ESTUDOS EM DESIGN
DESIGN ARTICLES

Framework para um Raciocínio Integrativo

Integrative Reasoning Framework

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Resumo
Neste artigo é apresentado um framework, denominado Raciocínio Integrativo, desenvolvido para expandir limites impostos por um modelo de educação ainda fragmentado. O conceito de Raciocínio Integrativo busca combinar qualidades e ativar competências de diferentes tipos de raciocínio – científico, senso comum e de design – para lidar com a realidade de maneira mais ampla e eficaz. O framework serviu como ponto de partida para a criação de um modelo educacional que integra diferentes áreas do conhecimento, tendo sido testado em um curso piloto. Apesar da aceitação positiva do curso, identificou-se a necessidade de aprimorar o framework original, levando à criação de uma ferramenta em formato Canvas para futuras aplicações. As considerações finais destacam o design como uma área interdisciplinar e integradora, discutindo os desafios culturais, epistemológicos e emocionais para a adoção de abordagens educacionais mais holísticas e reflexivas. Estudos futuros deverão investigar a adaptação de modelos que promovam competências reflexivas e criativas, preparando profissionais para cenários complexos e em constante transformação.
Palavras-chave: *Design Thinking*, Raciocínio de Design, Raciocínio Científico, Senso Comum, Raciocínio Integrativo.

Abstract
This article presents a framework called Integrative Thinking, developed to expand limits imposed by an education model that remains fragmented. The concept of Integrative Thinking aims to combine qualities and activate competencies from distinct types of reasoning – scientific, common sense, and design reasoning – to address reality in a broader and more effective way. The framework served as a starting point for creating an educational model that integrates different areas of knowledge and was tested in a pilot course. Although the course received positive feedback, it became clear that the original framework needed improvement, leading to the creation of a canvas tool for future applications. The final considerations highlight design as an interdisciplinary and integrative area, discussing cultural, epistemological, and emotional challenges to adopting more holistic and reflective educational approaches. Future studies should explore the adaptation of models that promote reflective and creative skills, preparing professionals for complex and ever-changing scenarios.
Keywords: *Design Thinking, Designerly Reasoning, Scientific Reasoning, Common Sense, Integrative Reasoning.*

Introduction

This article presents a framework called Integrative Thinking, developed to expand limits imposed by an education model that remains fragmented. The background for developing this model is the contemporary context marked by continuous technological advances that influence social behaviors and fierce competition among organizations in search of better market positions. According to *The Future of Jobs Report* from the World Economic Forum (2020), recent global transformations, including health and financial crises, have led economies into free fall, increased social inequalities, exposed inadequacies in employment contracts, and raised concerns about displacement caused by remote work technologies. To withstand this new reality, companies and professionals alike must transform, enhancing competencies that meet these new modes of operation. In this regard, the report maps out 26 countries, tracking the pace of change and highlighting the necessary competencies for the present and potential ones for the future. Among the required competencies for work, the report emphasizes critical thinking, problem-solving, self-management, clear communication, and teamwork.

An early warning is mentioned: global companies' ability to harness the growth potential of adopting new technologies is hindered by a lack of professional skills. This finding was consistent in 20 out of the 26 countries covered by the report. In the absence of ready talent, employers surveyed offer reskilling and upskilling opportunities to 62% of their workforce, intending to expand this provision by another 11% by 2025. However, employee engagement remains below expectations, with only 42% of employees opting to take company-supported upskilling courses.

One reason for this disengagement is the lack of self-awareness regarding what is known and unknown in work processes, as well as skepticism towards conventional teaching models that fragmented education and made disciplines strictly technical. What we observe in the desired competencies is that they often do not mention specific skills or professional specializations, but rather social skills that are rarely discussed in conventional education models.

Regarding the specialization of professions, French sociologist, anthropologist, and philosopher Edgar Morin (2001) agrees that specialization brings progress as it allows for the development of specific knowledge. However, he also argues that it points to regression, as the progress of fragmented knowledge always leads to a fragmenting practice. Reduction and simplification were necessary heuristic methods to set aside the subject and isolate the object so that it could be analyzed and observed without considering the environment and the influence of other subjects. Morin (2001) asserts that this has brought clear results to scientific progress, such as the discovery of molecules, atoms, and other particles. On the other hand, he emphasizes the importance of methods that consider objects in interaction with the environment. The combined effects of these fragmentations led to the creation of isolated empires like Physics, Biology, and Anthropology. According to the sociologist, these can only be connected in a fragmentary way by reducing the complex to the simple, leading to the incomprehensibility of one discipline to another, which the few interdisciplinary efforts have not overcome. He also argues that the split between science and philosophy that occurred from the 17th century onwards created a problem for science, which often lacks self-reflective capacity. Likewise, philosophy ceased to be empirically nurtured.

Beyond the professional and academic realms, most of the problems individuals face daily require applying competencies from different domains. Even simple questions like *"What will I cook for dinner?"* demand knowledge in different areas. A recipe for a typical dish is cultural heritage, while its preparation is a technological process. Reaching the level of culinary art requires scientific knowledge, such as the biochemistry involved in food transformation during cooking. However, as long as fields of study remain divided into two large domains – "Humanities" and "Technologies" – problems will be seen through a narrow lens, from only one perspective (Vicente, 2004). This leads to the recognition that "there is a new intellectual need in our postmodern societies: thinking about complexity. This means keeping in mind various features at the same time: subjective-objective, biological-cultural, scientific-professional, and so on." (Gallifa, 2019, p.16).

In this complex world, Cardoso (2012) claims that design is a great field of integrative possibilities. Being an area focused on planning interfaces and optimizing interstices, it tends to expand as systems become more complex and as the number of interrelationships between parts increases. Design tends, at some level, to interact with all fields of knowledge, so it should be conceived as an extended field that opens to various other areas, from the closest to the most distant ones. The foremost importance of design lies precisely in its ability to build bridges and forge relationships in a world increasingly fragmented by specialization and fragmentation of knowledge.

Despite numerous studies on education and design, this is still a field with room for investigation and new propositions. It is essential to propose models, methods, and tools to minimize the impacts of fragmented education, considering both adults and young professionals in training, as well as addressing the disintegration already felt by children in basic education.

Given this context, this article integrates Science and Design as essential constructs. The word Science encompasses a broad range of scientific fields that apply scientific reasoning to produce knowledge about nature (Simon, 1996). The word Design covers the wide range of professional activities (Buchanan, 1992) that apply the design way of thinking to deal with creating the artificial (Simon, 1996). By using these terms, it is assumed that the cognitive process behind each of them is shared, in some sense, by people engaged in one or both broad categories. By uniting the concept of reasoning—a way of thinking subjected to rules and corrections (Kahneman, 2013) – with the need to integrate various forms of knowledge, we arrive at a new proposal: Integrative Thinking.

The aim of defining Integrative Thinking is not to offer a magical formula for problem-solving, but rather a way of thinking that encourages developing competencies not yet honed by professionals. This reasoning helps address deficiencies not met during basic education or even in university. The proposal follows a contemporary effort to develop competencies not only in design but also across various fields, such as business (Martin, 2009) and medicine (Riegelman; Hovland, 2012), among others.

The challenge

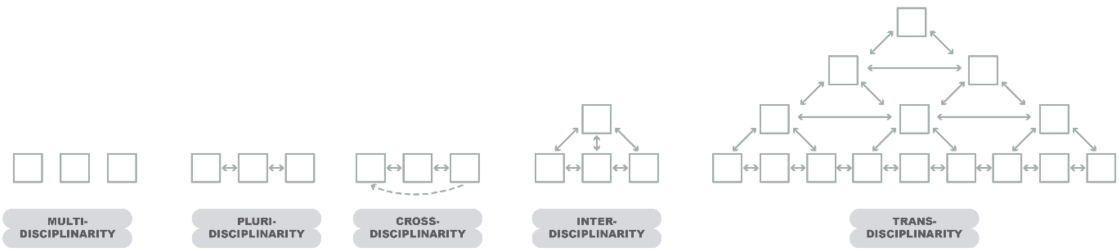
Discussing the relationship between Design and Science goes beyond the scope of this work. We do not avoid delving into this theoretical space, but doing so would divert from the focus on integration. We believe that debates like those of Farrell and Hooker (2012, 2015) and Galle and Kroes (2014) present arguments that can be used to defend different perspectives. From a design-oriented way of thinking, adopting a definitive solution to the "design versus science" dilemma is unnecessary, as such a solution would always be a theoretical construction rather than an absolute rule. Based on this premise, we draw upon a statement by Herbert Simon, which encapsulates the view that there are two paths in professional education that should not be neglected:

> In view of the key role of design in professional activity, it is ironic that in this century the natural sciences almost drove the sciences of the artificial from professional school curricula, a development that peaked about two or three decades after the Second World War. Engineering schools gradually became schools of physics and mathematics; medical schools became schools of biological science; business schools became schools of finite mathematics. The use of adjectives like "applied" concealed, but did not change, the fact. It simply meant that in the professional schools those topics were selected from mathematics and the natural sciences for emphasis which were thought to be most nearly relevant to professional practice. It did not mean that design continued to be taught, as distinguished from analysis. (SIMON, 1996, p. 111)

Herbert Simon's focus was on proposing a Science of the Artificial. In this article, however, the emphasis is not on that but on adopting Nigel Cross's concept of a Science of Design (Cross, 2006). Nonetheless, this does not change our agreement with Simon's view that the hypertrophy of science in education has unbalanced educational processes in several areas. Not only could design in any area been negatively affected, but science education has also suffered losses due to a lack of contact with real problem-solving.

If, during initial learning processes, people do not have opportunities to connect pieces of knowledge to solve multifaceted problems, they tend to approach future problems in a narrow way. It is common to talk about multidisciplinary and interdisciplinary approaches, but the real picture often consists of multidisciplinary groups of individuals who do not see beyond their immediate limits, attempting to work as interdisciplinary teams on problems that deserve a transdisciplinary approach. As presented by Newell (2013), Erich Jantsch developed a Hierarchy of Studies Transcending Disciplinarity, which describes in a simple and useful way the degrees of complexity of each level of interaction and integration among disciplines (Figure 1).

Figure 1: Jantsch's Hierarchy of Studies Transcending Disciplinarity



Source: Newell (2013)

An obvious challenge emerges in contemporary society: *"How to promote transdisciplinary organizations (profitable, not-profitable, governmental) if people mindset tends to be multidisciplinary or pluridisciplinary?"* A response for this challenge came from design when Design Thinking was spread in several contexts with the expectance that it will help to address the actual problem and help to generate a good solution. Design Thinking tools certainly contribute to advances in different areas of knowledge and practice. As a methodological approach it offers support to deal with social problems, business challenges, environmental dilemmas, and many other demands.

Design Thinking has become one the most important facets of Design for contemporary society. What was coined in the 1960's as an expression to name the mental process behind designers' activities, nowadays is known as a useful method or a panacea, depending on the experience of each one. (Christiaans; Almendra, 2012; Johansson-Sköldberg *et al*., 2013). Methods, methodologies, and processes have a long and very important role in design research history. For a long time, the production of Design theories was associated to Design methodologies. In the 1950s and 1960s pioneer design researchers, throughout the Design Methods Movement, tried to open the Black Box that hide the cognitive process designers develop to design in different fields. Cybernetics, Information Theory, and Cognitive Psychology had an important role to uncover designers' tacit knowledge and to formulate design methods and design curricula. As an unexpected result, for many people, the nature of design practice was confused with the design methods.

On the other hand, method is only a support to think, to reason better. Thinking and reasoning are high-level mental activities that depend on the set of beliefs that each person has, as well as affective and physiological states. For our purpose, we consider that beliefs consist of religiosity (or cosmovision), values and myths, and knowledge (tacit and explicit) (Schermer, 2011). The cultural context, educational background and lifelong experiences of each person shape his/her mental activity. Thus, it is easy to accept that a method per se is not sufficient to solve problems, as even solving the simplest problem requires knowledge, motivation, and some domain-specific skills.

Going back to the ideas we presented in the first paragraphs and associating it with our brief reflection on the limits of methods, we established our research question. It was based on the following premises: i. design practice is (or should be) a transdisciplinary practice (so, is integrative); ii. people have different personalities, abilities, knowledge, experiences, and backgrounds, which affect the way they solve problems (as above mentioned); iii. many times, children adopt a designerly way of thinking to solve new problems that needs a creative approach; iv. many times, children adopt a scientific thinking when proposing explanation for a phenomenon. The third and the fourth premises have not been presented before in this work. We adopted them as a belief we have based on literature, and personal observation and experience. Considering these premises, our research question was: how is it possible to enhance, through the design process, individual competencies for creative problem solving?[1]

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[1] We introduced creativity in our research question because non-creative problem solving is basically a process of applying rules, an "if-then process".

In addition, we identified barriers that may make it impossible for individuals to see the potential of the necessary transformations. These barriers are consistent with the concept of beliefs that drive our thinking, regardless of the method used. The most relevant are: cultural (these may originate from organizational culture, family or regional culture that impute disbelief in the integrative proposal); epistemological (these may be in relation to non-acceptance of the complexity perspective bias); and emotional (these can generate non-acceptance in relation to the perception of missing skills and those that need to be developed, given human nature).

In the end, our challenge was defined as the development of a set of frameworks and design tools that could be used in a flexible way, both individually as in teams, to enhance individual competencies for creative problem solving. In this article we present a framework that we consider will play an adequate role in the development of such competencies.

The basis

This article brings forward the main points of an extensive theoretical study based on **modes of thinking** (*Common Sense, Logical Reasoning, Scientific Reasoning, and Integral Thinking*); **Styles of Thought** (*Logical-Formal Thought, Mythical-Religious-Cultural Thought, Dialectical-Rational-Rhetorical Thought, Positive Creative Thought Oriented to Design, Symbolic-Spiritual Thought, Logical-Vision Post-Formal Thought, and Metaphysical Thought*); **Modes of Thinking in Design** (*Design Thinking, Designedly Thinking, and Design Reasoning*); **Modes of Being and Acting in Design** (*Competencies: abilities, skills, attitudes, knowledge, and experiences*); and **Modes of Learning in Design** (*Design Literacy*).

In the realm of Modes of Thinking and Design Thinking, three modes of reasoning were chosen to be worked on: Common Sense, Scientific Reasoning, and Design Reasoning. A guiding question framed the investigation: if scientific reasoning is used in the cognitive process in science, why not use design reasoning for the cognitive process in design?

Thus, the term “design reasoning” was adopted instead of “design thinking,” following Nigel Cross's expression “modes of design thinking,” and “reasoning” instead of “thinking,” following Dorst (2010), who used “design reasoning” with a similar intention. It is acknowledged that the term “design reasoning” is still a construct in development. Additionally, Johansson-Sköldberg et al. (2013) offer a broad view on the concept of design thinking and its variations – a topic that has been thoroughly explored by researchers since the 1980s. Based on Johansson-Sköldberg *et al*. (2013), design reasoning is defined as a conscious cognitive process that guides creative, practice-based activities to solve problems and make sense of things.

Following the initial question, an epistemologically consistent definition of scientific reasoning was sought that aligned with the adopted design theories. In Zimmerman (2000), scientific reasoning is viewed as a problem-solving process with commonalities to this study’s approach. She presents the Scientific Discovery as Dual Search (SDDS) model proposed by Klahr and Dunbar (1988), a framework that "represents an effort to integrate the concept formation approach with the reasoning and problem-solving approach into a single coherent model" (Zimmerman, 2000, p. 101). The SDDS views the scientific process as a dual search process that occurs iteratively in the hypothesis space and the experiment space. This process is similar to the concept of co-evolution in design problem-solving, as described by Dorst and Cross (2001) and recently reviewed by Cash *et al*. (2023).

Simultaneously, a definition of common sense was sought that aligned with the thinking modalities underpinning this proposal. In Benson and Dresdow (2009), Bernard Lonergan's definition of common sense is found: it is “a basic core of insights that enables a person to deal successfully with personal situations arising in daily life, according to the standards of the culture and class to which [the person] belongs.”

The next step was to include in the study base the mental processes that consciously or unconsciously guide people. Generally speaking, Schermer’s (2011) framework of worldview, values, myths, and knowledge was followed, but the need for something more specific and operational was identified. For this purpose, the advanced thinking modalities described by Gallifa (2019) were adopted (Table 1).

Table 1: Advanced modalities of thinking

Modalities of thinking	**Observation**
Logic-formal thinking	Mental operations that are applicable to solve mathematical and scientific problems.
Mythic-religious-cultural thinking	Systems of thought around the relationship of the individual with the cosmos.
Rational, dialectic, rhetoric thinking	Rationality: science, law, medicine, organizations, ethics, aesthetics, and so on. Reasoning: judgement and decision making, including degrees of uncertainty. Rhetoric: art of persuasion, persuasion, will-mobilizing, employed to produce eloquent discourses
Design-oriented, creative, positive thinking	Proposal oriented, prototype developer, and socio-critical based. There is a dynamic relationship between thinking modalities and mental states
Symbolic-spiritual thinking.	It is necessary for evolution, from literal-mythic-cultural systems to a more personal, experiential kind of religiosity-mysticism.
Post-formal, vision-logic thinking	This thinking depends on experience and has his own development: Systemic, metasystemic, paradigmatic, meta-paradigmatic. Intuition, in advanced modalities of thinking, has an impact at the moment of taking complex decisions.

Source: adapted from Gallifa (2019)

Another foundation for our proposal is Jay Doblin’s model of four dimensions of knowledge related to design, presented by Bezerra (2011). These dimensions lie in quadrants defined by the Subject-Object and Analysis-Synthesis axes:

- Human (Subject-Analysis): Fields that seek to understand the human being from physical, psychological, historical, and social perspectives. Within this dimension, the image of design is composed of emotional and symbolic values that meet emotional and social needs.
- Arts (Subject-Synthesis): Represents how the subject expresses and creates. Within this dimension, the image of design is connected to physical characteristics that appeal to the senses.

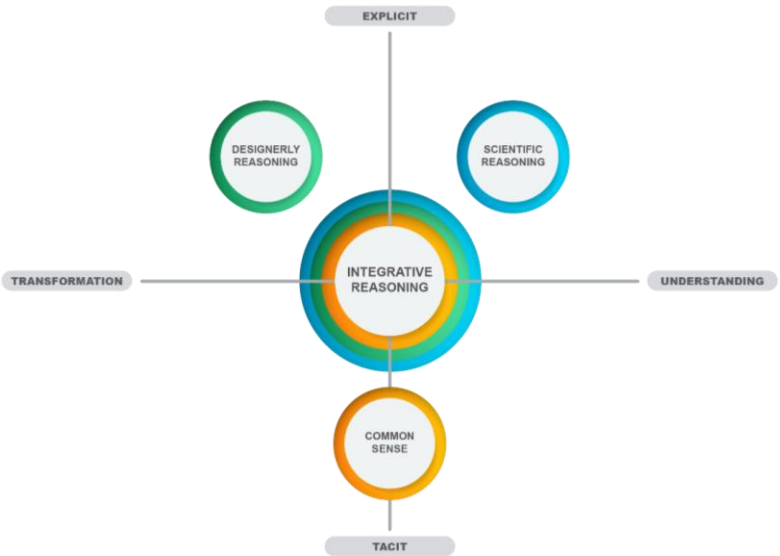
- Science (Object-Analysis): Aims to understand the objective and the concrete. Design is perceived as a tool that deduces or induces prescriptions based on accumulated knowledge.
- Technology (Object-Synthesis): The expression and realization of science. The image of design is composed of attributes of cognitive and rational characteristics. It is seen as a coordinated process aimed at changing the current situation for a better one.

Initially, this model was understood as the four pillars of design education. Later, it became evident that its application need not be limited to the design field. It can be useful in any area of professional and general education. Additionally, it is possible to apply it as a descriptive and prescriptive model and adapt it in numerous ways to function as a research or self-assessment tool.

The proposal

We began with the assumption that design reasoning operates explicitly, much like scientific reasoning. In fact, both mental processes also involve tacit knowledge and are influenced by common sense. However, the dominant feature in both cases is the availability and production of formal knowledge. Common sense, on the other hand, is characterized by the dominance of tacit knowledge—sometimes a diffuse set of beliefs. Following Herbert Simon’s view on the roles of Design and Science, we assume that the former aims to transform and the latter to understand reality. These assumptions form the basis of the framework. The next step in the framework's development was to include a fourth mode of reasoning that captures the nature and objectives of the other three. It was understood to be a mode of reasoning that shares qualities and activates competencies and potentialities that each of the other modes could offer in addressing a particular and contextualized problem. This set was called Integrative Thinking Figure 2 presents the elements of the framework: reasoning modes (Common Sense, Scientific Reasoning, Design Reasoning, and Integrative Thinking) and the knowledge axes (Explicit-Tacit and Transformation-Understanding).

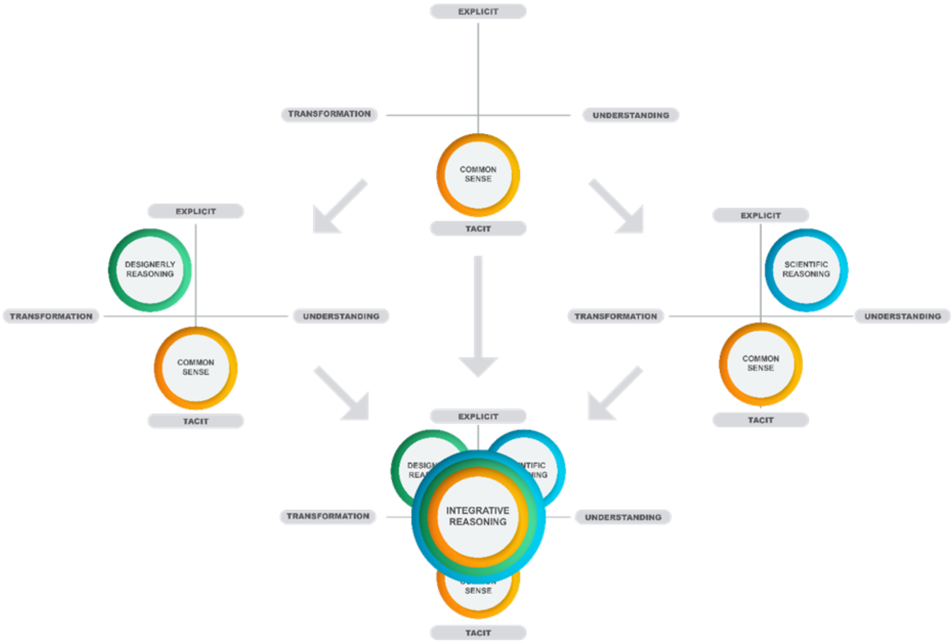
Figure 2: Elements of Integrative Reasoning Framework



Source: The Authors

We identified three situations in which the Integrative Thinking Framework can be applied to enhance competencies: people who rely solely on Common Sense; people who rely on both Common Sense and Design Reasoning; and people who rely on both Common Sense and Scientific Reasoning. The first corresponds to individuals without formal education, while the second and third refer to trained professionals. We understand that Design and Scientific Reasoning, as modes of reasoning, are independent of professional training. They should be developed by everyone as systematic problem-solving modes with different goals and approaches. Figure 3 shows the pathways someone could follow to achieve Integrative Thinking, starting from one of these three situations.

Figure 3: Paths for evolution to Integrative Reasoning

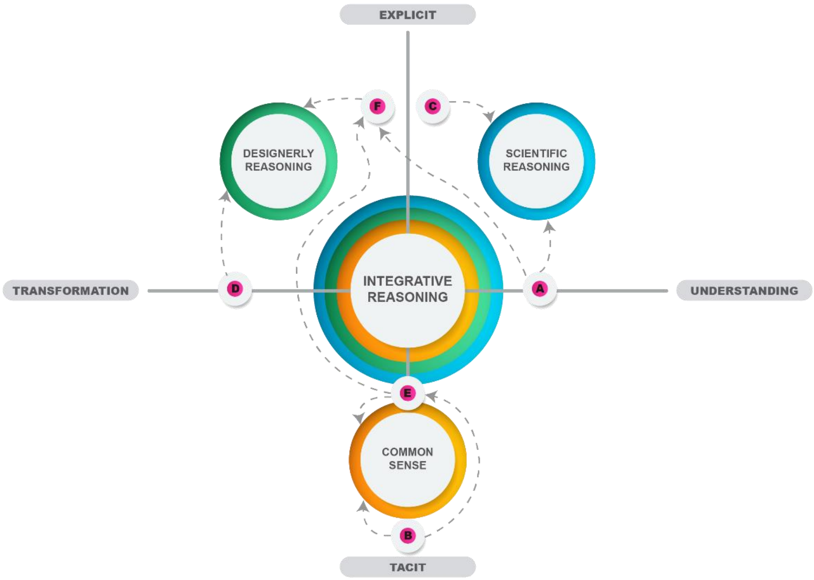


Source: The Authors

It is believed that John Doblin's model offers adequate support for promoting movement through the proposed framework's pathways. Through a self-assessment tool, it is possible to characterize an individual's profile and identify which knowledge dimensions they should be challenged in, with problems requiring the development of new competencies and the application of a different mode of reasoning.

For this evolution, the development process of Integrative Thinking should involve changes in how people think and reason, depending on their starting point, goals, and some other contextual and structural factors. It is not a "point-to-point journey"; it is a continuous and unpredictable experience. In any case, some theoretical connections were identified to help systematize the process (Figure 4). One such connection is the association between Gallifa's advanced thinking modalities and the framework's modes of reasoning. This is considered effective in promoting changes that influence and reinforce explicit modes of reasoning while reducing the relevance of irrational thinking within Common Sense.

Figure 4: Connections among the advanced modalities of thinking and the elements of the Integrative Reasoning Framework



Source: The Authors

It is assumed that Mythical-Religious-Cultural Thought (B) forms the basis of Common Sense. Other thinking modalities are present within Common Sense but do not play a significant role. The exception occurs when, through education and experience, Symbolic-Spiritual Thought (E) emerges and affects the permeability of Common Sense towards more sophisticated thinking modalities and new knowledge. This depends on the rejection of biases and misconceptions and sometimes implies a shift in worldview. It is concluded that the emergence of Symbolic-Spiritual Thought (E) also affects the emergence of Post-Formal Vision-Logical Thought (F), which can be considered an evolution of Logical-Formal Thought (A).

In this article's view, Creative-Positive Design-Oriented Thinking (D) and Post-Formal Vision-Logical Thought (F) are the basis of more sophisticated Design Reasoning. The essence of this mode of reasoning lies in Creative-Positive Design-Oriented Thought (D) from an ontological perspective. It is believed that Post-Formal Vision-Logical Thought (F) adds transcendence and complexity to this mode of reasoning.

Finally, it is considered that Dialectical-Rational-Rhetorical Thought (C) and Logical-Formal Thought (A) are ontologically the foundation of Scientific Reasoning. The influence of other thinking modalities on Scientific Reasoning is not overlooked. In a broader sense, Creative-Positive Design-Oriented Thinking (D) and Post-Formal Vision-Logical Thought (F) could be included as components of contemporary Scientific Reasoning.

The first test

The framework was first tested in a course aimed at entrepreneurs as part of a government program to support the Creative Industry in the State of Rio Grande do Sul (Brazil). The course was titled Integrative Thinking for Creative Businesses, and its target audience was micro and small business owners. It was offered online over three consecutive evenings, each lasting three hours. Thirty-four entrepreneurs from different economic sectors and backgrounds (artists, architects, fashion designers, journalists, photographers, administrators, engineers, etc.) participated in the course (none of them had formal design training). The course's theoretical content and visual diagrams were structured based on the theoretical foundation of the concepts outlined in this article. The aim of this first pilot course was not to test the method fully, but to gain an initial understanding of the educational proposal's acceptance, with a focus on competencies.

The first day's activities focused on theoretical approaches and problem-solving skills, aimed at improving participants' self-awareness of the complexity inherent in everyday problem-solving. Awareness of this complexity helps us to adopt more appropriate strategies and heuristics for contemporary life. On the second day, two business-related challenges were presented, which had to be solved using current strategies. During the process, participants were encouraged to reflect on their approaches. On the third day, the Integrative Thinking approach was introduced, and the same challenges from the second day were reintroduced to be solved in a new way, involving knowledge, beliefs, and values.

Figure 5: Integrative Reasoning steps

Source: The Authors

The process followed the diagram in Figure 5, which supported continuous reflective practice and presented the iterative process of four steps guiding activities for the development of Integrative Thinking. These steps are briefly described below:

1. **"Ask"** – Participants were asked to list their knowledge and beliefs about what might affect the solution to the problem.
2. **"Question"** – Participants were encouraged to seek deeper information on what they believed would or would not affect the problem-solving process.
3. **"Improve"** – A debate was proposed between participant groups to discuss the notes made in the first two steps.
4. **"Reflect"** – Each participant was asked to provide a report describing the problem-solving process they followed, including reflections and critiques.

To utilize the diagram, an editable PowerPoint file was made available on a shared drive. Each participant made a copy of the file for themselves and filled it in. Here, some difficulties emerged. The first was related to time – due to positive discussions in the earlier stages, there was not enough time to complete all the steps. The participants' profiles were more inclined towards dialogue. Here, an improvement point was identified: not leaving the use of diagrams only for the end of explanations but unfolding them into stages throughout the classes, or even building a complete, unified canvas as a final tool.

On the other hand, the integration of Humanities, Technologies, Arts, and Sciences was continually reinforced throughout the course. By reflecting on what each person knows, prefers, and believes, misunderstandings were corrected, prejudices were reduced, and transformations were proposed. These reinforcements, coupled with the participants' intense and engaged debate, increasingly highlighted the need for integrative propositions in education.

The next steps

As mentioned earlier, the first course was delivered as part of a government program aimed at fostering creativity and entrepreneurship. This experiment is part of doctoral research in design and was useful for identifying weaknesses in the applied method. Feedback was gathered from participants, the majority of whom were satisfied with the experience. However, from the researchers' perspective, it became clear that the framework's use as a tool was fragile. As a result, the study is now focusing on developing a Canvas-style tool for application in other courses that implement and test the Integrative Thinking Framework. Therefore, we consider the first edition of the course useful for testing the concept and evaluating the public's experience and satisfaction, given that the proposal incorporates both tacit and speculative scientific knowledge.

Moreover, for any change in thinking modes to be consistent, we believe the approach should be longitudinal. A portfolio of interconnected courses is being developed to foster longer-term engagement (the first version is outlined in Table 2).

Table 2: Portfolio of courses (first draft)

Course	**Brief description**
Development of Integrative Reasoning	A process that aims to develop individual skills that integrate different kinds of reasoning to deal with everyday situations.
Dealing with Uncertainty	A systematic approach for dealing with uncertainty in everyday situations aiming to generate the best set of solutions/options based on Integrative Reasoning approach.
Development of Designerly Scientific Reasoning	A systematic approach for using designerly methods and mindsets to support a scientific process (more abduction than induction and deduction).
Development of Scientific Designerly Reasoning	A systematic approach for using scientific methods and mindsets to support a design process (more induction and deduction than abduction).

Source: The Authors

Final Considerations

This article presented a framework called Integrative Thinking, developed to expand the limits imposed by a fragmented educational model. The backdrop for developing this model is the contemporary context, marked by continuous technological advances that influence social behaviors. By relating the themes of education, skill development, fragmented teaching, and design as an integrative process, we concluded that there are key premises that should guide future elaborations of the tool, method, and teaching models. These include:

- Design as an Integrative Activity: The design process is an integrative activity of knowledge and skills, aligning with Cardoso's (2012) vision that design creates bridges between different disciplines, fostering a more holistic practice.

- Design as a Creative Problem-Solving Activity: As pointed out by Buchanan (1992), design is a creative activity aimed at problem-solving, with its approach to wicked problems in which solutions emerge from the complex co-evolution of problem and solution.

- Individual Differences: Individual differences – such as personality, abilities, knowledge, and experiences – impact how people solve problems and collaborate in design processes. This reflects the importance of a personalized approach to design education, as suggested by Yee, Jefferies, and Michlewski (2017).

- In addition to these premises, it is essential to recognize the barriers that can hinder the adoption of integrative and innovative approaches in design. These barriers include:

- Cultural Barriers: These may arise from organizational, family, or regional cultures that limit the acceptance of transdisciplinary and integrative perspectives.

  Epistemological Barriers: Resistance to accepting complexity as an approach, which Morin (2001) identifies as essential for dealing with interconnected and interdisciplinary systems, still faces opposition in traditional teaching and practice contexts.

- Emotional Barriers: Obstacles related to difficulty in recognizing and developing lacking competencies, often driven by fear or individual insecurities about the ability to adapt.

Given these reflections, important directions for future study emerge. It will be necessary to deepen investigations into how educational models can be adapted to effectively integrate systems thinking and complex problem-solving into design education. Moreover, there is an opportunity to explore how designer training can more strongly incorporate competencies such as empathy, collaboration, and communication, as highlighted by Freitas and Almendra (2021), who point to these skills as fundamental in today's context.

Finally, future studies could investigate the implementation of more holistic teaching approaches that not only transmit technical knowledge but also develop reflective and creative skills in designers, preparing them to operate in complex and rapidly changing scenarios. These studies could evaluate the impact of transdisciplinary pedagogical methodologies and how they can be adapted to meet current needs in both academic and professional practice.

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