of seating and the continuity in their forms of project presentation. Finally, the individual actors in Teams X, T, D, F, and G were diffusion actors who chose to distinguish their networks from the main networks. This separation underscored the actors' choice of place and their preferences to work away from other networks. The diffusion actors remained, however, connected to their groups, even though they were not working in the same zones. These networks were attracted to the spheres where they felt moods of productivity, which ultimately represented the presence of a creative network. There were strong interactions in the display areas as well as on some edges of desks A and B. On the other hand, cold areas were free of movement and used, as shown in the window area on the northern wall, some empty spaces in the whiteboard area, and some places at desks A and B. Also, there was a decentralized movement in the classroom, and there was less interaction observed in using the center.

Findings from the Fourth Interview Question: Where in the Classroom Do You Feel Most Creative?

Pinning creativity, as I explained in Chapter 3, is a unique method developed to measure the creativity from different perspectives of the design practitioners. The section following presents the findings from the pinning creativity exercise in the focus group interviews, in which the participants used a set of pins to determine where they felt most creative in the classroom.



Figure 4.7: The final results of pinning creativity from the focus group interview activity.

In Figure 4.7, the results for the groups are illustrated by color coding for each group, using the classroom layout in which the study was conducted. The results show a multiplicity of options by the participants because they chose several places.

The results, as shown in Figure 4.7, indicate that the participants' choices show the most creative places in the classroom are at the corners, but also, to a lesser degree at the edges of the worktables. The results also show a considerable number of selections in places near the windows and areas near the natural light in Area B. In contrast, there are few choices locating creativity in Area A. Participants chose other spots they thought helped them feel most creative. Furthermore, some choices were limited to areas near the whiteboards and the teaching platform, while the class center was not selected by any of the participants.

Final Findings from the Observation Maps Analysis

This section explains the findings from the actors' movement maps and the pinning creativity map to understand the creative climate in the design classroom. As such, I layered the final map from both findings to study the interaction that occurred between all actors. According to the movement maps, my hypothesis shows that there were certain areas in the classroom that actors gravitated—what I have referred to as hot spots. Going into the focus group, I assumed that participants feeling of creativity would correspond to these observed hot areas on the maps I had created over the last several weeks. As I will demonstrate in this section, there was indeed a correlation between the movement maps and the pinning map. As shown in Figure 4.7, the students' pinning map coincided with my movement maps giving some evidence that creativity and network connectivity (hot spots) are correlated.

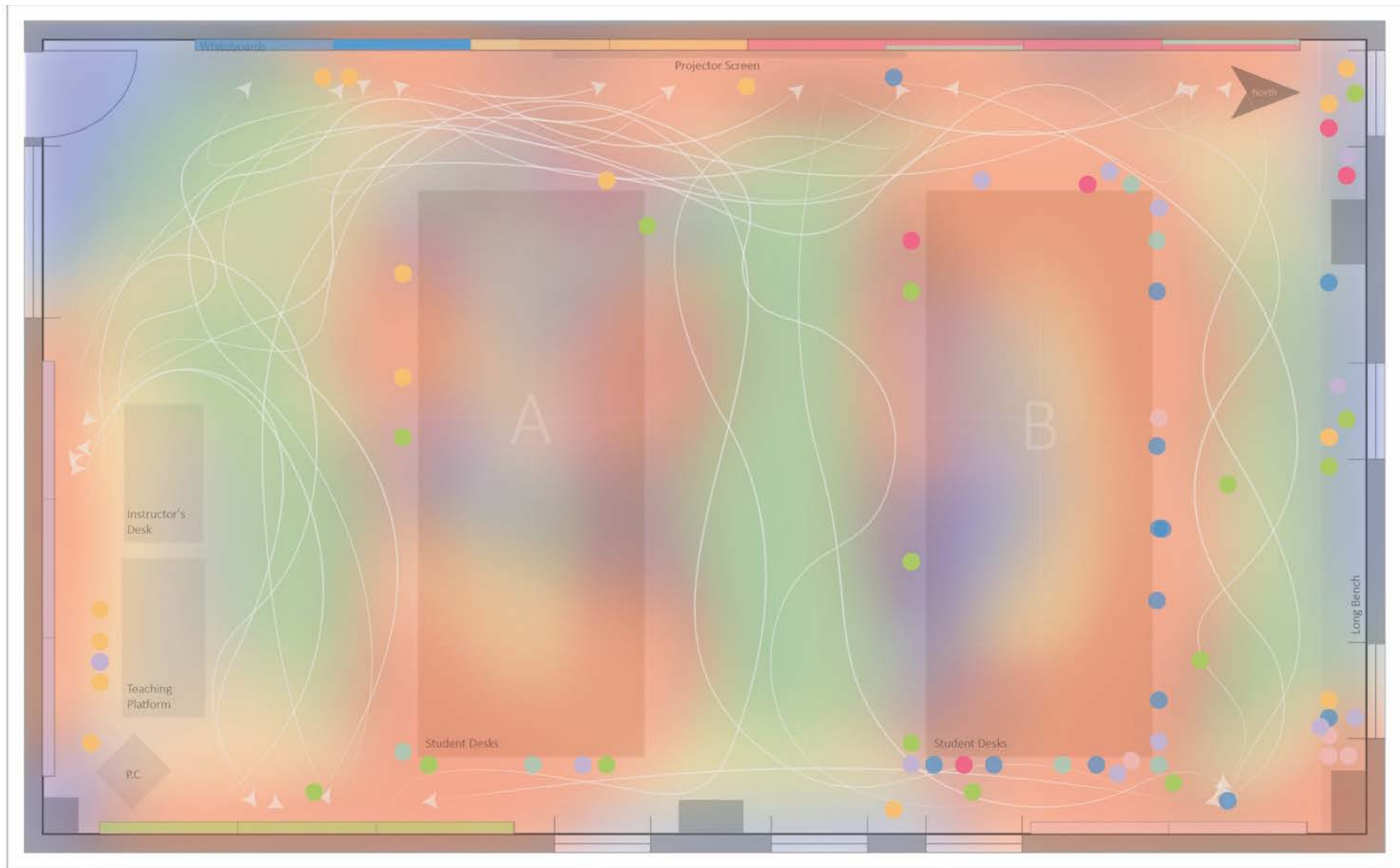


Figure 4.8: Creative climate map: the final finding from both actors movement and pinning creativity map.

My conclusion is thus that design classrooms have a distinctive weather system that facilitates a creative climate composed of hot and cold zones. The final climate map proves that creativity emerges when the hot spots maximize the connectivity of the interactions between the human actor (student) and non-human actor (corners, edges, and students' object). The creative climate map in Figure 4.8 has explained the fluid movement that creates the streams of interactions and generates spots of creativity between the sub-networks and diffused networks. The pattern that is revealed indicates a complex movement where actors connect and then diffuse across the network. As shown, the climate of some areas in the classroom became decentered or ignored, whereas others showed high interaction, a result which is represented through color coded cold, medium, hot, and warm spots.

The analysis of the creative map showed that the cold spots represent the neglected places where there was no close interaction between actors. In addition, it reflected climatic stability that indicates coldness and inflexibility in some areas because the difficulty of accessing these spots. For instance, it turned out that the area of the windows on the north wall showed no interaction with human actors, but there was dynamic movement against the windows where most actors met. Also, some spots represent lack of interactions between human and non-human actors, such as spots on desks A and B, the entrance, the corner near the teaching platform, and the window area. In my opinion, the cold areas play an active role in supporting the hot areas around the classroom. As shown, the cold areas come after hot areas, as is evident in the window area. Although there was a long bench along the wall, the actors did not react to it and preferred to use tables opposite the windows. On the other hand, the map displays significant patterns of maximum interactions, which range from warm to very hot

zones. These areas include desks B and A, the display area in the east and south wall, and the whiteboard area. The actors gathered mostly around the desk A because of the windows located near them, and this place allows them to view the whole class, and see the projector when the instructor presented the topic of the day. Furthermore, the human actors at desk B show high interaction because area B has great natural light. Including the use of the east wall corner near the B area, most actors interacted with this place and liked to work near the window. The whiteboard area had dynamic movements throughout the observation time because it was a strategic place that involved a lot of motion. Also, the large viewing areas helped all of the actors to interact with its location. On the south wall, the interaction was weak due to the limited space that was used within the teaching platform. Therefore, the lighting sources from windows caused the actors to gather in area B more than other places in the classroom.

Moreover, the study model in Figure 2.3 of the creative climate in the design classroom helped to highlight where the networks created their connectivity in the classroom. As is shown, this model focused on the physical components, but also allows for the interpretation of the creative states of the actors within various sub-networks. Thus, it helped to establish the places of interaction between the actors based on the interactive spots that were brainstorming their networks. This, in turn, created creative clouds, in which it saves the students choices for the display areas or the workplaces spots, which helped them to either make design decisions or develop their creative skills. For instance, the actor's movement maps show that both of the sub-network and the diffused network gathered in desk B more than table A. Therefore, these preferences had created the climate of their practicing creativity as

high spots, where there were; space for interaction, style arrangement, whiteboards, and the resources. Hence, all these elements supporting their creative practices and encouraging their engagement to space, and in turn, helps to locate the creative networks in the classroom.

Furthermore, using objects (non-human actor) impacted the interaction that fostered the classroom climate. As shown in Table 4.1, the object list indicated the most objects found on the surface of each network as well as the amount of time spent using them in each week. Design students used these objects constantly as network components and spread them out to connect with other elements in the network. Consequently, the findings in this data helped to reveal where the hot and cold spots formed the overall creative climate of the classroom as it corresponded to the pinning activity of the participants.

In conclusion, the maximum creativity appeared in the corners of the room and along the edges of tables. Based on the observation of all the maps, the center of the classroom between desk A and B was generally used by actors, but the actors went around the center because of the design of whiteboards and the classroom arrangement that forced them to circle throughout the space. However, the actors decentralized the classroom center, which was represented as an open area that allows the translation of the networks to occur between actors. Thus, this translation between the actors can fuse and diffuse the connectivity through the networks creating creative spots in the classroom. Ultimately, this interaction was reflected on the climate map of the classroom, where the hottest zones appeared in the form of maximum interaction circles reflecting the strength of movement around the tables, as well as horizontal movements around the whiteboard areas throughout the classroom.

Table 4.1: The networks components that the human actor used in building the creative networks.

WEEK	LAPTOPS	PHONES	TABLET/ IPAD	MOUSE	NOTEBOOKS	SKETCHBOOKS	PAPER/FOLDERS	PENCIL BAG	PEN/ MARKERS	BACKPACKS	LUNCH BAGS	LAPTOP CASE	WALLETS	KEYS CHINE	JACKET	WATER	DRINKS/COFFEE	FOOD/ SNACK	CHARGERS/CABLES	HEADPHONES
14-1	18	14	4	2	7	6	8	4	6	3	1	4	4	3	2	11	4	3	11	3
14-2	18	14	3	2	0	12	4	6	11	2	1	3	2	3	0	10	8	2	10	10
15-1	18	11	3	2	0	6	4	2	5	2	1	2	2	1	1	8	5	5	4	3
15-2	17	16	4	2	0	5	3	7	4	1	1	3	1	2	0	6	5	6	8	4

Table 4.2: Results of the classroom arrangements designed by the participants.

PARTICIPANTS	U- SHAPE	CLASSROOM	CLUSTER	CONFERENCE	DOUBLE	SQUARE
FOCUS GROUP F 3 MEMBERS	0	0	2	1	0	0
FOCUS GROUP C 3 MEMBERS	0	0	2	0	0	1
FOCUS GROUP P 4 MEMBERS	1	0	2	1	0	0
FOCUS GROUP T 3 MEMBERS	1	1	1	0	0	0
FOCUS GROUP D 4 MEMBERS	1	0	1	1	0	1
FOCUS GROUP X 3 MEMBERS	1	0	1	0	0	1
FOCUS GROUP G 3 MEMBERS	1	0	1	0	1	0

Findings from the Third Interview Question: How Would You Redesign the Classroom so that It More Effectively Promotes Creativity?

The responses to this question elucidated six different patterns of creative classrooms from the students' perceptions of creative environment in design classes. The renderings submitted by the participants came with a variety of choices and suggestions: U-shape, classroom rows, cluster style, conference arrangement, double shape style, and square (open square) style. Table 4.2 shows participants' preferences for a favored classroom style for practicing design. This table is quite revealing, indicating that U-shape and cluster style were the most identified styles of classroom design in these responses. The percentage of participants' preferences are depicted in Figure 4.9.

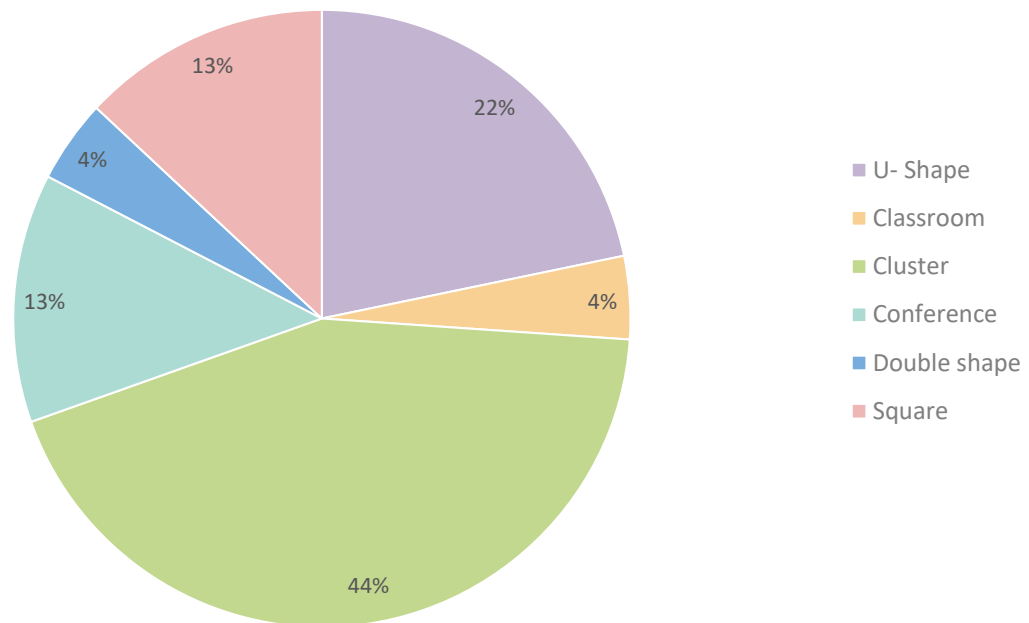


Figure 4.9: Chart of findings shows the classroom arrangements chosen by the participants.

In the following section, the answers are represented by six sets of drawings.

1. The U-shape was illustrated in several drawings from different focus groups during the interview. These results showed that the groups ended up using the classroom space and taking advantage of the form in which students felt connected. The drawings illustrated some preferences added from the participants. Examples were:

- The preference for the location of the teaching platform within the U-shape arrangement, where students felt the center of communication by the instructor, as in Figures 4.12, 4.13, and 4.14.
- Changing and adding more windows, as shown in Figures 4.10, 4.11, and 4.12.
- Adding additional furniture, such as a comfortable sofa, as shown in Figure 4.12.
- Adding some electrical appliances, such as a microwave oven, small refrigerator, storage cabinets and shelves, and more cables, as shown in Figure 4.13.

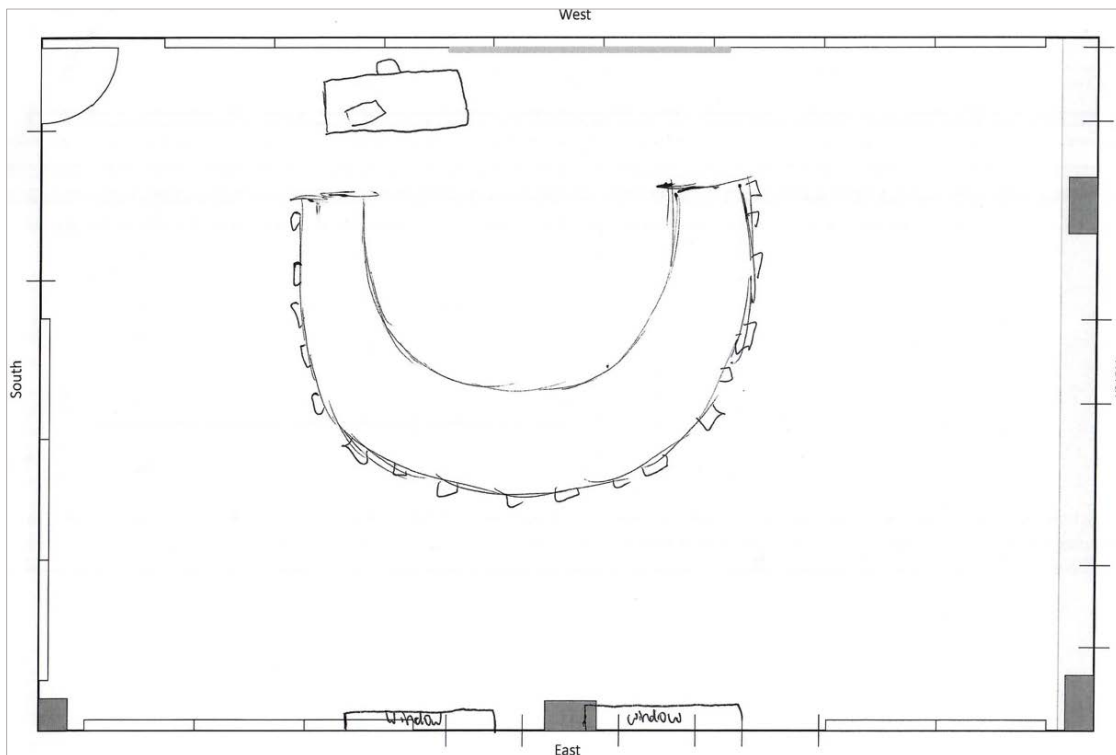


Figure 4.10: U-Shape style from the focus group interview results.

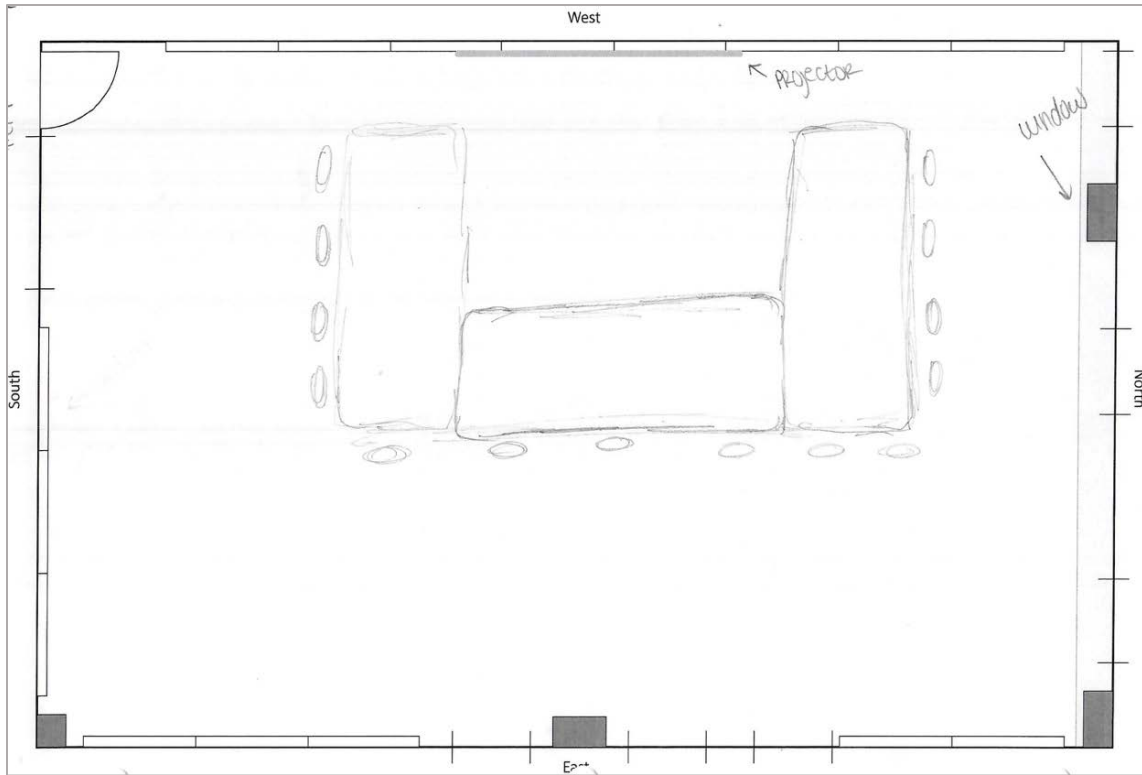


Figure 4.11: U-Shape style from the focus group interview results.

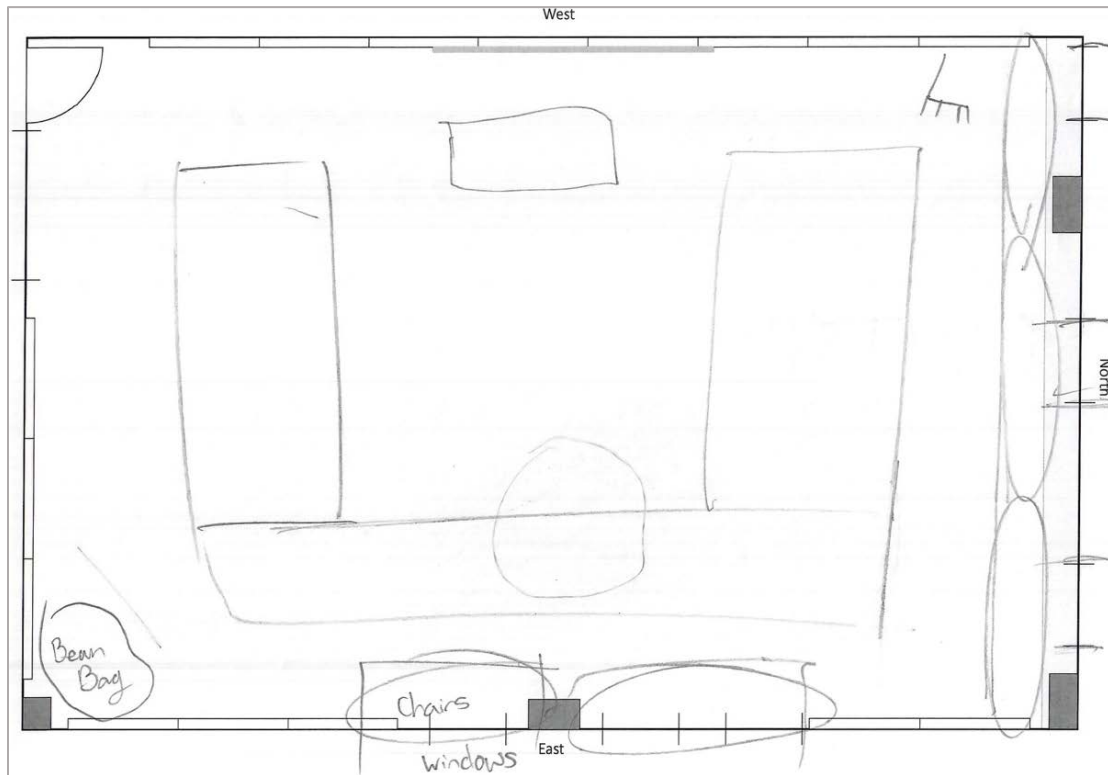


Figure 4.12: U-Shape style from the focus group interview results.

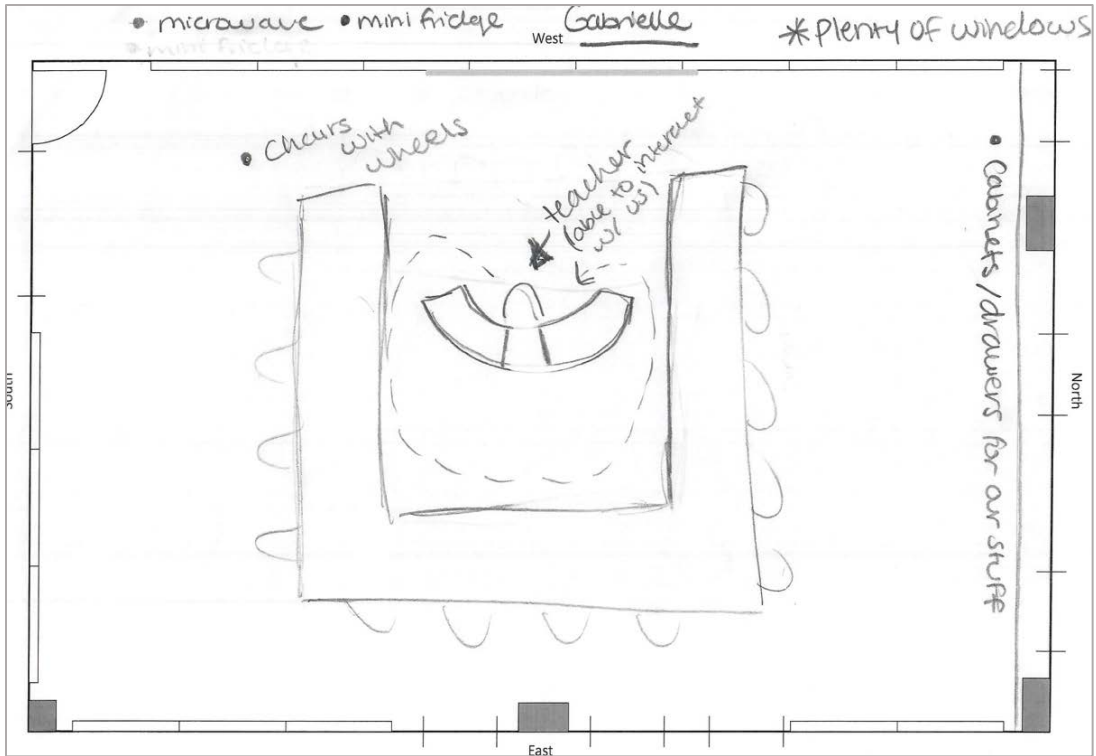


Figure 4.13: Shape style from the focus group interview results.

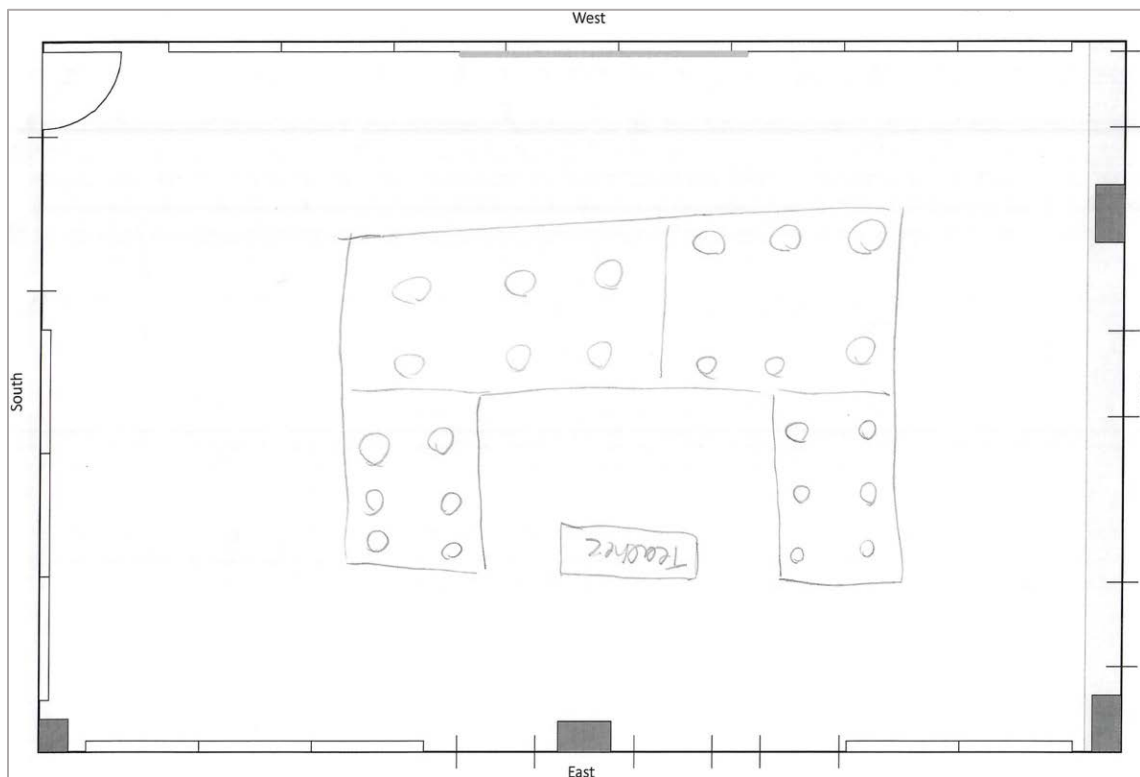


Figure 4.14: U-Shape style from the focus group interview results.

2. The classroom arrangement in Figure 4.15 illustrates where the participant chose to divide the tables into six sections, with the position of the teaching platform shifted behind the student seats. Also, the participant explained an additional preference for the desk use by providing a place for the cables so that the desks could be more convenient for working while charging devices.

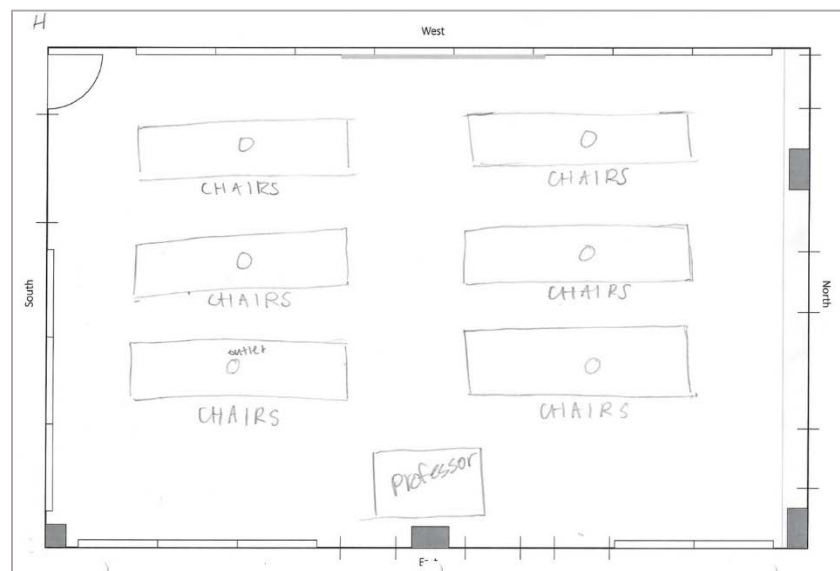


Figure 4.15: Classroom style from the focus group interview results.

3. For the cluster shape, the results show a variety of style arrangements. The drawings were divided into two parts, one of which was quadratic style, and the other was a rounded group style as follows:
- A) There were five responses in favor of applying quadratic style, providing some details from the participants' perspectives on the accessibility of objects. Figures 4.16 and 4.17 show participants' preferences in the classroom arrangements for a rectangular desktop shape that included working groups. The participants designed details that were important to them as designers. While working, it is important to have a desktop that provides accessible technology to work with more flexibility, for example. The technology that they suggested, such as a

desktop with a monitor and a multi-use cable, as shown in Figure 4.17, provides a more creative environment for designers. Furthermore, Figure 4.16 demonstrates how the participants preferred a projector screen that could be moved around the classroom, wheeled desks with adapters in the desk-legs, and a desktop with multi-use cables and wires.

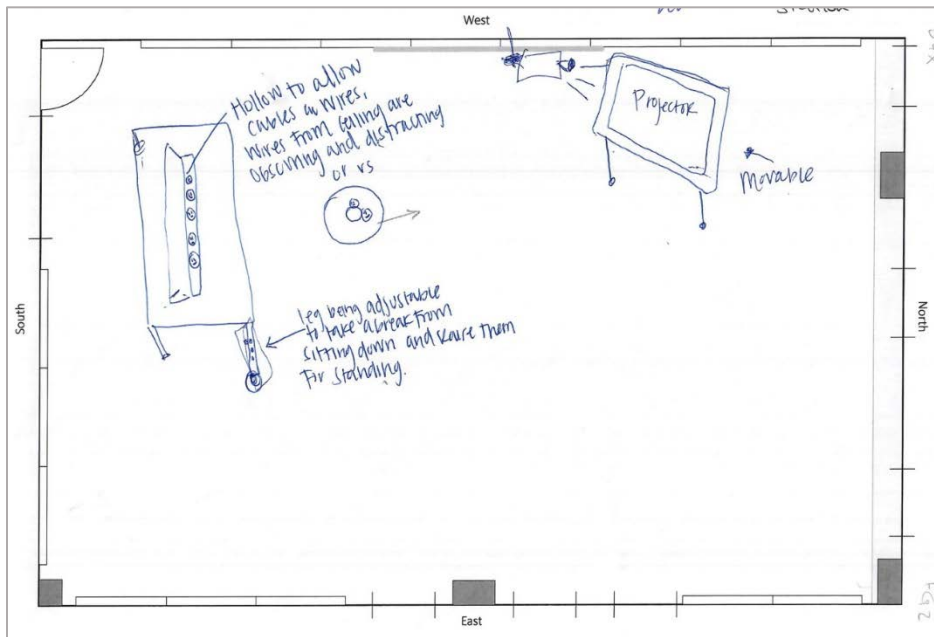


Figure 4.16: A rectangle style represents an extracted style from the original cluster style results.

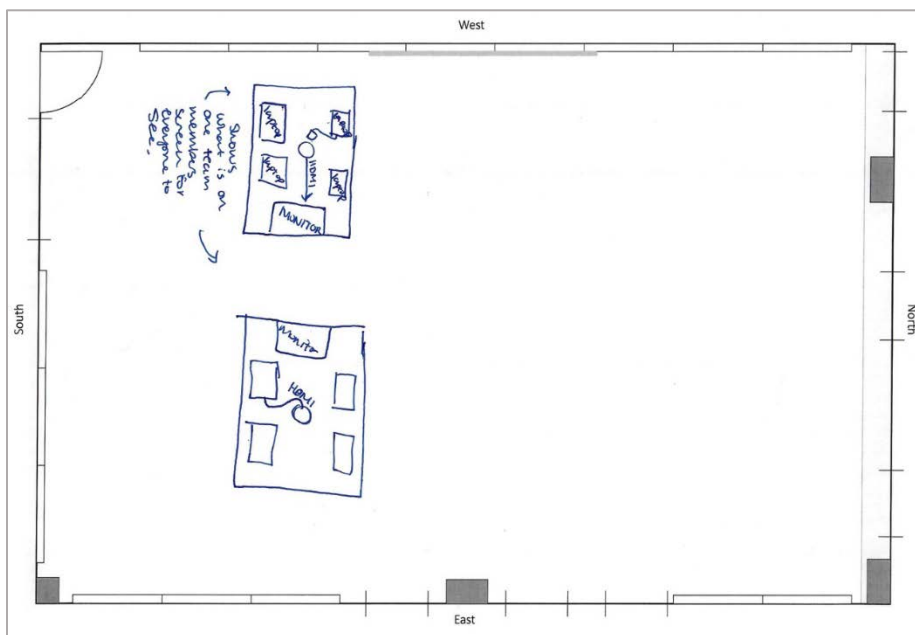


Figure 4.17: A rectangle style represents an extracted style from the original cluster style results.

Figure 4.18 shows a different perspective on redesigning the classroom to be more creative. The participant chose to arrange the desks into five workgroup stations around the classroom, which was similar to the U-shape style but in separate forms. Also, he placed the discussion table in the middle of the classroom and set the teaching table near the discussion table.

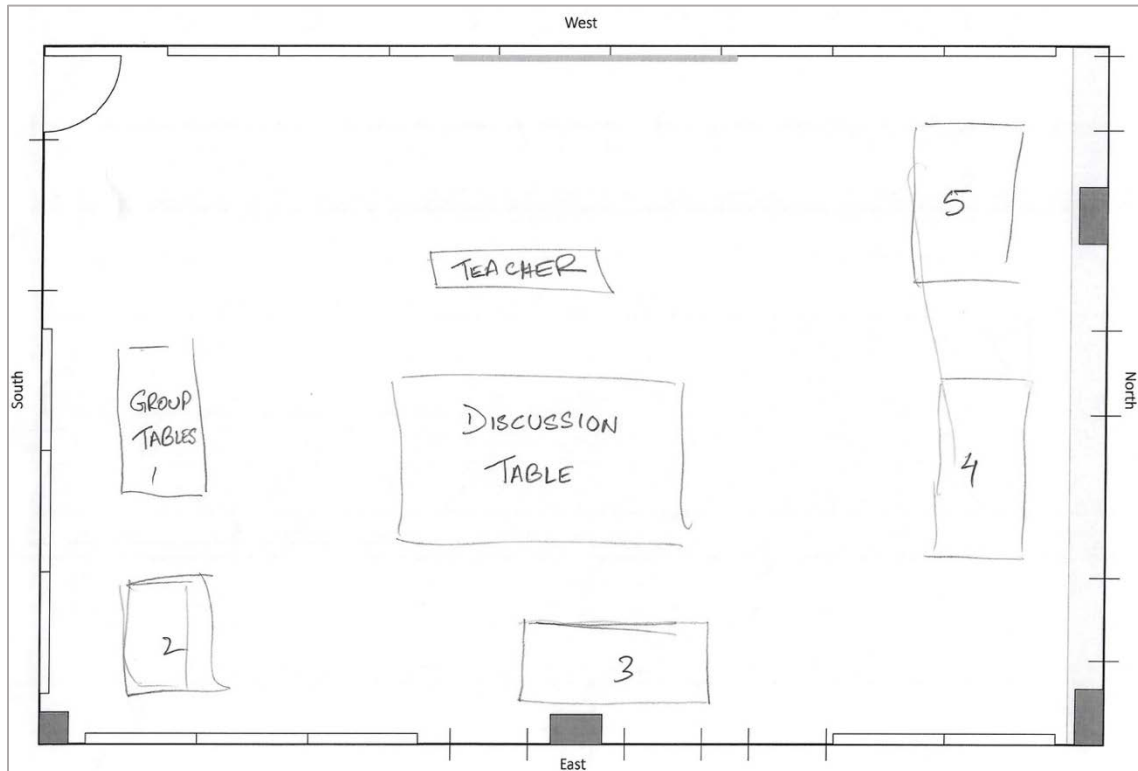


Figure 4.18: A different style of classroom arrangement that includes the cluster style.

In contrast, two of the participants had similar interpretations, as they preferred to reshape the arrangement of the tables into working groups without any details, as shown in Figures 4.19 and 4.20.

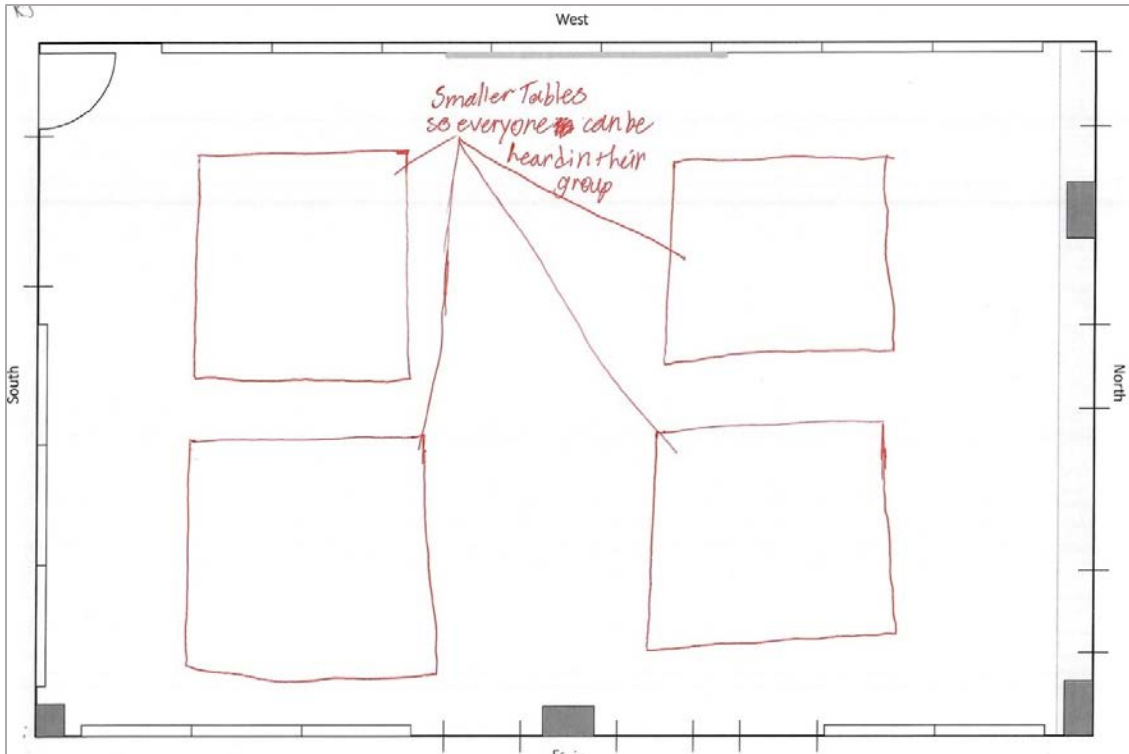


Figure 4.19: Clusters style represents the design of workgroup stations without details.

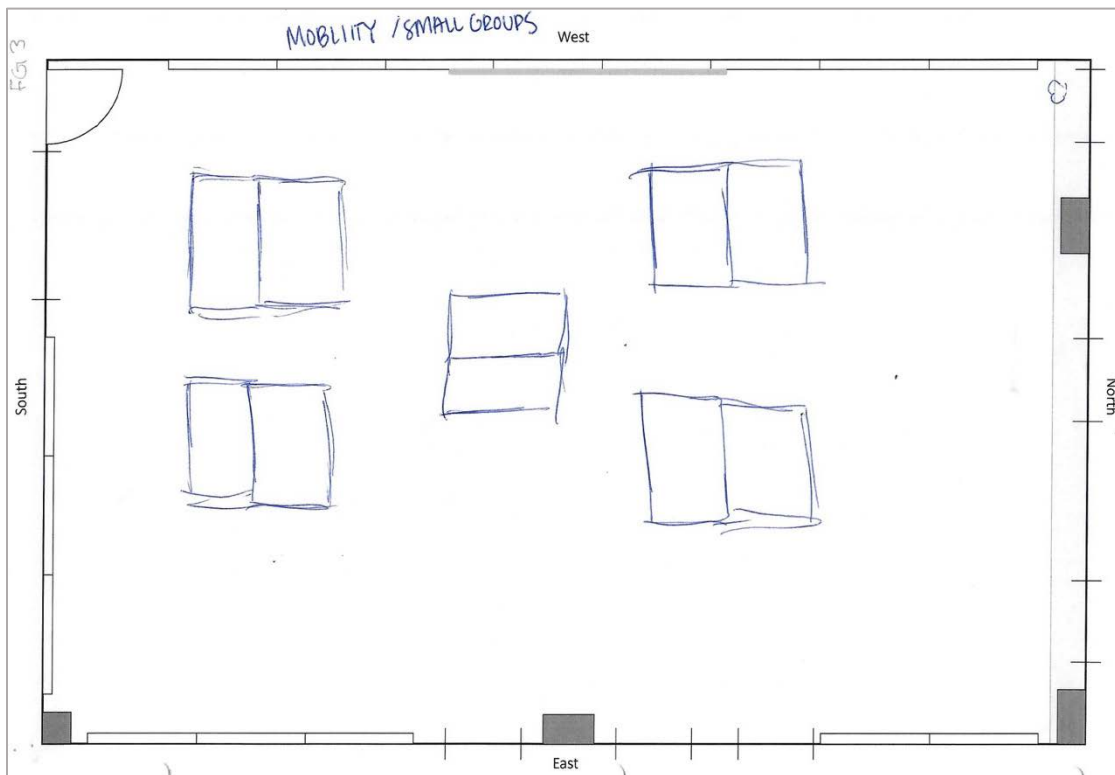


Figure 4.20: Clusters style represents the design of workgroup stations without details.

B) There were three designs suggested by the participants. In the first design, shown in Figure 4.21, the participant illustrated four oval tables distributed in the classroom space. The participant thought that this arrangement would be conducive to communicating and working as a group. Also, the participant suggested that the professor's table should be equipped with a chair for the student to facilitate discussion of the project.

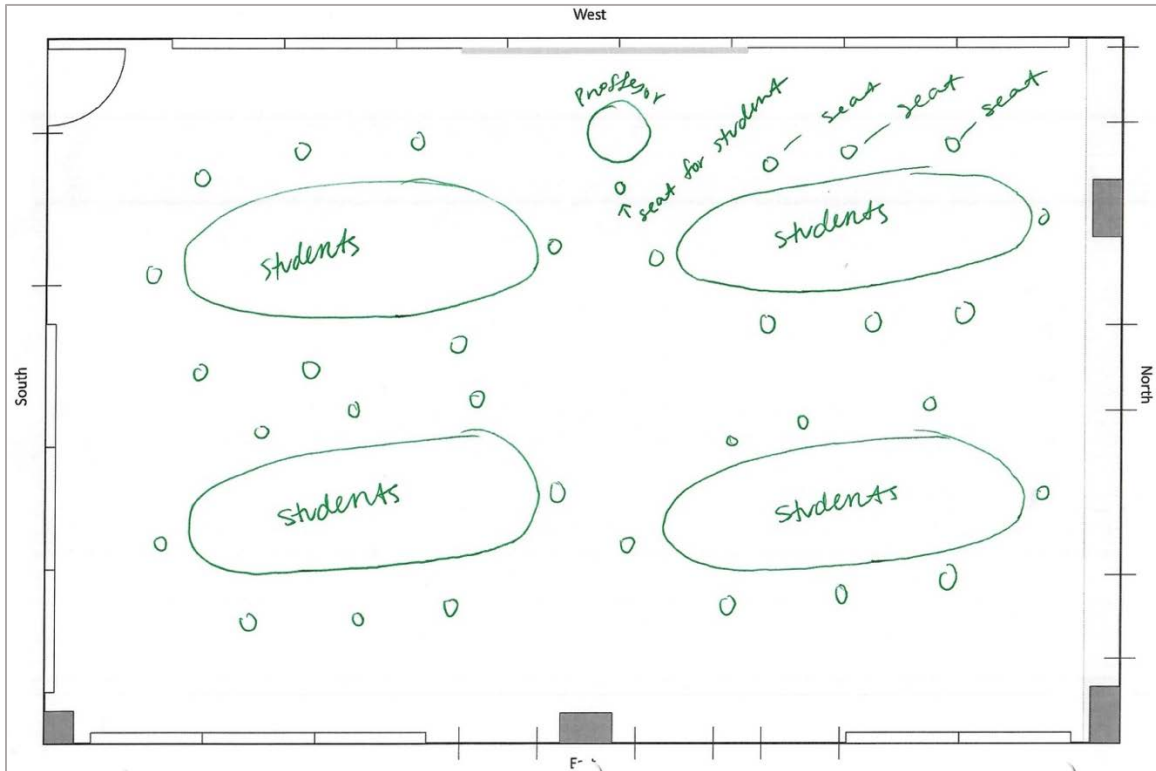


Figure 4.21: A rounded style from the focus group interview results.

In contrast, one of the participants designed the creative classroom from the perspective of small groups. Figure 4.22 included a small detail, the inclusion of a sofa and screen in the classroom corner. In addition, the drawing in Figure 4.23 illustrated the uses of the round table for classroom arrangement, and the participant added two items, a tall table to allow students to work standing in order to remain comfortable and productive throughout the class period and the printer as essential components of the creative classroom.

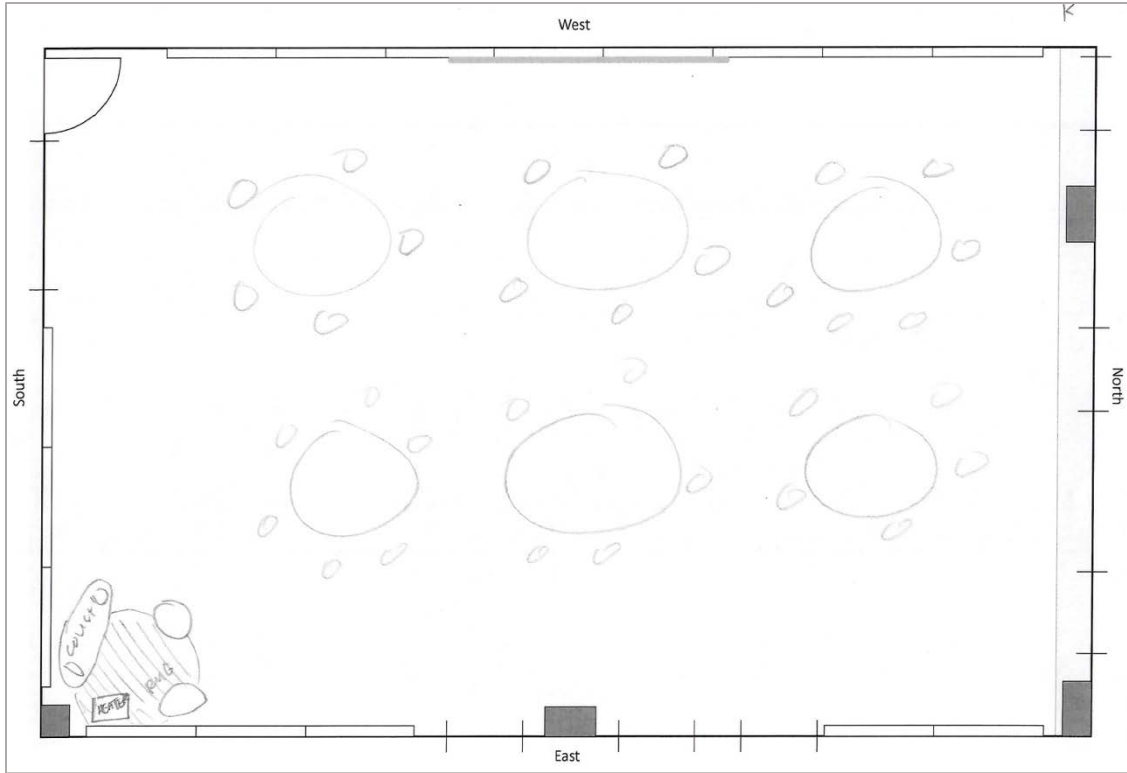


Figure 4.22: A rounded style from the focus group interview results.

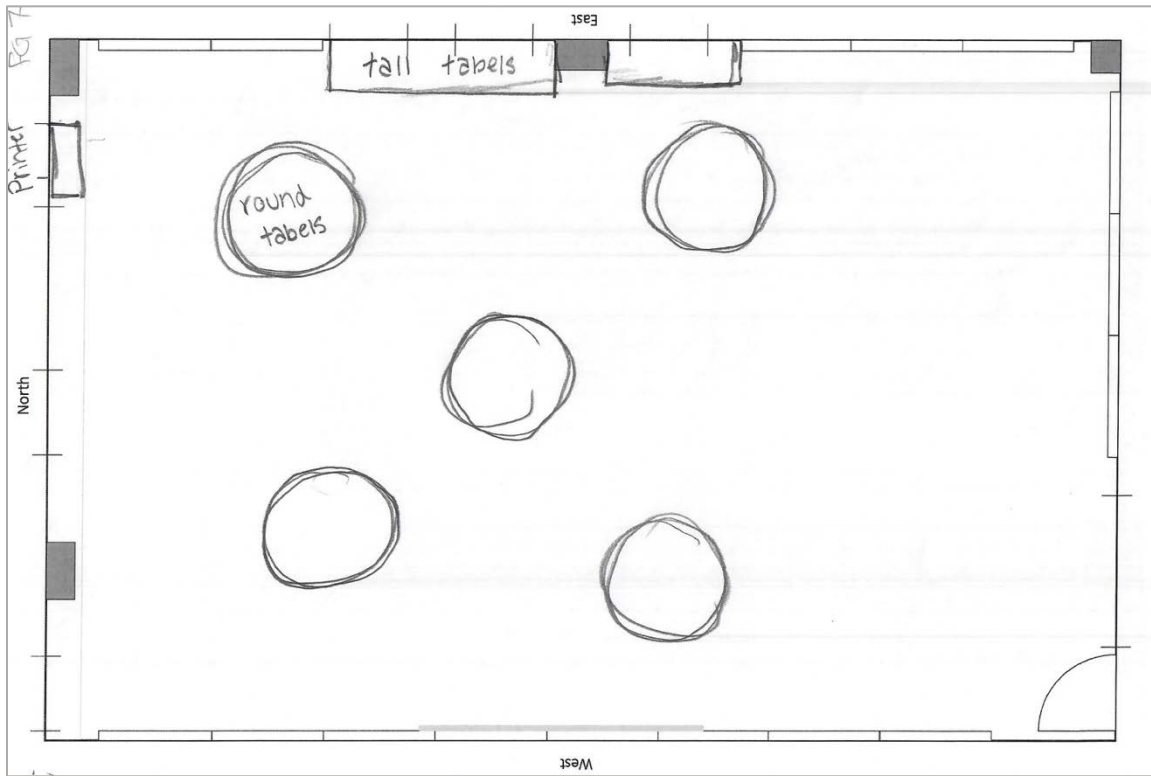


Figure 4.23: A rounded style from the focus group interview results.

From another perspective, the drawing in Figure 4.24 showed a different type of round shape, where the design of the desks was arranged in three half circles around the center of the classroom. The teaching platform with two stations, one for the computer and the other for the instructor, was placed in the left corner of the classroom.

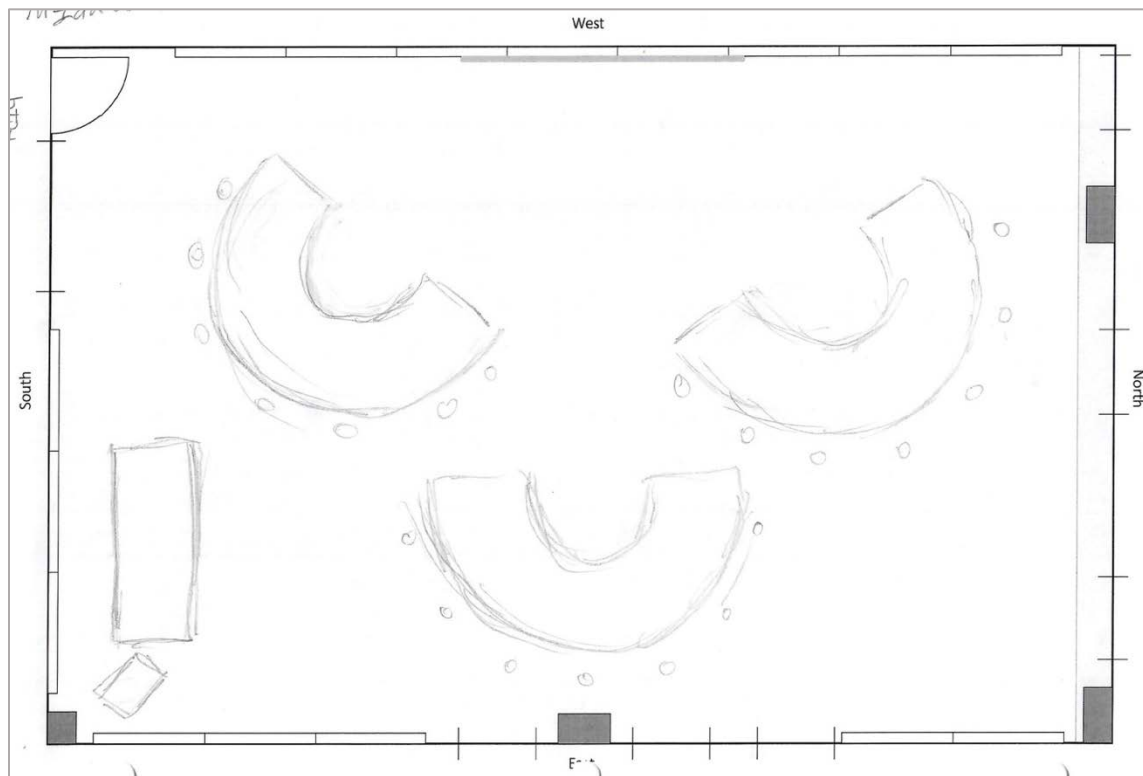


Figure 4.24: A different type of round shape from cluster style results.

One of the results from the focus groups showed a unique example of what a creative classroom looks like. The participant explained a different design of a round table where the students meet in a ring shape and sit in rotatable chairs. The response also suggested having a storage area (cubby) in the classroom and two movable tables, as shown in Figure 4.25.

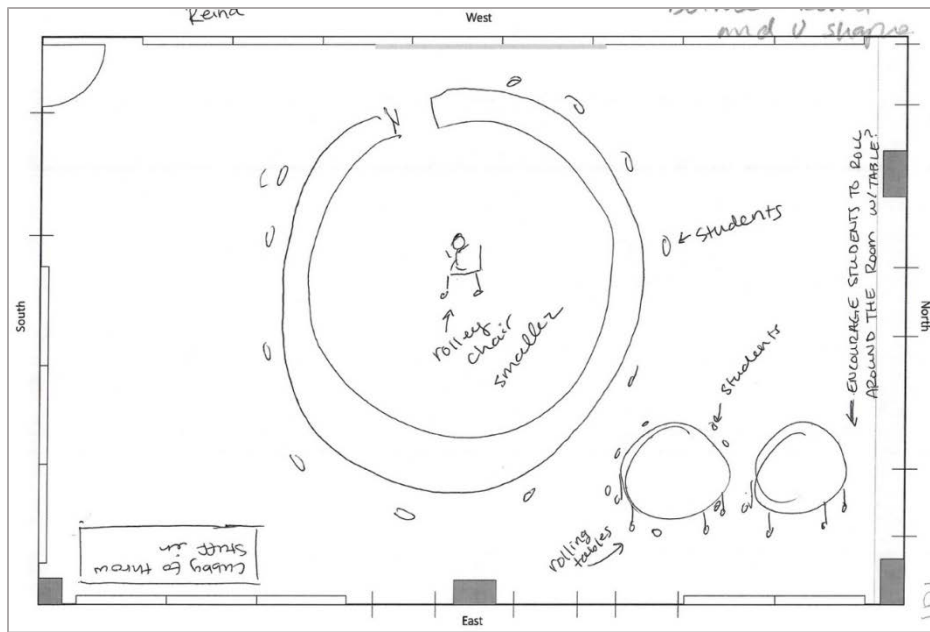


Figure 4.25: A different type of round shape from cluster style results.

4. The conference style results were distinct among three drawings: the first one represented two round tables on the sides of the class, as shown in Figure 4.26. This figure was simple, and the teaching platform was situated between the two tables without any further details.

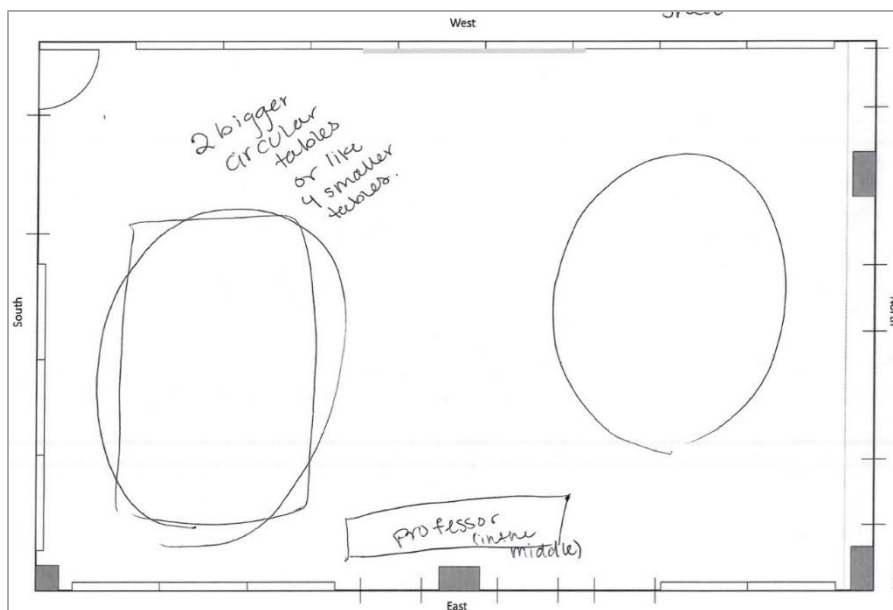


Figure 4.26: Conference style from the focus group interview results.

The other form of this style described a large table in the middle of the classroom with additional material details such as a Google Jam board, which would facilitate communication and presentations during group work, as in Figure 4.27. Also, the participant changed the shape of the windows, preferring large windows, and assigned one area of whiteboards along the wall. However, in Figure 4.28, the participant did not make any changes, as he preferred the current format as it was.

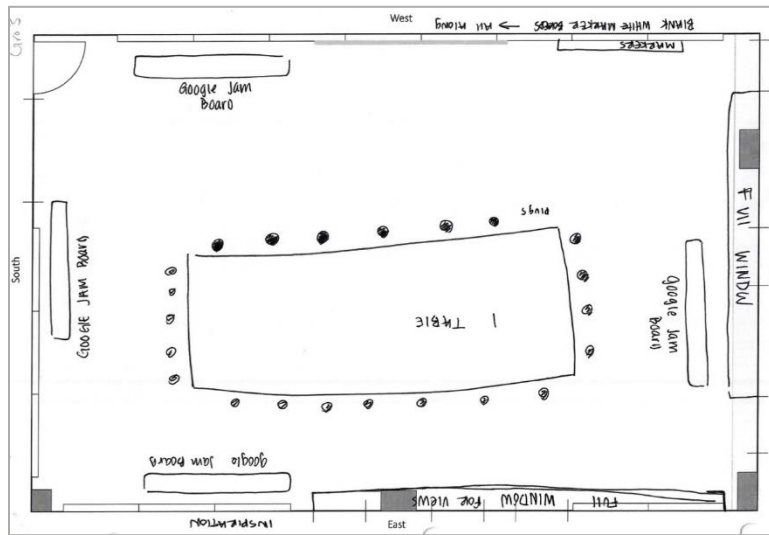


Figure 4.27: Conference style from the focus group interview results.

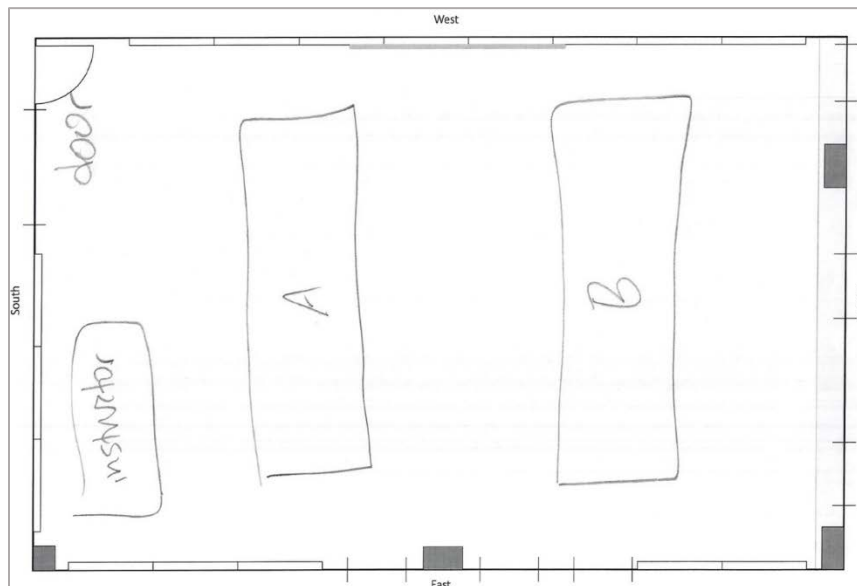


Figure 4.28: Conference style from the focus group interview results.

5. In contrast, the results from the double arrangement style with details, as shown in Figure 4.29, showed a different form of desk arrangement, including two presentation desks, huddle space, and two projectors. The participant almost completely filled the classroom space with objects that the designer needed to have for a creative learning environment.

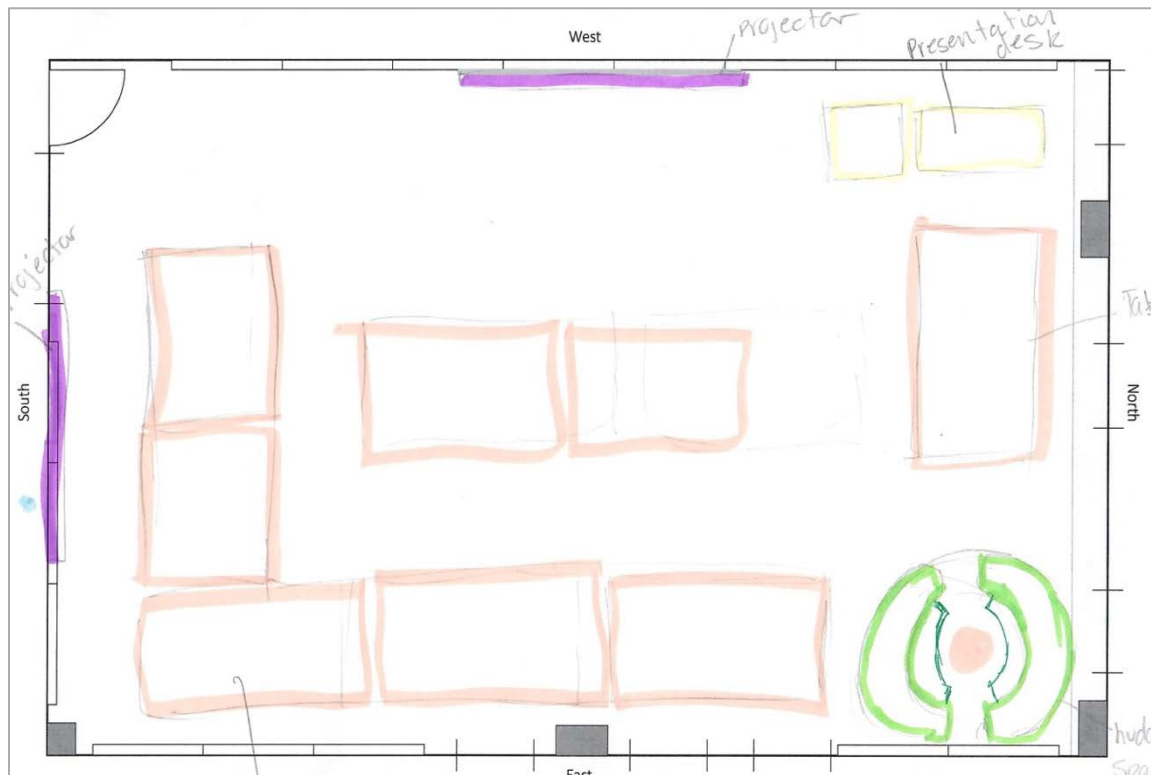


Figure 4.29: A double arrangement style from the focus group interview results.

6. The results of the square shape show the arrangement of a big square desk with chairs around it. The findings from this style implied the desk located in the middle of the classroom and then drew additional details to give the impression of a classroom that facilitates creativity.

As demonstrated below, Figure 4.30 included additional stand-up desks, a place for cubbies, and a place for hangers. The interesting aspect of this result was that the participant

sought to designate a place to relax by adding cushion bags and chairs in the empty spaces of this design. The participant utilized written phrases, such as “more homey” and “chill out area.”

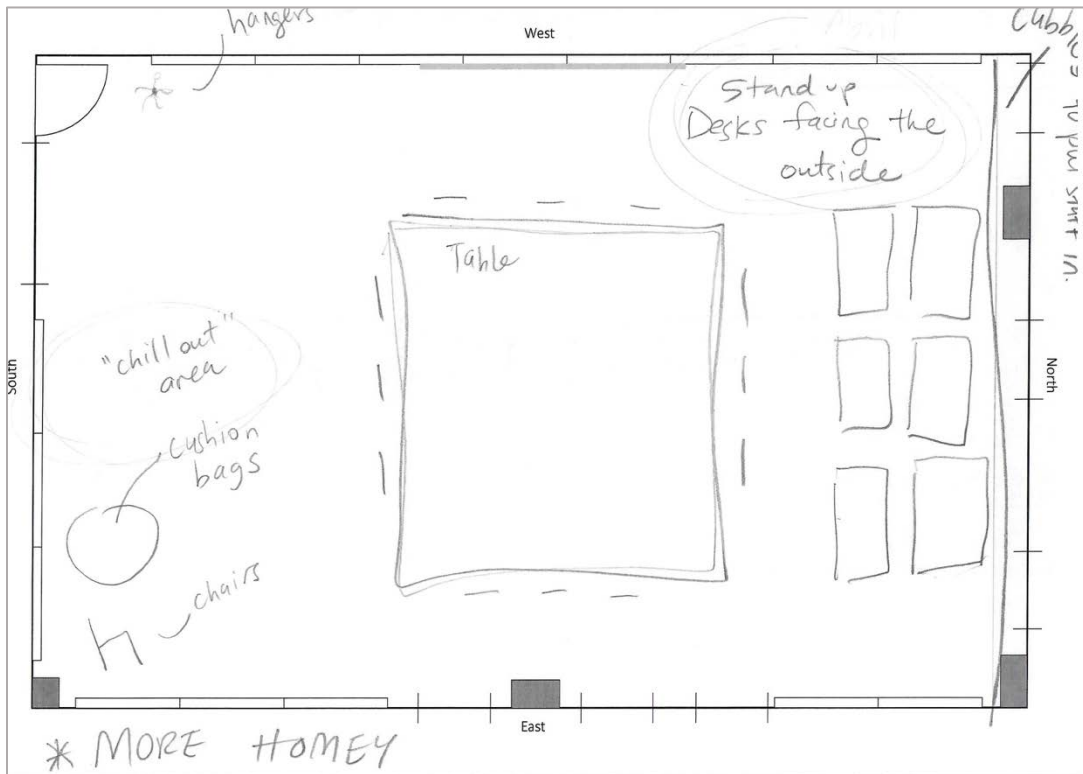


Figure 4.30: Square style from the focus group interview results.

Another simple form made use of the square arrangement style shown in Figure 4.31. The participant described a large square desk designed as a square ring so that the students could regularly sit around it while working on the design projects. There is no detail in this rendering except the addition of a rectangular desk for the professor in exchange for a place for students.

The final illustration of these findings came with a distinctive detail of the shape of the square circle, in which the student explained this form could help students communicate. Moreover, the participant suggested that the table design should include a mobile space that would allow students to sit in the center. The participant further added a suggested area that

contained a special place for thinking; he called it "window ledges for thinking," as shown in Figure 32.

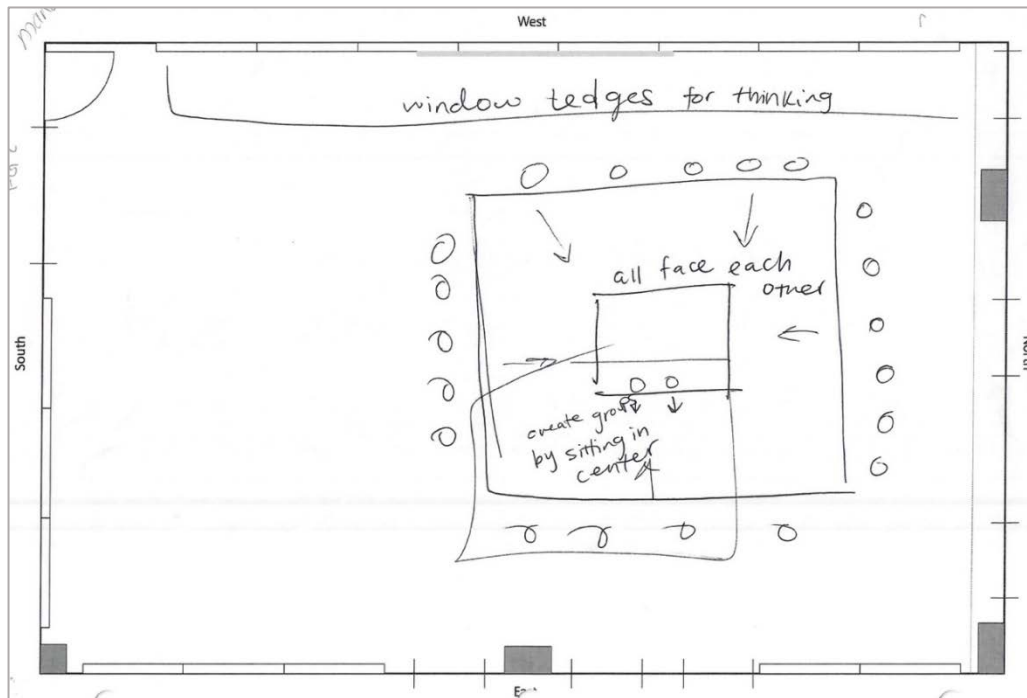


Figure 4.31: Square style from the focus group interview results.

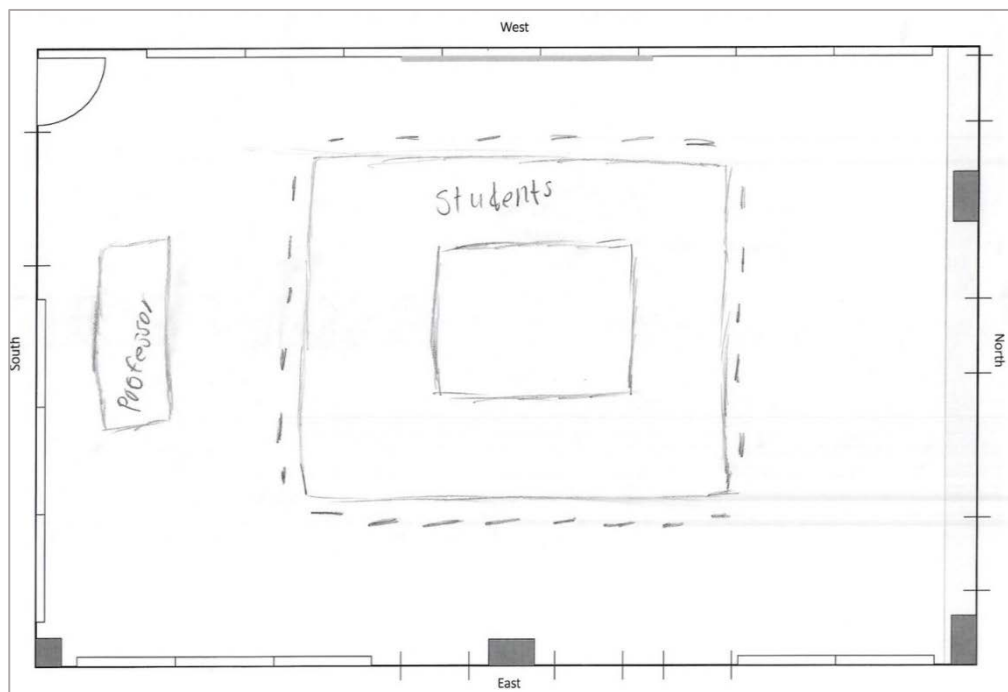


Figure 4.32: Square style from the focus group interview results.

Although there is diversity amongst the drawings, we can draw some general conclusions. Opposed to the movement maps above in which the center is underutilized, many of the illustrations by students emphasized the utilization of the center of the classroom as a place for maximal networking. Moreover, the results indicate several options in reshaping the classroom arrangement styles, as illustrated in Figure 4.9. A shared concern here is maximizing connectivity to promote creativity. Consequently, the results indicated that the participants focused on the communication level between the groups as they redesigned the classroom to highlight the seat positions. Further analysis showed that the role of technology was significant in these drawings, in which some participants illustrated the importance of having advanced technology in the classroom. As illustrated in Figures 4.15, 4.16, and 4.17, the tables were drawn equipped with a multi-use cable that would not obstruct student focus during the design process.

The results also showed the significant impact of the functionality of the movable desks and chairs, since they would allow students to have flexible mobility, as shown in Figures 4.20, 4.23, 4.25, and 4.32. Further, the instructor desk and the teaching platform were critical for the design students, as the results show that many participants preferred to place the instructor desk and the teaching platform in the middle of the classroom, as shown in Figures 4.12, 4.13, 4.14, 4.29, 4.30, 4.32, and 4.19. In contrast, the drawings of the corners of the classroom show that some participants filled this place with objects that facilitated relaxation, thinking, and assembly, as shown in Figures 4.29, 4.30, and 4.32. Moreover, they used written descriptions such as “more homey,” “chill out area,” “huddle space,” and “window ledges for thinking” to describe the peripheries of the classroom.

In sum, the results from the focus group drawings show that design students are concerned with maximizing connectivity for the general network in the center of the room while also leaving spaces on the periphery for both connected and diffused sub-networks. The classroom thus, should be a space where networks can fuse and diffuse.

Summary

These findings came in the form of interactive visual maps through the interaction of human and non-human actors in the classroom. In this analysis, terms are employed to symbolize the state of the actor in the network and describe its creative state. The results from observation and focus groups showed similarity in some data, such as the selection of angles, the neglect of the center, and interaction around the separation area. New results emerged from the climate interaction of creative networks and gave a new dimension to the objects design course in the classroom. In general, these results suggest that the non-human actors collaborated with the human actors to assemble creative networks in the learning environment of the classroom, which are detailed in Chapter 5.

CHAPTER 5

LET THE NETWORKS TALK!

Introduction

This study investigated the interaction between human and non-human entities and how their relationships create what can be called creative networks. This chapter includes a discussion of the study's significant findings, related to the literature on actor networks in art education, design, and learning environments. Moreover, this work attempts to provide a new understanding of creativity by considering the notion of the creative climate in a design classroom and learning environment. The study sought to answer the principal question, *How do things, spaces, and atmosphere affect the kinds of creativity that are possible in a design classroom?* The second question, *How can we map the networks of cooperation between students and objects in a design classroom visually to better understand the relational and emergent nature of creativity?* Following such cooperation over time, what lessons can we learn about classroom design that can enhance creative production?

This study focuses on how the classroom as a dynamic network of multiple actors and movements provide possibilities for creativity to emerge. This work reviewed the importance of the interaction between actors to locate creativity in a design classroom in order to better redesign a creative classroom for teaching design courses. Therefore, the ultimate goal of this work is to define the parameters of an "ideal creative place" by tracking participant interaction.

Discussion and Interpretation of Findings

Mapping creative networks as a method enhances understanding of the ways actors interact and connect with other entities within networks to assemble creative networks in the

classroom. Upon observing the maps, I created during the course of the study, I achieved a better understanding of the relationship between the space of the classroom and the students' practices. Also, I began to understand the important role of classroom arrangement and the ways design layout impacted not only the practice of design but also the decision-making of students. After studying the maps created from data collection, I was able to pinpoint essential factors influencing the location of creativity in the design classroom. I saw that mapping actors and their movements inside their environments helped designate creative directions and led to the rethinking of the classroom layout.

The primary finding of this study is that classroom space is a central and powerful influence upon the connections between actors that helps to create and enhance their relationships. In the data I discovered several critical factors related to both the production and the reduction of human actor interactions in the classroom. Maps based on the actors' movements and interactive activities in the classroom demonstrated four substantial factors contributing to an environment that fostered creativity in the design classroom: a) the creative climate as a system reveals the interaction and places of creativity in the classroom, b) the center vs. corners as a measure of interaction in classroom space design, c) roundness as a measure of classroom style and space connectivity usage , and d) plugs-in creativity as a measure of technology consolidation within the design of classroom elements. These models make possible the redefinition of the best characteristics of a classroom, not only for teaching, but also for the investigation and utilization of creative networks in the development of students' skills.

Discussion of Findings in Relation to Creative Climate

Most previous studies addressed the concept of creative climate from the perspective of developing individual skills in organizations and work environments, focusing on the forces hindering or promoting creativity (Ekvall, 1996; Mathisen & Einarsen, 2004; Hunter, Bedell, & Mumford, 2007; Péter-Szarka, 2012; Isaksen, Lauer, Ekvall, & Britz, 2001; Ekvall, 1996; Amabile, 1996). Such scholarship developed models to measure creativity that included conceptual categories of work environment hypothesized to influence creativity, as shown in Table 2.1 and Figure 2.2, which helped me improve the study model illustrated in Figure 2.3. In the study model, I endeavored to prove that interaction facilitates a creative atmosphere for innovative practice among actors, realizing that the impediments to creativity also fall within the classroom climate arena. The present study's findings on creative climate introduce a new method to measure the interaction-based classroom climate, which, in turn, can underwrite improvements in student user experience through classroom design restructure. Furthermore, although the term *creative climate* may connote the anthropocentric view common to previous scholarship, this study has also focused on the objects that foster creative climate, considering Gammon's (2013, p. ii) perspective on "climate-as-assemblage," indicating the impact of non-human objects on interaction in the classroom.

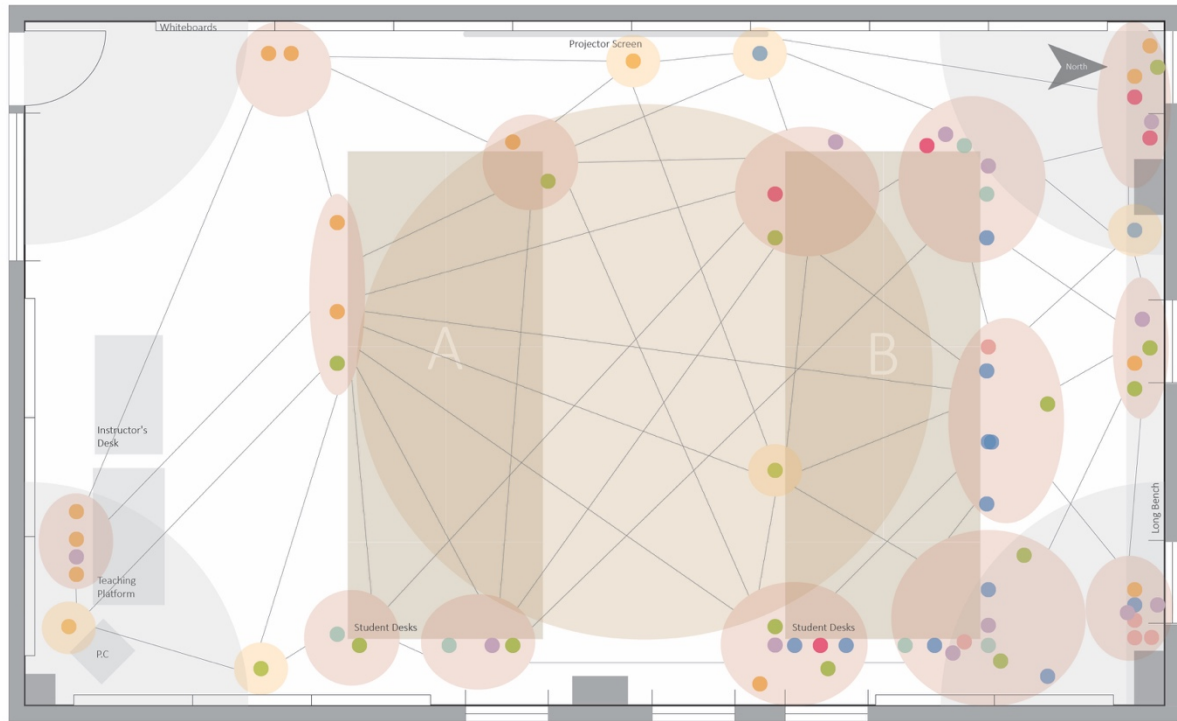
Based on the findings, this study fills the gap in previous studies by explaining the role of non-human actors in the creative climate in the classroom, as shown in Figure 4.10. In addition, the creative climate map findings in Chapter 4 underpinned an accurate analysis of the classroom cold spots that had been disregarded by the human actors, a finding consistent with Daly's (2019) view that some non-human actors have an agency that repels interaction with

human actors. At the same time, the maps documented how interaction with other objects demonstrated the energy that attracted human actors to engage with them.

The approach of this study, connecting the findings of observation and mapping the interaction of actors to develop visual maps in context, inaugurates a unique method that has not been employed in previous research related to creative climate. The evidence presented in this study's creative climate maps supports my assertion that classroom space helps to formulate a creative climate, the study of which may be employed to reconsider the design of the design classroom. An essential complementary finding is that the role of non-human actors in the development of creative skills is essential because the interaction between both human and non-human actors helps to enhance creativity as a location.

Discussion of Findings in Relation to Center vs. Corners

Most of the previous literature on classroom space and creativity, which I reviewed in light of actor-network theory in Chapter 2, underlines the importance of classroom space as an object that influences interaction between actors (Harrison, 2018; Triantafyllaki & Burnard, 2010). The current study confirmed the role of space and place in facilitating creativity, which coincided with the perspectives of Davies et al. (2013) and Warner and Myers (2009). It also corresponded with Thoring, Desmet, and Badke-Schaub (2018) studies that addressed the types of creative space, and the spatial qualities for the classroom. The focus of their methodologies was to conduct observations and interviews to provide results regarding the quality of space in the classroom in developing students' creative skills. However, the findings in Figure 5.1 and 5.2, implied different perspective of the role of interaction among actors that generates creative networks in classroom spaces.



This diagram highlights significant spots of interaction and how the actors connected to the classroom corners and center.

● Team P ● Team D ● Team F ● Team G ● Team C ● Team T ● Team X

Figure 5.1: A result showing the classroom center as a central network in the classroom.

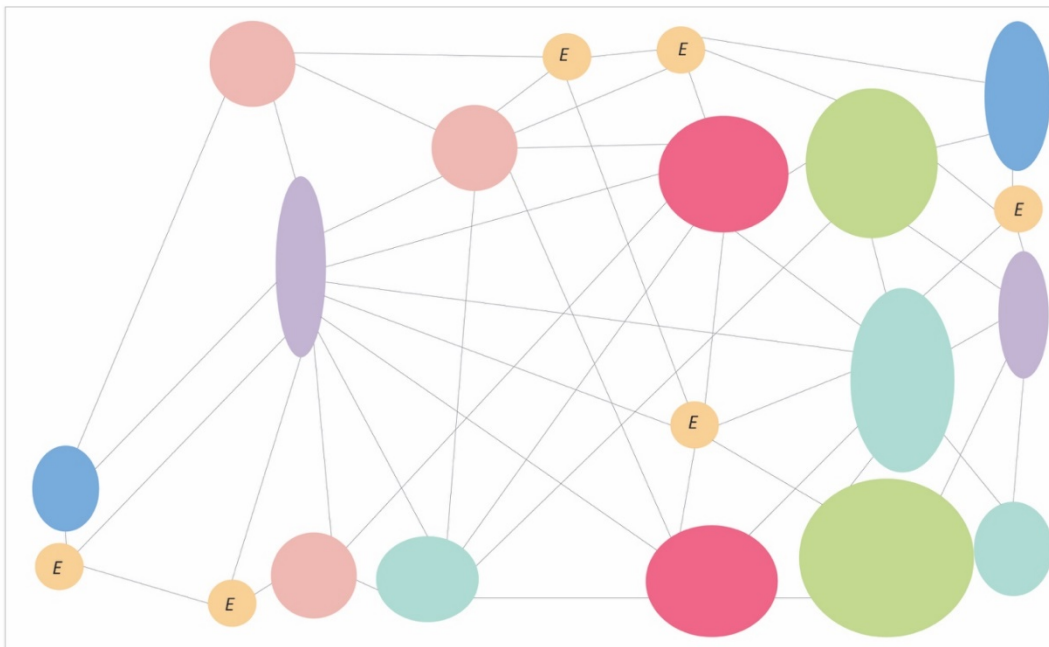
In this study, the center of the classroom is essential for facilitating connectivity between networks, but as shown in Figure 5.1, the corners act as main sources that contribute the creativity on the perimeter of general networks within sub-networks. Corners are considered impactful spots of the maximal connection network that administers the nodes that conducts interaction between actors. The findings, as shown in Figure 5.1, show a strong relationship between the corners and the center of the classroom. The findings indicate that the participants' choices revealed that the most creative places in the classroom were at the corners, mostly, but also, additionally, at the edges of the worktables. Considering ANT, the findings of the current study are consistent with Nottingham's (2017) work finding that ANT

facilitates an analysis of the materiality of learning environments in the development of design students.

In addition, the results show a considerable number of selections in places near the windows and areas near the natural light in Area B. In contrast, there were few choices locating creativity in Area A, as participants picked other spots, they thought helped them feel most creative. Furthermore, some choices were limited to areas near the whiteboards and the teaching platform, while the class center was not selected by any of the participants. The actor in the network avoided the classroom center and employed it as interactive extensions that help him to access other networks. These findings reveal that the center is a connection zone between the actors and not the configuration area of the networks. In this sense, creative networks are not assembling in central of the classroom; instead, these networks meet on borders and the corners in the classroom. Accordingly, *I can conclude that creativity is decentralized while connectivity is centralized*. The connectivity of the maximal and sub-networks represents as creative network nodes, where the connectivity derived their relationships from the corners in the classroom.

The findings of the correlational analysis in Figure 5.2 show that the classroom center is a central network through which network actors communicate. As all networks intersect in one center, yet the corners feed the interaction of creative networks. Hence, *corners and edges* function as a supply sources for other networks in the classroom—weather patterns emerge on the margins of classroom. Accordingly, these results reveal that diffusion networks (represented in small circles) were located at the edges of the classroom and were closer to more sub-networks. As such, corner 2, corner 3, and corner 4 are the source of assembly for the

actors to build creative networks. These corners foster the node of sub-networks, while some object edges of the classroom sustain the diffusion networks connected that were near to other sub-networks. These heterogeneous clusters explain the hot stream of interaction around the corners of the classroom, the edges of the desks, and the whiteboard areas, while the general weather in the center of the classroom remains a natural heat source of interaction in the classroom space as a whole.



This diagram presented the final findings and how the creative network has created the connections between the actors.

Figure 5.2: A study model distills the findings of the pinning creativity activity.

From the data in Figure 4.7, I designed the study map to outline the interaction of these networks, thus indicating that the interaction among human and non-human actors led to the identification of the source of the creative places in the classroom. As a result, the study model confirmed that interaction was an invisible moving through the designed classroom environment. Moreover, these signals were influenced by a number of triggers that facilitated cooperation between networks. In contrast, communication became weak if the use of design

was not appropriate and did not promote interaction between entities. The small, diffused networks appeared on the edges of the classroom and remained close to the larger networks. The maximum connectivity appeared amongst the large networks located in the corners of the classroom and the objects located there. The figure 5.2 visually illustrates the decentralizing tendency of the center of the classroom, which shaped the network interconnections among actors. The current study found that the corners represented the spheres of inspiration where actors frequently gathered, while the center was the communication area where all interacting entities intersected. In light of the participants' choices, the data that emerged from their responses confirmed that classroom space design supports the promotion of dominant networks, as I discussed in my review of the literature on classroom space and creativity in Chapter 2.

In sum, the findings of this study are different from the existing literature because they relied on the observed movement of the actors in relation to perceived moments and spaces of creativity by the actors themselves to generate an understanding of the dynamic nature of creative climate.

Discussion of Findings in Relation to Roundness

I use *roundness* as both a literal and a figurative term for the way connections between actors in the design classroom formed fully integrated networks, the form of circularity expressing connection. Roundness reflected the shape of the meeting points between the networks, and roundness also derived from the shapes drawn by participants, which precisely indicated a distinct form of circular communication among actors. This finding deals with classroom arrangement as an important factor associated with creativity. From my point of

view, the arrangement of the classroom refers to the relationships built among human and non-human actors such that they form the kind of association in which the human actor can produce and be creative. Previous literature has addressed classroom style arrangements as an important design factor in design classes. As mentioned in my literature review, Van Note Chism (2002) emphasized that the pattern of classroom arrangement at universities is as important as technology because of its impact on student interaction in the classroom, a phenomenon illustrated in Figure 2.1.

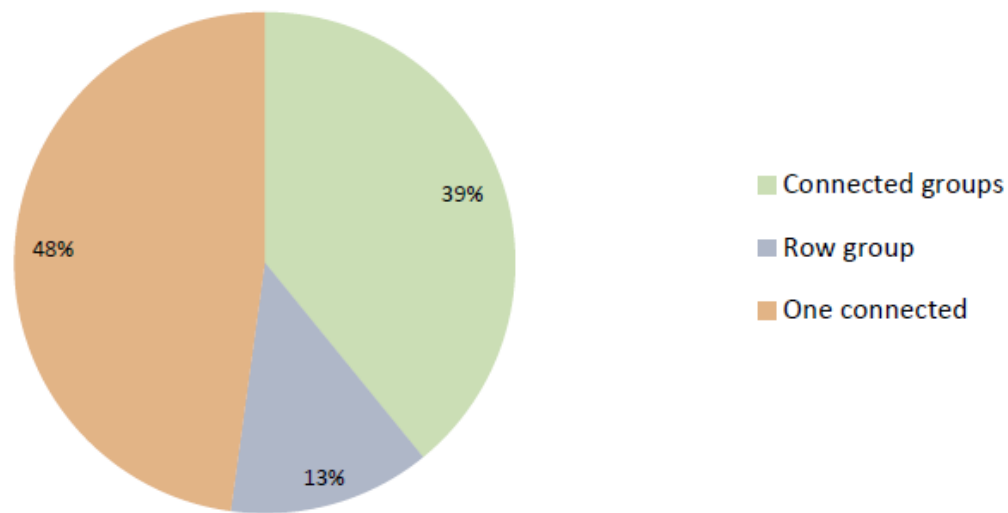


Figure 5.3: A schematic reflects the percentage of connected form selections in the classroom arrangement.

The findings of the present study show that the preferred arrangement of design classes depended on communication and group work, in other words, being connected. In this finding, the data indicated that such connectivity was reflected in actors' frequent choices to form a large group. The data also revealed a greater proportion of choices to remain in various forms of connectivity. Even when actors became decentralized, they remained within the networks and maintained connectivity in various ways (sub-network and diffused networks). Therefore, decisions about classroom arrangement heightened the power of communication between

human actors. Figure 5.3 shows the most common classroom arrangement style used to deliver connectivity between peers. This figure demonstrates that the one-connected-desk design was most preferred by the participants. In that case, the students' drawings supported the idea of sitting connected, implying that they felt creative next to their peers, which helped them to communicate more easily and make decisions about design.

As shown in students' drawings in Chapter 4, the results verified that the decentralized area was an open space for communication between networks in the classroom, which the actors used to build networks among various entities. Other significant findings related to roundness indicated the notable role of the edges in promoting connectivity between the networks. The data showed that students neglected the edges, creating round shapes instead. This might indicate how one of the most powerful actants in the classroom is completely invisible from the human point of view. This invisibility does not mean that edges were unimportant. Indeed, it might indicate the opposite: edges work only insofar as they are unobserved. For example, the edges allowed the students to face each other, which facilitated meeting points of collectivity between actors. The edge also is a point that separates sub-networks that focus around the point of the edge rather than turning away back toward the center. As such, the shape of the edges permitted the emergence of spaces encouraging the assembly of objects and human actors for maximal creativity to emerge as a hot spot. On the other hand, in a different way, roundness might be thought of as limiting creativity precisely by over emphasizing connectivity. Therefore, to build on the findings of this study I suggest employing an octagonal classroom style to foster forms of roundness that support various forms of connectivity associated with the generation of creative networks. Perhaps we can

state the following: roundness might encourage connectivity, but edges are important for creativity.

Connectivity was represented in the main findings on roundness. Hence, my findings create an important perspective on the rearrangement of classroom seats. This topic has been neglected in previous scholarship and has emerged in the present study because it brought to light student practitioners' perspectives on design. Finally, the correlation between the findings on the center and the findings on roundness is remarkable because it explains the form of decentralization the actors demonstrated coincidentally. Mapping the actors' interaction shows that decentralization is a form of making the connections between the entities and open the center as space to receive and establish communication between networks that reside around the center. Also, these findings suggest that the edges play a major role in connecting the nodes between networks.

Discussion of Findings in Relation to Connectivity and Plug-in Creativity

Classroom components facilitate students' ability to choose places they feel most productive, contemplative, and creative, based on the light and space. Previous studies, which I examined in Chapter 2, have reviewed the role of technology in the learning environment, which shapes the development of networks of actors that bring about a mood of creativity. The findings of the present study, derived from the data, confirm the utility of advanced technology in the design classroom. The findings derived from the data confirm such uses of advanced technology in the design classroom. This viewpoint is also consistent with the studies of Amiel and Reeves (2008) and McLellan and Nicholl (2013), which encourage the adoption of new technology and devices that promote creativity in educational environments.

The findings reveal the role of technology as a non-human factor that enhances creativity from two different perspectives, one of which considers technology as a positive impact that promotes creative practice. The other reflects on the absence of technology as a factor reducing creative practices. Accordingly, participants' perspectives focused on plug-in technology as an essential component that enriched their connection during the design process. It further affected their decision-making since the technology facilitated project critiques when it was available in the classroom. It appears likely that improving desk design for design students will stimulate networks to engender creative practices. The results also addressed the significance of the affordance and interaction of design products, a phenomenon reviewed by Xenakis and Arnellos (2013) and Maier, Fadel, and Battisto (2009). The results supporting the role of affordance were revealed in such effective interactions. Moreover, the findings of this study suggest that plug-in creativity encompasses not only technology but also other components of the classroom that facilitate the connection of both fused and diffused networks. The decentralization of the center is a model that represents plug-in creativity in classrooms. As I reviewed above, decentralization is an essential component of space that promotes association between actors; hence, it allows actors to plug into their networks. Also, decentralization can increase the efficiency of network construction, which was demonstrated by the way networks were located in the corners and the edges, avoiding the center. Centralization limits associations between actors, and it can obscure the precise location of the creative network, since the standardized gathering of networks at any one point may conceal the emergence of additional creativity. Connectivity, then, may be considered a type of plug-in creativity that stimulates the power of interaction among networks, facilitating the

rearrangement of seating style and the reconsideration of the design of the classroom materials. The forms of connectivity represented the actor-network language, translation. Therefore, the acts of diffusion and fusion, joining and dispersing, combining and separating, express the logging-in to networks between actors ultimately provides a theme to describe the performance of the networks. Lastly, the data reflected the participants' perspectives on classroom technology, referring to the objects as movable, flexible, and adjustable. Hence, the findings of the study highlight the role of non-human objects, the power of interaction with design classroom tools to promote creativity.

Limitations

This study had several limitations, including that the researcher attempted to investigate a new phenomenon that had not been examined before and had not been addressed in previous literature, resulting in a lack of sources that supported its hypothesis.

In general, this investigation used advanced techniques such as video recordings and sensors to obtain more accurate observation of movement and relied on technology in the collection of outputs. However, because the application was on a human sample, there were several complications in completing the IRB approval procedure, which had implications for pursuing the study. A time restriction resulted in additional contextual limitations on this study, restricting data to two weeks. The scope of the study would have been better served by a more extensive period in which to gather more data on the interactions among actors.

Due to the lack of technological support, I abandoned the idea of sensors, which would have moved this study in new directions in the study of classroom design. In addition, a camera was considered, but because of problems receiving approval, the use of a camera to record

motion interactions was rejected, so the I relied entirely on observation and data collection from focus groups. Another contextual limitation was the management of group interviews because the study was done in the last days of the semester, so there was difficulty conducting the interviews in a short time. In the qualitative data collection, I interviewed approximately 23 participants who were busy finishing the class project.

Recommendations for Future Research

Future research should design creative classrooms based on creative networks guided by the findings of this study. Such research should apply other technology to understand how these networks grow extend in the learning environment and how they impact learners' interactions. Further studies could also be conducted to develop the study models and produce multiple examples of creative networks in the classroom. Moreover, I suggest that future studies focus on designing sensors that might more accurately determine creative locations in the classroom. However, sensors take a long time to program, and are costly, so their cost-effectiveness must be considered.

Mapping creative networks is a unique method that can help various disciplines understand the effects of interaction on the creative process. For future research, I suggest considering the following interaction types as design principles to facilitate interaction among actors: creative climate, corners vs. centers, roundness and connectivity, and plug-in creativity. Likewise, the creative climate design model can be applied to reframe classrooms, taking into account the behavioral, cognitive, and design aspects of creativity. Moreover, researchers in diverse disciplines can apply the idea of mapping networks, but to obtain a rich experience in this area, I recommend starting by employing observation as a basic data collection tool and to

identify a study model based on observation to obtain standard results. Then, researchers should apply a second supporting tool to enhance the study: future research in education should consider studying mapping creativity as a phenomenon that redefines the field through the application of actor-network theory, which could become the platform for integrated research among various disciplines.

Conclusion

This study has introduced the idea of the power of things to create associations between entities in the learning environment and the classroom. The framework was articulated through actor-network theory in education and design. The literature review focused on linking ANT to the idea of interaction between human and non-human actors to create a network that fosters creativity. Based on the literature, this study crystallized the idea of creative climate resulting from the interaction among networks in the classroom and pursued its implications for classroom organization. This study introduced the idea of a creative climate which is an important phenomenon to understand the general atmosphere in the classroom based on the interaction between the student and the materials. Also, this study developed a model to understand how the interaction between human and nonhuman actors occurs, which in turn fosters creative climate in the classroom. Therefore, its main contribution to the field is an innovative methodology able to visually map the creative climate in the classroom as well as a sophisticated new vocabulary for describing the climate as a system of networks. By developing a new way of collecting and conceptualizing data through observations, focus groups, and visual mapping techniques, the results demonstrated the

validity of the initial hypothesis and opened space for future research in this area of classroom design.

The present inquiry completed qualitative research focused on examining undergraduate student interaction to map creative networks and locate creativity as a place that can enhance students' cognition through creative practices. By considering the interaction among human and non-human actors, this study endeavored to answer questions by developing tools of investigation that mapped the interaction between actors in a design classroom. The analysis of the qualitative data revealed unique findings about creativity, illuminating collaboration and association among actors as significant factors in the emergence of creativity. Moreover, these findings expand our understanding of the types of creative spaces for design practitioners and thus helps in designing a creative learning experience based on developing creative spaces in the classrooms. As such, ANT is essential to conceptualizing where the places in classrooms may be more desirable for creativity to occur.

The lessons we can learn about classroom design become clearer when we synthesize insights gained from classroom observation with perspectives voiced by participants in the focus group phase of the study. The analysis of qualitative data from the observation and focus groups identified four new types of substantive interaction styles that contributed to an environment that fostered creativity in the design classroom: a) the creative climate, b) the center vs. the corners in the design classroom, c) roundness, and d) plug-in creativity. These models may beneficially redefine the classroom not only for teaching but also as a place affording creative networks to be investigated and utilized to develop students' skills. Ultimately, the study has furthered our understanding of creativity by examining the

relationships between entities that foster the emergence of creativity, especially in the design classroom. The study also revealed that creativity is a *product* of the network, and thus, the application of the research may vary from one class to another. However, similar models focused on (a) observations, (b) focus group pinning activities, and (c) visual mapping strategies might be used to reveal creativity within a wide variety of classrooms, and potentially other settings. The description of network I offer in this dissertation cannot be generalized, but a similar mapping strategy can be applied to identify the types of networks that can produce patterns of creativity.

The implications of this study in art education open new opportunities for research in the design of innovative classrooms. The study opens onto expanded theories of the importance of the actor network and creative networks in efforts to address educational barriers, as well as the urgency of rethinking creativity as a climate that can be identified through the mapping of the interaction among entities. Also, this study emphasizes how creative climate connects to many aspects that might go unrecognized as contributors to creativity, such as small details of the learning environment (like corners and edges), students' skills, access to technologies and devices, teaching styles, classroom equipment, and curriculums.

APPENDIX A
IRB APPROVAL LETTER



THE OFFICE OF RESEARCH AND INNOVATION
Research and Economic Development

April 12, 2019

PI: Tyson Lewis
Study Title: Mapping Creative Networks in a Design Classroom

RE: Human Subjects Application # IRB-19-128

Dear Dr. Tyson Lewis:

In accordance with 45 CFR Part 46 Section 46.104, your study titled "Mapping Creative Networks in a Design Classroom" has been determined to qualify for an exemption from further review by the UNT Institutional Review Board (IRB).

Attached to your Cayuse application in the Study Detail section, under the Attachments tab, are the consent documents with IRB approval.

No changes may be made to your study's procedures or forms without prior written approval from the UNT IRB. Please contact The Office of Research Integrity and Compliance at 940-565-4643 if you wish to make any such changes. Any changes to your procedures or forms after 3 years will require completion of a new IRB application.

We wish you success with your study.

Sincerely,

A handwritten signature in black ink that reads "Shelley Riggs". The signature is written in a cursive style with a large initial "S".

Shelley Riggs, Ph.D.
Professor
Chair, Institutional Review Board

SR:jm



UNIVERSITY OF NORTH TEXAS®

Informed Consent for Studies with Adults

TITLE OF RESEARCH STUDY: Mapping the Creative Network in Design Classroom

RESEARCH TEAM: Lama A. Harkan, University of North Texas (UNT) Department of Art Education (PI). The project is part of a dissertation being conducted under the supervision of Dr. Tyson Lewis, University of North Texas (UNT) Department of Art Education.

You are being asked to participate in a research study. Taking part in this study is voluntary and not required by your instructor for this course. Refusal to participate will not affect your class standing. The investigators will explain the study to you and will answer any questions you might have. It is your choice whether or not you take part in this study. If you agree to participate and then choose to withdraw from the study, that is your right, and your decision will not be held against you.

You are being asked to take part in a research study about mapping creative networks in design classrooms. Through this study, we hope to learn more about best practices of using students' interactions to design creative classrooms. The study may benefit the field of art and design education by providing insights into students' needs for creative classroom environments.

Your participation in this research study involves investigating your interaction in the design classroom within a design course (ADES 2523.501 Patterns & Systems, Dr. Michael Gibson). You will be asked to participate in observation sessions that will last 4 weeks, 3 hours twice a week. During these sessions, the researcher will observe you working on your project. You will be asked to wear sensor bracelets that will have a digital code to record your movements while you are in class. In addition, you possibly will be selected for a focus group interview that will take 60 minutes of your time after the observed class. The interview during the focus group will be voice recorded. After the interview is over, the transcribed text will be sent to you for your review and approval. Illustrative quotes from the interview will be used to represent the findings in the final research. More details will be provided in the next section.

You will be given a bracelet when the class time STARTS. This device will be connected to a sensor station to record your movements throughout the class period. Then you will return it to the researcher AFTER the class time ENDS.

You might want to participate in this study if you are interested in learning about your physical movements and interaction with objects in the classroom while doing a design project.

However, you might not want to participate in this study if you do not have the time to participate in two focus group sessions for 60 minutes, or not interested in this study.

You may choose to participate in this research study if you are one of the students at ADES 2523-501 Digital Patterns and Systems in IX and UX Design for the Spring semester 2019 at UNT.

Reasonable risks or foreseeable discomforts involved in participating in this study are negligible when compared to the positive potentials for improving classroom design through this research.

DETAILED INFORMATION ABOUT THIS RESEARCH STUDY: The following is more detailed information about this study, in addition to the information listed above.

PURPOSE OF THE STUDY: The purpose of this study is to investigate patterns of interactions that are important for the emergence of creativity, or the failure of creativity to appear. Specifically, the study aims to explore students' interaction toward mapping creative networks in a design classroom.

TIME COMMITMENT: Participation in this study is expected to last approximately three hours, twice a week for four weeks during the class time. The focus group interview will be only for one session that will approximately take 60 minutes after class time ends.

STUDY PROCEDURES: The study will proceed through several phases; the first will be the observation stage; in this process, I will start observing students twice a week for three weeks and record their movements and interactions by the sensor waves. The second phase will be the focus group interview, in this stage, the participants will be audio recorded because some of the interview questions will indicate what phrases and expressions will be used mostly to build creative maps. The last phase will be pinning creativity during a focus group, in which participants will have a classroom layout throughout the interviewing process and pin the spots where they feel most creative.

AUDIO/VIDEO/PHOTOGRAPHY: Include this section if audio/video/photography that will be included as part of the research study, otherwise delete this section.

- I agree to be audio recorded during the research study.
- I agree that the audio recording can be used in publications or presentations.
- I do not agree that the audio recording can be used in publications or presentations.
- I do not agree to be audio recorded during the research study.

You may still participate if you do not agree to be audio recorded.

The recording will be immediately destroyed after transcription.

POSSIBLE BENEFITS: Your participation may help you learn about your design performance, and how you engage with the objects that influence your creative experience in the classroom.

POSSIBLE RISKS/DISCOMFORTS: No foreseeable risks are involved in this study.

If you experience excessive discomfort when completing the research activity, you may choose to stop participating at any time without penalty. The researchers will try to prevent any problem that could happen, but the study may involve risks to the participant, which are currently unforeseeable. UNT does not provide medical services, or financial assistance for emotional distress or injuries that might happen from participating in this research. If you need to discuss your discomfort further, please contact a mental health provider, or you may contact the researcher who will refer you to appropriate services. If your need is urgent, helpful resources include [provide relevant 24 hour resource information and campus or community resources].

This research study is not expected to pose any additional risks beyond what you would normally experience in your regular everyday life. However, if you do experience any discomfort, please inform the research team (include 24 hour help resource information).

COMPENSATION: There are no compensation will be offered for participation in this study.

CONFIDENTIALITY: Efforts will be made by the research team to keep your personal information private, including research study, and disclosure will be limited to people who have a need to review this information. All paper and electronic data collected from this study will be stored in a secure location on the UNT campus and/or a secure UNT server for at least three (3) years past the end of this research Any identifying information will be maintained in separate hard desk locked files locations. The data will be coded so that the student's name and the information is not available to anyone except the principal investigator. Research records will be labeled with a code or pseudonym and the master key linking names with codes will be maintained in a separate and secure location.

Your participation in this study is anonymous, and the information you provide cannot be linked to your identity.

For focus groups, participants in the focus group interview will be invited to choose their pseudonyms to ensure confidentiality. Please be advised that although the researchers will take these steps to maintain confidentiality of the data, the nature of focus groups prevents the researchers from guaranteeing confidentiality. The researchers would like to remind participants to respect the privacy of your fellow participants and not repeat what is said in the focus group to others.

The results of this study may be published and/or presented without naming you as a participant. The data collected about you for this study may be used for future research studies that are not described in this consent form. If that occurs, an IRB would first evaluate the use of any information that is identifiable to you, and confidentiality protection would be maintained.

While absolute confidentiality cannot be guaranteed, the research team will make every effort to protect the confidentiality of your records, as described here and to the extent permitted by law. In addition to the research team, the following entities may have access to your records, but only on a need-to-know basis: the U.S. Department of Health and Human Services, the FDA (federal regulating agencies), the reviewing IRB, and sponsors of the study.

CONTACT INFORMATION FOR QUESTIONS ABOUT THE STUDY: If you have any questions about the study you may contact Lama Harkan at lamaharkan@my.unt.edu or Dr. Tyson Lewis at [REDACTED]. Any questions you have regarding your rights as a research subject, or complaints about the research may be directed to the Office of Research Integrity and Compliance at 940-565-4643, or by email at untirb@unt.edu.

CONSENT:

- Your signature below indicates that you have read, or have had read to you all of the above.
- You confirm that you have been told the possible benefits, risks, and/or discomforts of the study.
- You understand that you do not have to take part in this study and your refusal to participate or your decision to withdraw will involve no penalty or loss of rights or benefits.
- You understand your rights as a research participant and you voluntarily consent to participate in this study; you also understand that the study personnel may choose to stop your participation at any time.
- By signing, you are not waiving any of your legal rights.

Please sign below if you are at least 18 years of age and voluntarily agree to participate in this study.

SIGNATURE OF PARTICIPANT

DATE

***If you agree to participate, please provide a signed copy of this form to the researcher team. They will provide you with a copy to keep for your records.**

APPENDIX B
INTERVIEW PROTOCOL

Institution: University of North Texas

Interviewee:

Interviewer: Lama Harkan

Topics Discussed: Creativity and the using of classroom space

Documents Obtained:

- Signed Consent
- Audio Recording
- Pinning Creativity sheet

Post Interview Comments:

- The moderator will ask the participants to choose a nickname for this focus group.
- The moderator will explain the session protocol and explain the pinning creativity activity.
- The moderator will ask the participants to use the sheets while they discuss the interview questions.

Introductory Protocol (for audio interviews):

The purpose of this interview is to confirm earlier data that was collected through the recorded interaction. This focus group interview may reveal additional details that could not be obtained through previous tool.

For note-taking and analysis purposes, this interview will be digitally recorded. As you previously signed the consent form that indicated your understanding of the study purpose and your participation as a voluntary act, you reserve the right to withdraw from this study at any point with no penalties. If you have any question or concern, you can contact Dr. Tyson Lewis at [REDACTED] or Mrs. Lama A Harkan [REDACTED]

After the interview is over, the recording will be transcribed and the transcription text will be sent to you for your review and approval. The researcher are the only key personnel who will have the access to the recordings. Recordings will be kept for three years beyond the conclusion of the study and then deleted from the hard drive on which they are kept. The confidentiality of your information will be maintained in any publications or presentations come out of this study as we will refer to you by pseudonym.

We planned this interview to last no longer than 60 minutes. During this time, we have several questions to cover. Then, each participant will fill the pinning activity sheet.

(Question asked during this interview are stemmed from the findings of the previous interaction collected through the observation data)

Interview Introduction:

You have been invited to this interview because our analysis of your interaction identified you as someone who had interesting interaction behavior in the classroom. This research focuses on mapping students' interaction and the possibilities of using these interactions to design creative maps. We will try to learn more about your perspective of your interaction in this classroom.

Interview Questions:

9. What do you think creativity is?
10. Do you think this classroom encourages or discourages creativity?
11. How would you redesign the classroom so that it more effectively promotes creativity?
12. Where in the classroom do you feel most creative?
13. When you feel creative while working on a project, do you use tools you bring with you?
14. What things do you prefer to use when you feel most creative?
15. How do you use them?
16. Do you use things in relation to classroom technology equipment? If so, how do you use them?

Conclusion:

The transcription of this interview will be sent to your email for your review and approval.

Thank you for your time and participation in this study.

APPENDIX C
INDIVIDUAL OBSERVATION SHEET

Individual observation sheet

Interaction behavior with things:

High Normal Low

Work spot:

Hot Warm Medium Cold

Desk spot: A B

Other spot: test

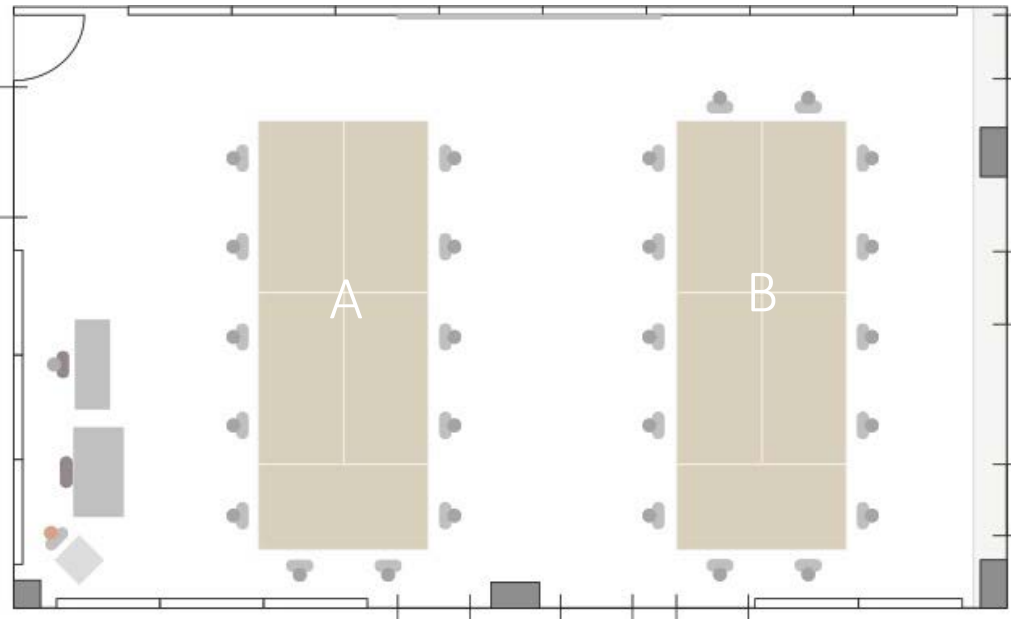
Table of things:

Laptop	Phone	Tablet	Mouse	Notebook	Sketchbook	Paper	Pencilier	Pen	Backpack	Lunch bag	Laptop case	Wallet	Keys chine	Jacket	Water	Soft drinks	Food	Charger/cable	Headphone

Other things not listed:

test

Comments



Week number

Project name

observation date

APPENDIX D
GROUP OBSERVATION SHEET

Group Observation sheet

Group member: Mandi-Kenra-Jacqueline

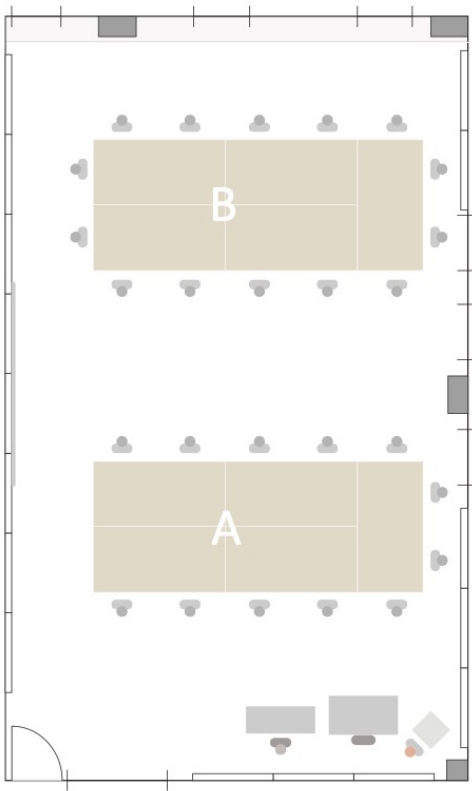
Work spot: Hot Warm Medium Cold

Interaction with members: High Normal Low

Group member's tasks on presenting project:

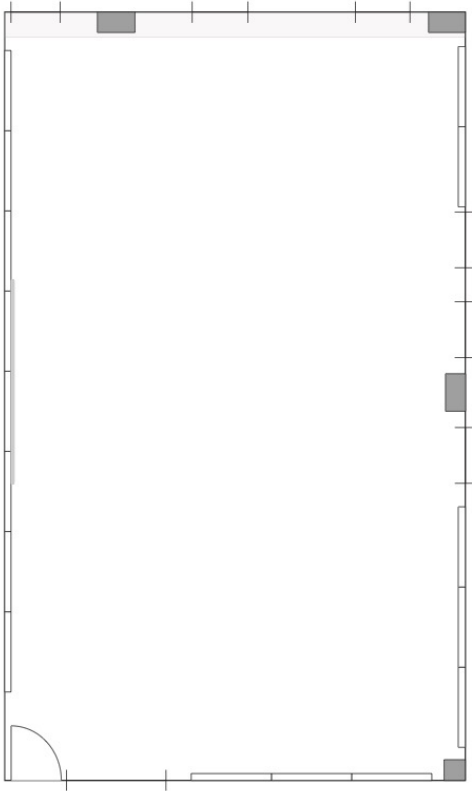
Comments:

Week number



Spot analysis layout

Project name



Moves analysis layout

Observation date

APPENDIX E

A DESIGN SHEET OF PINNING CREATIVITY

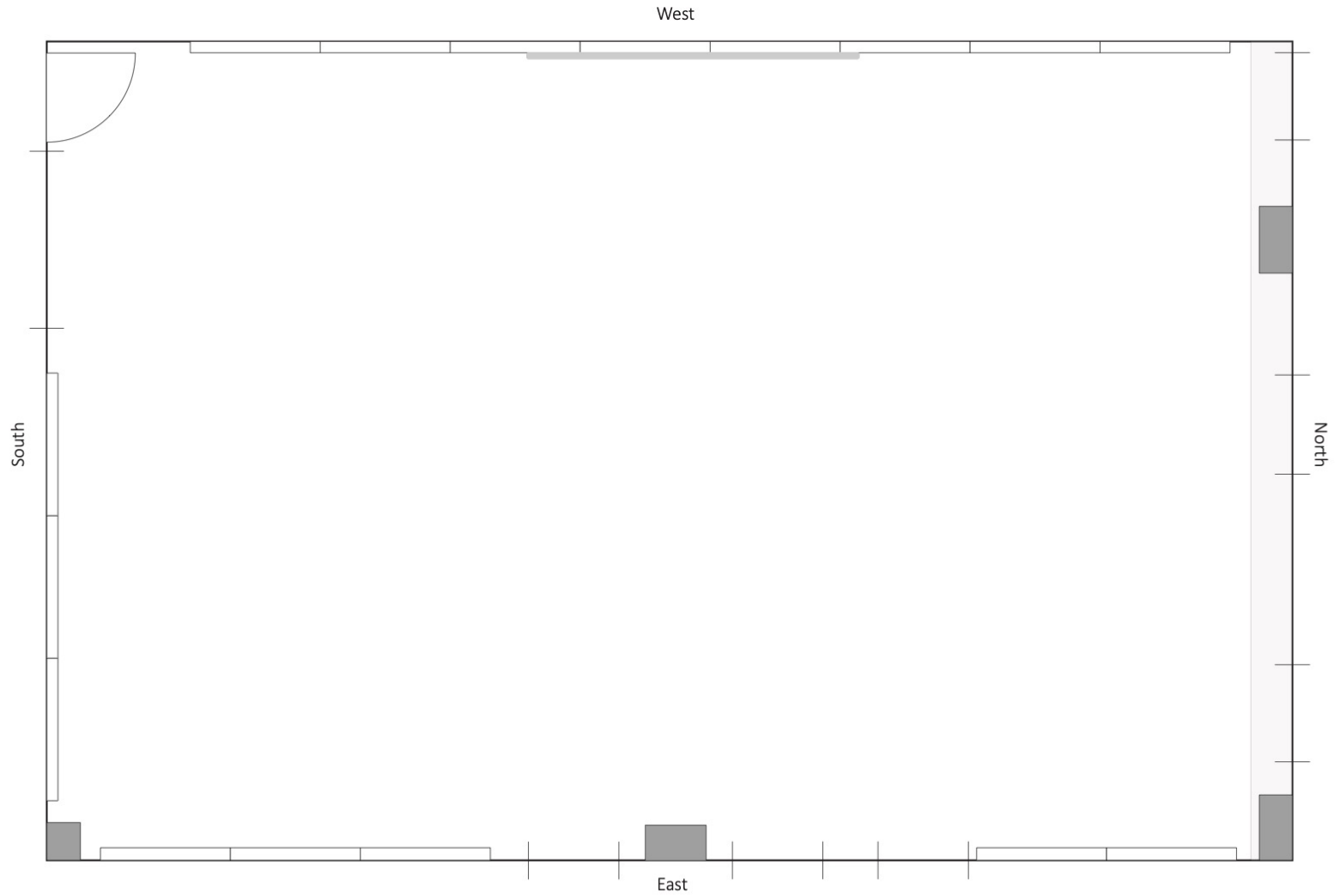
Pinning Creativity
Focus Group Activity



APPENDIX F

A DESIGN SHEET OF DRAWING PINNING CREATIVITY

Pinning Creativity
Focus Group Activity



REFERENCES

- Adler, L. (1979). To learn what's on the consumer's mind try some focused group interviews. *Sales and Marketing Management*, 9, 76-80.
- Alcadipani, R., & Hassard, J. (2010). Actor-Network Theory, organizations and critique: towards a politics of organizing. *Organization*, 17(4), 419-435.
- Alhussain, D., Loudon, G., & Wilgeroth, P. (2016, September). *Creativity in product design education: Understanding the learning environment*. Paper presented at DS 83: Proceedings of the 18th International Conference on Engineering and Product Design Education (E&PDE16), Design Education: Collaboration and Cross-Disciplinarity, Aalborg, Denmark.
- Amabile, T. (1996). *Creativity in context*. Boulder, CO: Westview Press.
- Amabile, T. (2011). *Componential theory of creativity*. Harvard Business School. Retrieved from <http://www.hbs.edu/faculty/publication%20files/12-096.pdf>
- Amabile, T. M. (1983). The social psychology of creativity: A componential conceptualization. *Journal of Personality and Social Psychology*, 45(2), 357.
- Amabile, T. M. (1988). A model of creativity and innovation in organizations. *Research in Organizational Behavior*, 10(1), 123-167.
- Amabile, T. M. (1997). Motivating creativity in organizations: On doing what you love and loving what you do. *California Management Review*, 40(1), 39-58.
- Amabile, T. M., & Conti, R. (1999). Changes in the work environment for creativity during downsizing. *Academy of Management Journal*, 42(6), 630-641.
- Amabile, T. M., Conti, R., Coon, H., Lazenby, J., & Herron, M. (1996). Assessing the work environment for creativity. *Academy of Management Journal*, 39(5), 1154-1184.
- Amiel, T., & Reeves, T. C. (2008). Design-based research and educational technology: Rethinking technology and the research agenda. *Journal of Educational Technology & Society*, 11(4), 29.
- Andersen, L. B., Danholt, P., Halskov, K., Hansen, N. B., & Lauritsen, P. (2015). Participation as a matter of concern in participatory design. *CoDesign*, 11(3/4), 250-261. doi:10.1080/15710882.2015.1081246
- Anderson, N. R., & West, M. A. (1998). Measuring climate for work group innovation: Development and validation of the team climate inventory. *Journal of Organizational Behavior: The International Journal of Industrial, Occupational and Organizational Psychology and Behavior*, 19(3), 235-258.

- Andrienko, G. L., & Andrienko, N. V. (1999). Interactive maps for visual data exploration. *International Journal of Geographical Information Science*, 13(4), 355-374.
- Argona, C. A. (2001). *Identifying Ekvall's 10 dimensions of creative climate in an aesthetic education setting* (Master's thesis). Retrieved from <https://digitalcommons.buffalostate.edu/cgi/viewcontent.cgi?referer=&httpsredir=1&article=1033&context=creativeprojects>
- Arnaboldi, M., & Spiller, N. (2011). Actor-network theory and stakeholder collaboration: The case of cultural districts. *Tourism Management*, 32(3), 641-654.
- Ashforth, B. E. (1985). Climate formation: Issues and extensions. *Academy of Management Review*, 10(4), 837-847.
- Barbour, R. S., & Morgan, D. L. (Eds.). (2017). *A new era in focus group research: Challenges, Innovation and Practice*. New York, NY: Springer.
- Barrett, P., Davies, F., Zhang, Y., & Barrett, L. (2017). The holistic impact of classroom spaces on learning in specific subjects. *Environment and Behavior*, 49(4), 425-451.
- Barrett, P., Zhang, Y., Moffat, J., & Kobbacy, K. (2013). A holistic, multi-level analysis identifying the impact of classroom design on pupils' learning. *Building and Environment*, 59, 678-689.
- Bartholomee, L. (2017). *How does it feel to be creative?* (Doctoral dissertation). Denton, Texas: University of North Texas. Retrieved from <https://digital.library.unt.edu/ark:/67531/metadc1062833/?q=bartholomee>
- Beery, T. A., Shell, D., Gillespie, G., & Werdman, E. (2013). The impact of learning space on teaching behaviors. *Nurse Education in Practice*, 13(5), 382-387. doi:10.1016/j.nepr.2012.11.001
- Belzile, J. A., & Öberg, G. (2012). Where to begin? Grappling with how to use participant interaction in focus group design. *Qualitative Research*, 12(4), 459-472.
- Bennett, J. (2004). The force of things: Steps toward an ecology of matter. *Political Theory*, 32(3), 347-372. doi:10.1177/0090591703260853
- Bennett, J. (2009). *Vibrant matter: A political ecology of things*. Durham, NC: Duke University Press.
- Berg, B. L., (2007). *Qualitative research methods for the social sciences* (6th ed.) Boston, MA: Allyn & Bacon A Pearson Education Company.
- Biagioli, M., Grimaldi, S., & Ali, H. (2018, June). *Designer's emotions in the design process*. Paper presented at Design Research Society 2018 Catalyst Conference, Limerick, Ireland.

Retrieved from

<http://ualresearchonline.arts.ac.uk/12486/1/Biagioli%2C%20Grimaldi%2C%20Ali%20Designers%20emotions%20in%20the%20design%20process.pdf>

- Bilda, Z., Edmonds, E., & Candy, L. (2008). Designing for creative engagement. *Design Studies*, 29(6), 525-540. doi:10.1016/j.destud.2008.07.009
- Bjögvinsson, E., Ehn, P., & Hillgren, P. A. (2012). Design things and design thinking: Contemporary participatory design challenges. *Design Issues*, 28(3), 101-116.
- Blair, J. M. (2015). *Animated autoethnographies: Using stop motion animation as a catalyst for self-acceptance in the art classroom* (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses Global. (Order No. 10032217)
- Boerboom, L., & Ferretti, V. (2014). Actor-Network-Theory perspective on a forestry decision support system design. *Scandinavian Journal of Forest Research*, 29, 84-95. doi:10.1080/02827581.2014.946960
- Bohner, G., Goety, G., Richter, H., & Serdil, R. (1978). Strategies of questioning in interviews: A communication research program. *Communication*, 4(1), 91-109.
- Bown, O. (2015). Attributing Creative Agency: Are we doing it right?. In H. Toivonen, S. Colton, M. Cook, & D. Ventura (Eds.), *Proceedings of the Sixth International Conference on Computational Creativity June* (p. 17).
- Brandt, C. B., Cennamo, K., Douglas, S., Vernon, M., McGrath, M., & Reimer, Y. (2013). A theoretical framework for the studio as a learning environment. *International Journal of Technology and Design Education*, 23(2), 329-348.
- Brown, J. S., Collins, A., & Duguid, P. (1989). Situated cognition and the culture of learning. *Educational researcher*, 18(1), 32-42.
- Burgess, J., Clark, J., & Harrison, C. M. (2000). Knowledges in action: An actor network analysis of a wetland agri-environment scheme. *Ecological Economics*, 35(1), 119-132.
- Calder, B. J. (1977). Focus groups and the nature of qualitative marketing research. *Journal of Marketing Research* 14(3), 353-364.
- Callon, M. (1986). The sociology of an actor-network: The case of the electric vehicle. In M. Callon, J. Law, & and A. Rip (Eds.), *Mapping the dynamics of science and technology* (pp. 19-34). London, England: Palgrave Macmillan.
- Callon, M. (1987). Society in the making: The study of technology as a tool for sociological analysis. In T. Huges, & T. Pinch (Eds.), *The social construction of technological systems: New directions in the sociology and history of technology* (pp. 83-103). London, England: MIT Press.

- Callon, M., & Latour, B. (1981). Unscrewing the big Leviathan: How actors macrostructure reality and how sociologists help them do so. In K. Knorr-Cetina & A.V. Cicourel (Eds.), *Advances in social theory and methodology: Toward an integration of micro- and macro sociologies* (pp. 277-303). London, England: Routledge and Kegan Paul.
- Candy, L., & Costello, B. (2008). Interaction design and creative practice. *Design Studies*, 29(6), 521-524. doi:10.1016/j.destud.2008.07.002
- Chioncel, N. E., Veen, R. V. D., Wildemeersch, D., & Jarvis, P. (2003). The validity and reliability of focus groups as a research method in adult education. *International Journal of Lifelong Education*, 22(5), 495-517.
- Cho, E. C., & Youn-Kyung, K. (2012). The effects of website designs, self-congruity, and flow on behavioral intention. *International Journal of Design*, 6(2). Retrieved from <https://libproxy.library.unt.edu/login?url=https://libproxy.library.unt.edu:2165/docview/1270361653?accountid=7113>
- Christiaans, H., & Almendra, R. A. (2010). Accessing decision-making in software design. *Design Studies*, 31(6), 641-662. doi:10.1016/j.destud.2010.09.005
- Cibulka, J. (2001). The changing role of interest groups in education: Nationalization and the new politics of education productivity. *Educational Policy*, 15, 12-14. doi:10.1177/0895904801015001002
- Coole, D., & Frost, S. (Eds.). (2010). *New materialisms: Ontology, agency, and politics*. Retrieved from <https://libproxy.library.unt.edu:2160>
- Cooper, A., Reimann, R., Cronin, D., & Noessel, C. (2014). *About face: the essentials of interaction design*. Hoboken, NJ: John Wiley & Sons.
- Cox, K. K., Higginbotham, J. B., & Burton, J. (1976). Applications of focus group interviews in marketing. *The Journal of Marketing* 40(1), 77-80.
- Cressman, D. (2009). A brief overview of actor-network theory: Punctualization, heterogeneous engineering and translation. *ACT Lab/Centre for Policy Research on Science & Technology (CPROST) School of Communications, Simon Fraser University*. Retrieved from <http://blogs.sfu.ca/departments/cprost/wp-content/uploads/2012/08/0901.pdf>
- Csikszentmihalyi, M. (1988). Society, culture, and person: A systems view of creativity. In R.J. Sternberg (Ed.) *The nature of creativity: Contemporary psychological perspectives* (pp. 325-339), Cambridge, MA: Cambridge University Press.
- Daly, J. (2019). Superkilen: Exploring the human–nonhuman relations of intercultural encounter. *Journal of Urban Design*. Advance online publication. <https://doi.org/10.1080/13574809.2019.1622409>

- Davies, D., Jindal-Snape, D., Collier, C., Digby, R., Hay, P., & Howe, A. (2013). Creative learning environments in education—A systematic literature review. *Thinking skills and creativity, 8*, 80-91.
- Davis, N. (2017). *Digital technologies and change in education: The arena framework*. Retrieved from <https://libproxy.library.unt.edu:2160>
- Deleuze, G. (1988a). *Foucault*. Minneapolis, MN: University of Minnesota Press.
- Deleuze, G. (1988b). *Spinoza: Practical philosophy*. San Francisco, CA: City Lights Books.
- Discipline and Punish. (n.d.). In *SparkNotes*. Retrieved from <http://www.sparknotes.com/philosophy/disciplinepunish/>
- Dwiartama, A., & Rosin, C. (2014). Exploring agency beyond humans: The compatibility of Actor-Network Theory (ANT) and resilience thinking. *Ecology and Society, 19*(3), 28.
- Easterday, M. W., Gerber, E. M., & Rees Lewis, D. G. (2018). Social innovation networks: A new approach to social design education and impact. *Design Issues, 34*(2), 64-76.
- Edmonds, E. A. (2007). Reflections on the nature of interaction. *CoDesign, 3*(3), 139-143. <https://doi.org/10.1080/15710880701251427>
- Ekvall, G. (1996). Organizational climate for creativity and innovation. *European Journal of Work and Organizational Psychology, 5*(1), 105-123. doi:10.1080/13594329608414845
- Ekvall, G., & Ryhammar, L. (1999). The creative climate: Its determinants and effects at a Swedish university. *Creativity Research Journal, 12*(4), 303-310.
- Ekvall, G., & Tangeberg-Anderson, Y. (1986). Working climate and creativity: A study of an innovative newspaper. *Journal of Creative Behavior, 20*(3), 215-225
- Elisa Navarro Morales, M., & Londoño, R. (2018). Inverted classroom teaching in the first-year design studio, a case study: Inverted classroom teaching in the design studio. *British Journal of Educational Technology*. doi:10.1111/bjet.12711
- Fenwick, T. (2010a). Reading educational reform with actor network theory: Fluid spaces, otherings and ambivalences. *Educational Philosophy and Theory, 43*, 114-134.
- Fenwick, T. (2010b). (un) Doing standards in education with actor-network theory. *Journal of Education Policy, 25*(2), 117-133.
- Fenwick, T., & Edwards, R. (2010). *Actor-network theory in education*. London, England: Routledge.

- Fenwick, T., & Edwards, R. (2012). *Researching education through actor-network theory*. Malden, MA: John Wiley & Sons.
- Fenwick, T., & Landri, P. (2012). Materialities, textures and pedagogies: Socio-material assemblages in education. *Pedagogy, Culture & Society*, 20(1), 1-7. doi:10.1080/14681366.2012.649421
- Fenwick, T., Edwards, R., & Sawchuk, P. (2011). *Emerging approaches to educational research: Tracing the socio-material*. London, England: Routledge.
- Fleischmann, K. R. (2006). Boundary objects with agency: A method for studying the design–use interface. *The Information Society*, 22(2), 77-87.
- Fleith, D. (2000). Teacher and student perceptions of creativity in the classroom environment. *Roeper Review*, 22(3), 148-161.
- Ford, C. M., & Gioia, D. A. (2000). Factors influencing creativity in the domain of managerial decision making. *Journal of Management*, 26(4), 705-732.
- Forlano, L. (2016). Decentering the human in the design of collaborative cities. *Design Issues*, 32(3), 42-54.
- Foucault, M. (1977). *Discipline and punish: The birth of the prison*. New York, NY: Pantheon Books.
- Fox, S. (2000). Communities of practice, Foucault and actor-network theory. *Journal of Management Studies*, 37(6), 853-867.
- Fox, S. (2005). An actor-network critique of community in higher education: Implications for networked learning. *Studies in Higher Education*, 30(1), 95-110. doi:10.1080/0307507052000307821
- Freedman, K., Heijnen, E., Kallio-Tavin, M., Kárpáti, A., & Papp, L. (2013). Visual culture learning communities: How and what students come to know in informal art groups. *Studies in Art Education*, 54(2), 103-115. doi:10.1080/00393541.2013.11518886
- Friedman, K. (2001). Creating design knowledge: From research into practice. In E. W. L. Norman & P. H. Roberts (Eds.), *Design and technology educational research and curriculum development: The emerging international research agenda* (pp. 31- 69). Retrieved from <https://dspace.lboro.ac.uk/dspace-jspui/bitstream/2134/953/1/norman-roberts2001.pdf>
- Gammon, A. R. (2013). *Climate as assemblage: Imagining an ecological metaphysic* (Master's thesis). Retrieved from <https://scholarworks.umt.edu/cgi/viewcontent.cgi?article=1219&context=et>

- Georg, S. (2015). Building sustainable cities: tools for developing new building practices? *Global Networks*, 15(3), 325-342. doi:10.1111/glob.12081
- Gisbert-López, M. C., Verdú-Jover, A. J., & Gómez-Gras, J. M. (2014). The moderating effect of relationship conflict on the creative climate-innovation association: The case of traditional sectors in Spain. *The International Journal of Human Resource Management*, 25(1), 47-67. doi:10.1080/09585192.2013.781525
- Granito, V. J., & Santana, M. E. (2016). Psychology of learning spaces: Impact on teaching and learning. *Journal of Learning Spaces*, 5(1).
- Hall, P. (2012). Afterword: On mapping and maps. *Design Philosophy Papers*, 10(2), 157-167. doi:10.2752/089279312X13968781797959
- Harrison, M. (2018). Space as a tool for analysis: Examining digital learning spaces. *Open Praxis*, 10(1), 17-28.
- Hasirci, D., & Demirkan, H. (2003). Creativity in learning environments: The case of two sixth grade art-rooms. *The Journal of Creative Behavior*, 37(1), 17-41.
- Hasirci, D., & Demirkan, H. (2007). Understanding the effects of cognition in creative decision making: A creativity model for enhancing the design studio process. *Creativity Research Journal*, 19(2-3), 259-271.
- Hendriks, N., Huybrechts, L., Slegers, K., & Wilkinson, A. (2018). Valuing implicit decision-making in participatory design: A relational approach in design with people with dementia. *Design Studies*, 59, 58-76.
- Hong, H., Chang, Y., & Chai, C. S. (2014). Fostering a collaborative and creative climate in a college class through idea-centered knowledge-building. *Instructional Science*, 42(3), 389-407. doi:10.1007/s11251-013-9289-y
- Hood, E. J., & Kraehe, A. M. (2017). Creative matter: New materialism in art education research, teaching, and learning. *Art Education*, 70(2), 32-38.
- Hunter, S. T., Bedell, K. E., & Mumford, M. D. (2007). Climate for creativity: A quantitative review. *Creativity Research Journal*, 19(1), 69-90.
- Hye, J. K., Park, J. H., Yoo, S., & Kim, H. (2016). Fostering creativity in tablet-based interactive classrooms. *Journal of Educational Technology & Society*, 19(3), 207-220. Retrieved from <https://libproxy.library.unt.edu/login?url=https://libproxy.library.unt.edu:2165/docview/1814440971?accountid=7113>
- Isaksen, S. G., & Ekvall, G. (2010). Managing for innovation: The two faces of tension in creative climates: Two faces of tension in creative climates. *Creativity and Innovation Management*, 19(2), 73-88. doi:10.1111/j.1467-8691.2010.00558.x

- Isaksen, S. G., Lauer, K. J., Ekvall, G., & Britz, A. (2001). Perceptions of the best and worst climates for creativity: Preliminary validation evidence for the situational outlook questionnaire. *Creativity Research Journal*, *13*(2), 171-184.
- James, L. R., & Jones, A. P. (1974). Organizational climate: A review of theory and research. *Psychological Bulletin*, *81*(12), 1096.
- James, L. R., & Sells, S. B. (1981). Psychological climate: Theoretical perspectives and empirical research. In D. Magnusson (Ed.), *Toward a psychology of situations: An interactional perspective* (pp. 275-295). Abingdon, England: Taylor & Francis.
- Jankowska, M., & Atlay, M. (2008). Use of creative space in enhancing students' engagement. *Innovations in education and teaching international*, *45*(3), 271-279.
- Jindal-Snape, D., Davies, D., Collier, C., Howe, A., Digby, R., & Hay, P. (2013). The impact of creative learning environments on learners: A systematic literature review. *Improving schools*, *16*(1), 21-31.
- Keeney, R. L. (1994). Creativity in decision making with value-focused thinking. *MIT Sloan Management Review*, *35*(4), 33.
- Kirst, M. W., Meister, G., & Rowley, S. R. (1984). Policy issue networks: Their influence on state policymaking. *Policy Studies Journal*, *13*, 247-263.
- Kitzinger, J. (1995). Qualitative research: Introducing focus groups. *BMJ*, *311*(7000), 299-302.
- Koyama, J. P. (2012). Making failure matter: Enacting no child left behind's standards, accountabilities, and classifications. *Educational Policy*, *26*(6), 870-891.
- Kroll, T., Barbour, R., & Harris, J. (2007). Using focus groups in disability research. *Qualitative Health Research*, *17*(5), 690-698.
- Krueger, R. A. (1988). *Focus groups: A practical guide for applied research*. Newbury Park, CA: Sage Publications.
- Langstrand, J., & Elg, M. (2012). Non-human resistance in changes towards lean. *Journal of Organizational Change Management*, *25*(6), 853-866.
- Latour, B. (1984). The powers of association. *The Sociological Review*, *32*(S1), 264-280.
- Latour, B. (1987). *Science in action: How to follow scientists and engineers through society*. Cambridge, MA: Harvard University Press.
- Latour, B. (1990). Technology is society made durable. *The Sociological Review*, *38*(1_suppl), 103-131. doi:10.1111/j.1467-954X.1990.tb03350.x

- Latour, B. (1992) Where are the missing masses? The sociology of a few mundane artifacts. In W. E. Bijker and J. Law (Eds), *Shaping technology/building society: Studies in sociotechnical change* (pp. 225–258). Cambridge, MA: The MIT Press.
- Latour, B. (1996). On actor-network theory. A few clarifications plus more than a few complications. *Soziale Welt*, 47(4), 369-381.
- Latour, B. (2005). *Reassembling the social: An introduction to actor-network theory*. Oxford, England: Oxford University Press.
- Latour, B. (2007). Can we get our materialism back, please? *Isis*, 98(1), 138-142.
doi:10.1086/512837
- Latour, B. (2009). *Politics of nature: How to bring the sciences into democracy*. Retrieved from <https://libproxy.library.unt.edu:2160>
- Law, J. (1986). On power and its tactics: a view from the sociology of science. *The Sociological Review*, 34(1), 1-38.
- Law, J. (1987). Technology and heterogeneous engineering: The case of Portuguese expansion. *The social construction of technological systems: New directions in the sociology and history of technology*, 1. Cambridge, MA: MIT Press.
- Law, J. (1992). Notes on the theory of the actor-network: Ordering, strategy, and heterogeneity. *Systems practice*, 5(4), 379-393.
- Law, J. (1999). After ANT: complexity, naming and topology. *The Sociological Review*, 47(1_suppl), 1-14.
- Law, J. (2009). Actor network theory and material semiotics. In B. S. Turner (Ed.), *The new Blackwell companion to social theory* (pp. 141- 158). Malden, MA and Oxford, UK: Blackwell Publishers.
- Law, J., & Callon, M. (1988). Engineering and sociology in a military aircraft project: A network analysis of technological change. *Social Problems*, 35(3), 284-297.
- Law, J., & Hassard, J. (1999). *Actor network theory and after*. Oxford, England and Malden, MA: Blackwell Publishers/*The Sociological Review*.
- Law, J., & Singleton, V. (2014). ANT, multiplicity and policy. *Critical policy studies*, 8(4), 379-396.
- Lederman, L. C. (1990). Assessing Educational Effectiveness: The Focus Group Interview as a Technique for Data Collection? *Communication Education*, 39(2), 117.
doi:10.1080/03634529009378794

- Lewis, T. (2005). Creativity--A Framework for the Design/Problem Solving Discourse in Technology Education. *Journal of technology education, 17*(1), 35-52.
- Lewis, T. E. (2018). The pedagogical power of things: Toward a post-Intentional phenomenology of unlearning. *Cultural Critique, 98*, 122-144.
- Liamputtong, P. (2011). *Focus group methodology: Principle and practice*. Thousand Oaks, CA: Sage Publications.
- Lin, Y. S. (2011). Fostering creativity through education--a conceptual framework of creative pedagogy. *Creative Education, 2*(3), 149.
- Luna, E., Ernst, J., DeLuca, V. W., & Kelly, D. (2018). Enhancing classroom creativity. *Technology and Engineering Teacher, 77*(6), 26-31.
- Magyari-Beck, I. (1998). Is creativity a real phenomenon? *Creativity research journal, 11*(1), 83-88.
- Maier, J. R. A., Fadel, G. M., & Battisto, D. G. (2009). An affordance-based approach to architectural theory, design, and practice. *Design Studies, 30*(4), 393-414. doi:10.1016/j.destud.2009.01.002
- Mangioni, V., & McKerchar, M. (2013). Strengthening the validity and reliability of the focus group as a method in tax research. *EJournal of Tax Research, 11*(2), 176-190. Retrieved from <https://libproxy.library.unt.edu/login?url=https://libproxy.library.unt.edu:2165/docview/1443490189?accountid=7113>
- Marková, I., Linell, P., Grossen, M., & Salazar Orvig, A. (2007). *Dialogue in focus groups: Exploring socially shared knowledge*. Sheffield, England: Equinox Publishing.
- Martens, Y. (2008). *Unlocking creativity with the physical workplace*. Paper presented at Conference in Facilities Management, Heriot Watt University, Edinburgh, Scotland. Retrieved from <http://www.irbnet.de/daten/iconda/CIB11908.pdf>
- Mathisen, G. E., & Einarsen, S. (2004). A review of instruments assessing creative and innovative environments within organizations. *Creativity Research Journal, 16*, 119-140.
- McDaniel, J. E. (2001). *The shaping of national reading policy: Using the structural approach to examine the politics of reading* (Doctoral dissertation). Retrieved from ProQuest Dissertations and Theses Global. (Order no: 3029391)
- McDonagh-Philip, D., & Denton, H. (1999). Using focus groups to support the designer in the evaluation of existing products: A case study. *The Design Journal, 2*(2), 20-31. doi:10.2752/146069299790303570

- McDonald, J. K., Rich, P. J., & Gubler, N. B. (2018). The perceived value of informal, peer critique in the instructional design studio. *TechTrends*, 1-11.
- McLean, C., & Hassard, J. (2004). Symmetrical absence/symmetrical absurdity: Critical notes on the production of Actor-Network accounts. *Journal of Management Studies*, 41(3), 493-519. doi:10.1111/j.1467-6486.2004.00442.x
- McLean, L. D. (2005). Organizational culture's influence on creativity and innovation: A review of the literature and implications for human resource development. *Advances in Developing Human Resources*, 7(2), 226-246.
- McLellan, R., & Nicholl, B. (2013). Creativity in crisis in Design & Technology: Are classroom climates conducive for creativity in English secondary schools?. *Thinking Skills and Creativity*, 9, 165-185.
- Mintrom, M., & Vergari, S. (1998). Policy networks and innovation diffusion: The case of state education reforms. *The Journal of Politics*, 60, 126-148.
- Mohamed, M. Z., & Rickards, T. (1996). Assessing and comparing the innovativeness and creative climate of firms. *Scandinavian Journal of Management*, 12(2), 109-121. doi:10.1016/0956-5221(96)00003-6.
- Morgan, D. L. (1996). Focus groups. *Annual Review of Sociology*, 22(1), 129-152.
- Nae, H. (2017). An interdisciplinary design education framework. *The Design Journal*, 20(suppl), S835-S847. doi:10.1080/14606925.2017.1353030
- Nespor, J. (2002). Networks and contexts of reform. *Journal of educational change*, 3(3-4), 365-382.
- Nespor, J. (2011). Devices and educational change. *Educational Philosophy and Theory*, 43(Suppl), 15-37. doi:10.1111/j.1469-5812.2009.00611.x
- Niedderer, K., Ludden, G., Clune, S., Lockton, D., Mackrill, J., Morris, A., . . . Hekkert, P. (2016). Design for behaviour change as a driver for sustainable innovation: Challenges and opportunities for implementation in the private and public sectors. *International Journal of Design*, 10(2). Retrieved from <https://libproxy.library.unt.edu/login?url=https://libproxy.library.unt.edu:2165/docview/1819560651?accountid=7113>
- Norman, D. (2013). *The Design of Everyday Things: Revised and Expanded Edition*. New York, NY: Basic Books.
- Nottingham, A. (2017). Feel the fear: Learning graphic design in affective places and online spaces. *International Journal of Art & Design Education*, 36(1), 39-49. doi:10.1111/jade.12058

- Novak, J. D., & Cañas, A. J. (2008). The theory underlying concept maps and how to construct and use them. *Práxis Educativa*, 5(1), 9-29
- Nystrom, P. C., Ramamurthy, K., & Wilson, A. L. (2002). Organizational context, climate and innovativeness: adoption of imaging technology. *Journal of Engineering and Technology Management*, 19(3-4), 221-247.
- O'Brien, M. (2003). Focus groups supporting effective product development. In Joe Langford and Deana McDonagh (Eds.). *The Design Journal*, 6(1), 61-62.
doi:10.2752/146069203790219317
- O'Byrne, I., Radakovic, N., Hunter-Doniger, T., Fox, M., Kern, R., & Parnell, S. (2018). Designing spaces for creativity and divergent thinking: Pre-service teachers creating stop motion animation on tablets. *International Journal of Education in Mathematics, Science and Technology*, 6(2), 182-199.
- Paget, E., Dimanche, F., & Mounet, J. P. (2010). A tourism innovation case: An actor-network approach. *Annals of Tourism Research*, 37(3), 828-847.
- Papanek, V. J. (1984). *Design for the real world: Human ecology and social change*. New York, NY: Van Nostrand Reinhold.
- Péter-Szarka, S. (2012). Creative climate as a means to promote creativity in the classroom. *Electronic Journal of Research in Educational Psychology*, 10(3), 1011-1034.
- Pierce, C. (2015). Against neoliberal pedagogies of plants and people: Mapping actor networks of biocapital in learning gardens. *Environmental Education Research*, 21(3), 460-477.
doi:10.1080/13504622.2014.994168
- Pierre Johnson, M., Ballie, J., Thorup, T., & Brooks, E. (2017). Living on the edge: Design artefacts as boundary objects. *The Design Journal*, 20(sup1), S219-S235.
- Pin. (n.d.). In *Merriam Webster online*. Retrieved from <https://www.merriam-webster.com/dictionary/pin>
- Reynolds, F. D., & Johnson, D. K. (1978). Validity of focus-group findings. *Journal of Advertising Research*, 18(3), 21-24.
- Roth, W. (1996). Knowledge diffusion in a grade 4-5 classroom during a unit on civil engineering: An analysis of a classroom community in terms of its changing resources and practices. *Cognition and Instruction*, 14(2), 179-220.
doi:10.1207/s1532690xci1402_2
- Runco, M. A. (2008). Creativity and education. *New Horizons in Education*, 56(1), 107-115.

- Sayes, E. (2014). Actor–Network theory and methodology: Just what does it mean to say that nonhumans have agency? *Social Studies of Science*, 44(1), 134-149.
doi:10.1177/0306312713511867
- Schneider, B., & Reichers, A. E. (1983). On the etiology of climates. *Personnel Psychology*, 36(1), 19-39.
- Schön, D. A. (1983). *The reflective practitioner: How professionals think in action*. New York, NY: Basic Books.
- Schön, D. A. (1995). Knowing-in-action: The new scholarship requires a new epistemology. *Change: The Magazine of Higher Learning*, 27(6), 27-34.
- Schumpeter, J. (1934). *The theory of economic development*, Boston, MA: Harvard University Press.
- Senbel, M., Girling, C., White, J. T., Kellett, R., & Chan, P. F. (2013). Precedents reconceived: Urban design learning catalysed through data rich 3-D digital models. *Design Studies*, 34(1), 74-92.
- Shaviro, S. (2014). *The universe of things: On speculative realism*. Minneapolis, MN: University of Minnesota Press.
- Simon, H. A. (1969). *The sciences of the artificial*. Cambridge, MA: MIT Press.
- Simonton, D. K. (2003). Scientific creativity as constrained stochastic behavior: The integration of product, person, and process perspectives. *Psychological Bulletin*, 129(4), 475.
- Sinfield, D., & Cochrane, T. (2018). Augmenting visual design: Designing the changing classroom. *E-Learning and Digital Media*. Advance online publication.
<https://doi.org/10.1177/2042753018773769>
- Sommer, R., & Olsen, H. (1980). The soft classroom. *Environment and Behavior*, 12(1), 3-16.
- Song, M., & Miskel, C. (2005). Who are the influentials? A cross-state social network analysis of the reading policy domain. *Educational Administration Quarterly*, 41, 7-48.
doi:10.1177/0013161X04269515
- Stewart, D. W., Shamdasani, P. N., & Rook, D. W. (2007). *Focus groups: Theory and practice*. Thousand Oaks, CA: Sage Publications.
- Storini, C., Binder, T., Linde, P., & Stuedahl, D. (2015). Designing things together: Intersections of co-design and actor-network theory. *CoDesign: International Journal of CoCreation in Design and the Arts*, 11(3), 149-151.

- Szybillo, G. J., & Berger, R. (1979). What advertising agencies think of focus groups. *Journal of Advertising Research, 19*(3), 29-33.
- Tatnall, A., & Burgess, S. (2002, June). Using actor-network theory to research the implementation of a BB portal for regional SMEs in Melbourne, Australia. Paper presented at 15th Bled Electronic Commerce Conference: “eReality: Constructing the eEconomy,” Bled, Slovenia, University of Maribor.
- Thoring, K., Desmet, P., & Badke-Schaub, P. (2018). Creative environments for design education and practice: A typology of creative spaces. *Design Studies, 56*, 54-83.
- Tillander, M. D. (2008). Cultural interface as an approach to new media art education. *Dissertation Abstracts International: Section A. Humanities and Social Sciences, 69*(8), 2992.
- Toivanen, T., Halkilahti, L., & Ruismäki, H. (2013). Creative pedagogy—Supporting children’s creativity through drama. *The European Journal of Social & Behavioural Sciences, 7*(4).
- Tong, A., Sainsbury, P., & Craig, J. (2007). Consolidated criteria for reporting qualitative research (COREQ): A 32-item checklist for interviews and focus groups. *International Journal for Quality in Health Care, 19*(6), 349-357.
- Treffinger, D. J., Isaksen, S. G., Dorval, K.B. (1996). *Climate for creativity and innovation: educational implications*. Idea capsules, Report number 9003. Sarasota, FL.: Center for Creative Learning.
- Triantafyllaki, A., & Burnard, P. (2010). Creativity and arts-based knowledge creation in diverse educational partnership practices: Lessons from two case studies in rethinking traditional spaces for learning. *Multidisciplinary Research in the Arts UNESCO Observatory E-Journal*. DOI: 10.13140/2.1.1248.0642
- Van der Tuin, I., & Dolphijn, R. (2010). The transversality of new materialism. *Women: A cultural review, 21*(2), 153-171.
- Van Note Chism, N. (n.d.). *How classroom design affects teaching and learning*. Retrieved from <https://www.paragoninc.com/am-site/media/article-classroom-design.pdf>
- Van Note Chism, N., & Bickford, D. J. (2002). Improving the environment for learning: An expanded agenda. *New Directions for Teaching and Learning, 2002*(92), 91-98. doi:10.1002/tl.83
- Walter, C. (2012). A Framework for Creating Creative Workspaces. *Proceedings of the European Conference on Knowledge Management, 2*, 1267–1274. Retrieved from <https://libproxy.library.unt.edu:9443/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=lls&AN=82397654&scope=site>

- Warner, S. A., & Myers, K. L. (2009). The creative classroom: The role of space and place toward facilitating creativity. *Technology Teacher*, 69(4), 28-34.
- Waters, M. (2014). *Sustaining pedagogic innovation in vocational education settings: an actor-network theory account* (Doctoral dissertation, University of Melbourne). Retrieved from <https://minerva-access.unimelb.edu.au/bitstream/handle/11343/54856/DEd%20Thesis%20-%20Sustaining%20pedagogic%20innovation%20in%20VET%20settings%20%20Melinda%20Waters%202014.pdf?sequence=1&isAllowed=y>
- Wong, F. W., Lam, P. T., & Chan, E. H. (2009). Optimising design objectives using the Balanced Scorecard approach. *Design Studies*, 30(4), 369-392.
- Woodman, R. W., Sawyer, J. E., & Griffin, R. W. (1993). Toward a theory of organizational creativity. *Academy of Management Review*, 18(2), 293-321.
- Xenakis, I., & Arnellos, A. (2013). The relation between interaction aesthetics and affordances. *Design Studies*, 34(1), 57-73. doi:10.1016/j.destud.2012.05.004
- Yaneva, A. (2009). Making the social hold: Towards an actor-network theory of design. *Design and Culture*, 1(3), 273-288.
- Young, T. V. (2005). *Understanding coalitions in state educational policy issue networks: The selection of alliance partners in reading policy issue networks* (Doctoral dissertation.) Retrieved from Proquest Dissertations and Theses Global. (Order no: 3163976)
- Young, T. V., & Miskel, C. G. (2002, April). *A structural approach to understanding influence in California educational policy: An application of social network analysis to a state educational policy domain*. Paper presented at the annual meeting of The American Educational Research Association, New Orleans, LA.
- Young, T. V., Wang, Y., & Lewis, W. D. (2016). Explaining how political actors gain strategic positions: Predictors of centrality in state reading policy issue networks. *Educational Policy*, 30(6), 799-819.
- Zakirova, V. G., & Purik, E. E. (2016). Creative Environment Formation in Design Professional Training. *International Journal of Environmental and Science Education*, 11(9), 2323-2332.
- Zaugg, H., & Warr, M. C. (2018). Integrating a creativity, innovation, and design studio within an academic library. *Library Management*, 39(3/4), 172-187.
- Zhou, C. (2018). A study on creative climate in project-organized groups (POGs) in China and implications for sustainable pedagogy. *Sustainability*, 10(1), 114.

Zimmerman, E. (2009). Reconceptualizing the role of creativity in art education theory and practice. *Studies in Art Education*, 50(4), 382-399.