

Design Research in the Social Realm: An Analysis of a Theoretical Design model

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ABSTRACT

This paper discusses the role of design research in the social realm. The objective of this paper is to examine the theoretical design model as the interdisciplinary lens used for studying the development of social inclusion of a person with Down syndrome (PDS) in Malaysia. The discussion mainly focuses on the concerns in design research as a framework that support the role Design Research in a real life case problem. As well as interpret and edit the raw data with the support of systems thinking.

Keywords: Design Research, Social Inclusion, Interdisciplinary, Systems Thinking

1.0 INTRODUCTION

Disability issues in Malaysia are likely categorised as a complex and ‘ill-structured problem’. Disability issues in Malaysia are capable of eliciting very different perceptions and values as Singh (2008) identifies a significant challenge to disability issues in Malaysia lies in the lack of uniform professional and equality services by health, welfare and the education department. For example, the dilemma in policy making and implementation in Malaysian education for persons with disabilities may correlate with the inadequate translation of policy, which may in turn lead to discrimination and unsystematic planning, as suggested by Jelas and Ali (2012). The issue of the culture of elitism, which revolves around education quality standards designed to maintain excellent examination results, plausibly further isolates people with Down syndrome (Jelas & Ali, 2012). Issues of inclusivity for people with Down syndrome and concerns in getting the necessary literacy education in schools have become complex in Malaysia (Ali, Mustapha, & Jelas, 2006; Jelas & Ali, 2012).

A change of this magnitude would involve a broad range of stakeholders in a significant organisational shift. Sternberg (cited in Owen et al., 2009) argues that the process of change requires a concentrated effort that includes identifying the cultural problems within an organisation that stand in the way of change.

The objective of this paper is to address the relationship of the theoretical design model as the interdisciplinary lens used for examining the development of social inclusion of a person with a Down syndrome (PDS) in Malaysia. Down syndrome is a common disability occurring throughout the world. Hoe (1989) analysed the statistics for live births including the number of new-borns with DS in 1989. Out of the 34,522 live births in Kuala Lumpur's maternity hospital, 36 of them had Down syndrome. By extrapolation, it is estimated that Malaysia has a ratio of 1:959 or 1 baby with Down syndrome to every 959 live births (Hoe, Boo, & Clyde 1989). As, in 2012, among the estimated 29 million people in Malaysia (Airil Haimi & Intan Azreena, 2001) 359,203 of them are reported to have a degree of disability (Department of Social Welfare Malaysia, 2012).

There are many strategies for the education of children with Down syndrome that are well documented in international literature (Bird & Thomas, 2002; Connolly, Morgan, & Russe, 1984; Dmitriev, 1982; McVay, Wilson, & Chiotti, 2003; Oelwein, 1995; Wisniewski, 1990). However, there is less research and understanding of educational strategies for Down syndrome (or DS) in the Malaysian context (Hoe, Boo, & Clyde, 1989). The discussion mainly focuses on the framework that supports the role of Design Research in a real life case problem such as understanding the education strategies for PDS in Malaysia. As well as interpret and edit the raw data with the support of systems thinking.

- Firstly, how can design research interpret the raw data of a complex case such as the twinned issue of PDS rights and understanding barriers to social inclusion in Malaysia without positioning itself in a contextual ambiguity of 'practice' and 'theory'?
- Secondly, how can Design Research interpret and edit the raw data of a 'complex' case study such as PDS rights and understanding barriers to social inclusion in Malaysia?

2.0 DISCUSSION ON COLLECTED WORKS

2.1 The concerns in Design research

First of all, how can design research interpret the raw data of a complicated case such as the twinned issue of PDS rights and understanding barriers to social inclusion in Malaysia without positioning itself in a contextual ambiguity of 'practice' and 'theory'? Such concerns have, as suggested by Love (2000), led to the development of theories concerning mixed methods in design research. Love (2000) recommends the importance of clarifying relationships between individual concepts and theories, and between these different concepts and theories and their underlying assumptions. Kimbell (2011) highlights a similar concern and further suggests '[t]here are some design professionals that take solving complex social issues as their domain, often but not always working in close collaboration with specialists in public services from health care to those working with disadvantaged families.'

In 1984, Cross critically analysed Design Research and identified four overlapping themes, which also represent the chronological development of research into design. However, Dixon (1989) argues there is 'the confusion in design theory by regarding all Design Research as being in a pre-theoretic stage.' Consequently, in 1993, Cross (1993) reported on topical theoretical developments that qualify his previous findings. However as the field matures, design methodology has resulted in clarifying the differences between design and science (Cross, 1993). However, potentially places design research into practical and theoretical confusion. Accordingly, the context of the research is paramount in interdisciplinary work (Love,

2000). Furthermore, if design research is confusing the practice and theory, then design research processes need restructuring (Thoring & Muller, 2011).

At the same time, however, Love (2000) argues that Cross's short history of Design Methodology is problematic in its suggestion of Kuhnian-style development. Moreover, the different sub-paradigms of design theory across all paradigms in Cross's study creates further terminological confusion in the field of Design Research (Love, 2000). Love (2000) proposes that Design Research requires restructuring and states, 'What remains needed is ... structuring existing concepts and theories to bind the unnecessary growth in abstraction and terminology ... so that it is clearer to a design researcher which concepts, theories and theoretical strands are pragmatically more useful or better justified, and what their relationships are to each other.'

For example, Design thinking has subsequently developed to become a significant and accessible Design Research theoretical model. Ladner (2009) observes that design thinking is the new 'It-Girl' of management theory. He comments that it provides managers with creative solutions to old problems. However, design thinking alone will not solve problems for innovation because lack of creativity was never the issue. Kimbell (2011) proposes that it is necessary to rethink design thinking in terms of three primary concerns: (1) As a cognitive style; (2) As a general theory of design; (3) As an organisational resource.

There are different ways of using the Design Thinking model (Kimbel, 2011). Nevertheless, it continues to be debated as Nussbaum (2011) succinctly puts it, 'Design Thinking itself has become a key issue.' Design Thinking initially offered large companies defined by a culture of efficiency a whole new process that promised to deliver creativity. Nussbaum (2011) agrees that these changes would not have occurred without Design Thinking. 'Humanistic Design' is an enormous advance in the field of social change facilitated, in part, by developments in Design Thinking (Shea, 2012). Examples include work by the 'Acumen Fund', 'Project H', Arson's students at 'Memorial Sloan Kettering', 'Stanford's K-12 initiative', IDEO at the 'Mayo Clinic' and 'Kaiser Permanente', which would not have occurred without the approach of Design Thinking.

In 2013, Nussbaum proposed the emergence of Creative Intelligence. It is a concept derived from Design Thinking. He asserts that Design Thinking broke design out of its specialised, narrow, and limited base, and connected it to more important issues and a wider universe of profit and non-profit organisations (Nussbaum, March 2013). In comparison, Creative Intelligence expands that social engagement and frames problems in new ways by using low or high capacity intelligence to frame and solve problems. At any rate, creativity in innovation is not a new concept. In 2002, Theodore Levitt (2002) had previously written about creativity being the fuel of innovation. He expresses concern that creativity can be destructive to business when practical implementations fail. Levitt (2002) explains that '[c]reativity as it is commonly defined—the ability to come up with brilliantly novel ideas— can be destructive to businesses.' He continues to explain that '... by failing to take into account practical matters of implementation, big thinkers can inspire organizational cultures dedicated to an abstract chatter rather than purposeful action. In such cultures, innovation never happens—because people are always talking about it but never doing it.'

2.2 The influence of Systems Thinking

So, how can Design Research interpret and edit the raw data of a ‘complex’ case such as PDS rights and understanding barriers to social inclusion in Malaysia? Design Research involves organising the concern with reference to the efficiency of communication, the technology used, and the social responsibility at stake (Bennett, 2006). The primary concern of Design Research is to develop a clearer paradigm and to have pragmatically more useful or better-justified strands. The biggest concern is how to structure existing concepts and theories, and avoid unnecessary abstraction at the same time. A framework is needed which defines and expresses what constitutes knowledge about that situation. It can also help draw a distinction between research and novel writings and make the research recoverable.

Bruce Archer (1969) nonetheless argues that Design Research faces a major challenge. The challenge lies in the adaptation of systematic methods borrowed from computer techniques, which constitute a fundamental challenge to conventional ideas about design – specifically the advocacy of systematic methods of problem-solving, adopted from computer techniques and management theory, which are used for the assessment of design problems and development of design solutions. The growing advocacy of such systematic methods can be seen in examples from data visualisation (Friendly, 2009) and mapping information (Brightman & Banxia Software Limited, 2003).

According to Friendly (2009), the method for problem-solving changes over time as newer information is discovered with the advancement of technology. For example, systemic methods for problem-solving on understanding data visualisation are dated back as early as the 17th century. In the context of the science of visual representation, data is defined as information, which has been abstracted in a schematic form including variables for the units of information. As, Friendly’s (2009) has categorised an example of these problem-solving techniques in his paper. While, Jenny Brightman and Banxia Software Limited (2003) has categorised examples of mapping information into four different methods dated back to the early 1990s examples can be found in her paper.

Typically, Design Research leads to ‘design making’ and in the context of Graphic Design, it often speaks of design as a process (Holland, 2001). Vianna et al. (2012) state in *Design Thinking Business Innovation*, ‘After the data collecting stages ... the next actions are analysis, and synthesis of the information obtained ... [which is in turn] arranged to form patterns posing challenges that will assist in clarifying the problem.’ *Design Thinking Business Innovation* offers suggestions for how future research may be conducted along these lines. The list of processes for analysis and synthesis includes Insight Card, Affinity Diagram, Conceptual Map, Guiding Criteria, Personas, Empathy Map, User’s Journey, and Blueprint (Vianna et al., 2012).

Dubberly (2008) observes that the concept of design is expanding. This expanding concept of design creates an environment in which objects created by the designer can change. Dubberly (2011) states, ‘... this concept of design aims to sustain nature, humanity, technology and to illustrate harmonised cultural differences and distilling issues of the past, present and future into a dynamic balance.’ However, what happens when Design Research is incorporated as part of an interdisciplinary study involving issues of social inclusion? The International Council of Graphic Design Association (ICOGRADA) has published its first Design Education Manifesto. The publication outlines many changes in the context of design practices and theory, and redefines them as visual communication for the future of design education (Dubberly, December 5, 2011; ICOGRADA, October 2000).

The context of design research in Graphic Design is also shifting. The shift is not focussed on what new knowledge is produced but how it is produced. This shift in worldview and framing has influenced change in organising structures from individual design to web design. The management of design education, be it in terms of 'top-down' or 'bottom-up' management, has to be responsive to this shift and embrace multiple knowledge (ICOGRADA, October 2000). Many design subjects have become interdisciplinary. The issue of creating an object is linked to the issue of social experience while the need for creating products is related to a concern for networks of interaction and communities in a system. In addition, design research is experiencing a further paradigm shift with the advent of the Internet, as explained in Porter (1998) and Ess and Dutton (2013).

2.3 The relationship of design research and systems thinking

Design Research has developed to account for such changing views. The subjective opinions held by designers and the concrete objects conceived, planned and produced act as expressions of those changing views (Buchanan, 1992). The term 'design' is commonly associated with products' quality or aesthetic appearance. Some even define the primary goal of design as a discipline is to communicate the quality of aesthetic appearance in people's lives (Vianna et al., 2012). For example, Joan Costa (2012) is an expert in visual communication who has written about the paradigm shift in design research in the context of graphic design. Costa states that 'the notion of the project in Graphic Design will extend beyond the graphic to the visual dimension of being'.

Graphic design products such as posters, logos, websites, packaging and way-finding boards do not simply signify things, rather they cause communication. According to Costa, everything requires communication and it is impossible to avoid the transmission of information without communication. Arnheim (1968), in his book *Visual Thinking*, maintains that the way people perceive information is also reflective of the way we think. For example, Simon and Larkin (1987) examine how the brain seeks to make connections that generate meaning. Our eyes and brain work together to 'understand' what we see in our environment.

According to Arnheim (1968), the designer's way of looking at information is similar to the way in which a mind works as it analyses and synthesises information. But as Ritchey (1991) observes, 'Careless interpretation of analysis and synthesis definitions has sometimes led to quite misleading statements. For instance, synthesis is useful because it creates wholeness or analysis is inadequate because it reduces wholeness to alienated parts.' Buchanan (1992) nonetheless believes that the 'art of design is experimental thinking.' Examples of successful research methods that involve seeing information as analysis and synthesis can be viewed in the works of William Playfair (Tufte, 1990).

Nevertheless Love (2000) argues that the problems in Design Research are mainly due to the unnecessary multiplicity of theoretical concepts. For example, Popper (1976) likewise addresses the problem of theoretical confusion and validation. He provides an analysis of the relationships between the following three worlds. World 1 refers to physical objects and material things. World 2 is the subjective world of mental objects. World 3 relates to objective knowledge. Phillips (1989) analyses Popper's Three Worlds. By referring to research on getting English native speakers to speak Russian, he provides an example illustrating one of the problems facing a design theorist who is attempting to formulate a well-justified theory about the internal creative processes of designers. He concludes that any theories regarding design must involve both the material and subjective worlds. At the same time, however, the real test of theories in design lies in their

validation and coherency. Theories related to design research need to be consistent with other well supported theories across disciplines apart from the field of design (Phillips, 1989). The test of theories in design resides in whether they have broader applications and not restricted only to the area of design research (Love, 2000).

At any rate, this process can be troublesome given the natural human tendency to avoid change, even when it is ultimately positive (Owen et al., 2009). Communicating information through Design Research can start a theory that exists before practice occurs, and practice may bring results after several attempts to obtain consistency (Friedman, 2001). It takes time to build on a theory in research and much longer to put it into practice, which will lead to a consideration of how theory might actually affect the rate of productivity/outcome.

Appraising the properties of the 'whole' rather than its component parts is recommended by Checkland and Poulter (2010). Systems thinking see interrelationships rather than linear cause-and-effect chains. It functions to comprehend the processes of change rather than snapshots of change (Senge, 1990). The early Systems Thinkers were nonetheless over-ambitious in their belief that the dynamics of a system could completely analysed (Flood, 1999). Barton and Haslett (2007) advocate ripping apart an element and analysing the pieces one by one, and by subsequently putting the parts back together again (or synthesis) one can arrive at an analysis of the issue as a whole.

Systems thinking are a crucial component in sustaining research involving complexity theory and many of the insights that now labelled 'complexity' are classic systems concepts (Flood, 1999). Indeed, it considers how to intervene in a human activity system rather than defining human activity with complete accuracy (Flood, 1999). The insights supported by Soft Systems thinking are often as useful as any. It is a system nested within systems and the interrelationships across an organisation. The problem situation must be taken into account when a change of intervention signifies planning (Flood, 1999). The change of intervention indicates that organisation-wide approaches are sometimes required. For example, an understanding of interdependencies of the discipline can be used to enhance the effectiveness of implementing change (Checkland & Poulter, 2010).

Illustrating the network with the support of systems thinking is an important element in design Research in the Social Realm because they provide simplified, abstracted figures or caricatures to convey essential meanings (Hall, 1996). Design Research consist a set of elements, connected together, which as a whole form a theoretical consistency. Senge (1990) notes that being able to step back far enough from the details 'to see the forest for the trees' is to be valued. However, for most of us when stepping back, we still see lots of trees. When attempting to make improvements, we often simply choose our favourite ideas to focus our attention and efforts to provide change. The benefit of Systems Thinking in Design Research lies in its capacity for seeing through the complexity to the underlying structures generating change.

3.0 CONCLUSION

The role of design research in the social realm is to further provide clear knowledge in visual form, of support systems to their carers either in the public or private organisations. Valuing people's initiative creates an active focus on service changes derived from a genuine desire, on the part of key stakeholders, to promote positive experiences in the lives of people with learning disabilities. The influence of systems thinking and design research, for example, can spark plausible holistic perspectives when viewed as a whole

rather than the collections of parts. For example, to provide sets of information that is known as 'data' (sets of numbers, statistics, narratives etc.) which then designed into graphical sets that can transfer an effective message to the viewer.

As Horn (1989) discusses, 'Ill-structured problems concern the various people having very different perceptions. The perception incorporates the values concerning the people's nature, the people's causes, the people's boundaries, and the people's solutions. Those are the problems that bring out two or more points of view from the first mention of the problem'. The challenge in this study is in placing a Design Research perspective in a real life situation such as the development of social inclusion of PDS in Malaysia. Placing Design Research into a social studies context speaks of beyond interdisciplinary research approach, moreover a trans-disciplinary research.

A framework that can support Design Research, as well as interpret and edit the raw data is with the support of systems thinking. The processes are recoverable by anyone interested in subjecting the work to critical scrutiny. Systems thinking include both analysis and synthesis in problem-solving (Senge, 1990). It seeks to sort information and group important data in a way to provide better understanding and support for the multiple disciplines of an organisation. Thus, Systems thinking is necessary to Design Research in the Social Realm because it is a suitable method to review the information data concerning the development of social inclusion of PDS in Malaysia.

Having clear understanding of the practical and theoretical methods in Design Research is essential. A further study on Systems thinking and Design Research, as a representation of an interdependent praxis is important to interpreting and editing raw data in a complex case. Particularly in an approach which can be used to help understand the barriers for the social inclusion of PDS in Malaysia.

REFERENCE

- Airil Haimi, A., & Intan Azreena, H. (2001). A Disabling Education: The case of disabled learners in Malaysia. *Disability & Society*, 16(5), 655-669.
- Ali, M. M., Mustapha, R., & Jelas, Z. M. (2006). An Empirical Study on Teachers' Perceptions towards Inclusive Education in Malaysia. *International Journal of Special Education*, 21(3), 36-44.
- Archer, B. (1969). *Systematic method for designers; Technological innovation: a methodology*. London: Council of Industrial Design & Inforlink for Science Policy Foundation.
- Arnheim, R. (1968). *Visual Thinking*. University of California Press: Berkeley.
- Barton, J., & Haslett, T. (2007). Analysis, synthesis, systems thinking and the scientific method: rediscovering the importance of open systems. *Systems Research and Behavioral Science*, 24(2), 143-155. doi: 10.1002/sres.816

- Bennett, A. (2006). *Design studies :Theory and research in graphic design* (Vol. 1). New York: Princeton Architectural Press
- Bird, G., & Thomas, S. (2002). Providing effective speech and language therapy for children with Down syndrome in mainstream settings: A case example. *Down Syndrome News and Update*, 2(1), 30-31.
- Brightman, J., & Banxia Software Limited. (2003). *Mapping methods for qualitative data (QDS)*. Paper presented at the Strategies in Qualitative Research: Methodological issues and practices using QSR NVivo and NUD*IST, Institute of Education.
- Buchanan, R. (1992). Wicked Problems in Design Thinking. *Design Philosophies and Theories*, 96-100.
- Checkland, P., & Poulter, J. (2010). Soft systems methodology. In *Systems approaches to managing change: A practical guide* (pp. 191-242). Springer London.
- Connolly, B. H., Morgan, S., & Russe, F. F. (1984). Evaluation of Children with Down Syndrome Who Participated in an Early Intervention Program: Second Follow-up Study. *Physical Therapy*, 4(10), 5.
- Costa, J. (2012). Cambio de paradigma: la Comunicación Visual. Retrieved from <http://ruilira.com/change-of-paradigm-visual-communication/>
- Cross, N. (1984). *Developments in design methodology*. Chichester & New York: Wiley.
- Cross, N. (1993). Science and design methodology: a review. *Research in engineering design*, 5(2), 63-69.
- Department of Social Welfare Malaysia. (2012). Statistics report of registered Person with Disabilities (PWD). Retrieved June, 2012, from http://www.jkm.gov.my/index.php?option=com_jdownloads&Itemid=314&task=viewcategory&catid=34&lang=ms
- Dixon, J. R. (1989). On Research Methodology Towards a Scientific Theory of Engineering Design. In S. L. Newsome, W. R. Spillers & S. Finger (Eds.), *Design Theory '88* (pp. 316-337). New York: Springer.
- Dmitriev, V. (1982). *Time to Begin: Early Education for Children with Down syndrome*. USA: Caring, Inc.
- Dubberly, H. (2008). Design in the Age of Biology: Shifting From a Mechanical-Object Ethos to an Organic-Systems Ethos. *Interactions*, 15(5), 35-41.
- Dubberly, H. (December 5, 2011). Input for updating the ICOGRADA Design Education Manifesto. Retrieved December 7, 2011, from <http://www.dubberly.com/articles/design-education-manifesto.html>
- Ess, C. M., & Dutton, W. H. (2013). Internet Studies: Perspectives on a rapidly developing field. *New Media & Society*, 15, 633-643.

- Flood, R. L. (1999). *Rethinking The Fifth Discipline: Learning within the unknowable*. London: Routledge.
- Frances Owen, Julien, M., Brock University Ontario, Sales, C., Tardif-Williams, C. Y., Vyrostko, B., Stoner, K. (2009). Ensuring Rights: Systemic and Educational Approaches. In F. Owen & D. Griffiths (Eds.), *Challenges to the Human Rights of people with Intellectual Disabilities* (Chapter 10). London: Jessica Kingsley Publisher.
- Friendly, M. (2009). Milestones in the history of thematic cartography, statistical graphics, and data visualization. Canada: National Sciences and Engineering Research Council of Canada.
- Hall, B. S. (1996). The Didactic and the Elegant: Some Thoughts on Scientific and Technological Illustrations in the Middle Ages and Renaissance. In B. S. Baigire (Ed.), *Picturing Knowledge: Historical and Philosophical Problems Concerning the Use of Art in Science* (pp. 3-39). Toronto: University of Toronto Press
- Hoe, T. S., Boo, N. Y., & Clyde, M. M. (1989). Incidence of Down's syndrome in a large Malaysian maternity hospital over an 18 month period. *Singapore medical journal*, 30(3), 246-248.
- Holland, D. (Ed.). (2001). *Design Issues: How Graphic Design Informs Society*. New York: Allworth Press.
- Horn, R. E. (1989). *Mapping hypertext : the analysis, organization, and display of knowledge for the next generation of on-line text and graphics*. Lexington, MA : Lexington Institute.
- ICOGRADA. (October 2000). *Design Education Manifesto*. Paper presented at the International Council of Graphic Design Associations (or ICOGRADA) Congress, Seoul.
- Jelas, Z. M., & Ali, M. M. (2012). Inclusive education in Malaysia: policy and practice. *International Journal of Inclusive Education*, 1-13. doi: 10.1080/13603116.2012.693398
- Kimbell, L. (2011). Rethinking Design Thinking: Part I. *Design and Culture*, 3(3), 285-306. doi: 10.2752/175470811x13071166525216
- Ladner, S. (2009). Design thinking's big problem. Retrieved from <http://copernicusconsulting.net/design-thinkings-big-problem/>
- Levitt, T. (2002). Creativity Is Not Enough. *The Innovative Enterprise*, 137 - 145.
- Love, T. (2000). Philosophy of Design: a Meta-Theoretical Structure for Design Theory. *Design Studies*, 21(3), 293-313.
- McVay, P., Wilson, H., & Chiotti, L. (2003). "I See What You Mean!" Examples of Visual Tools to Promote Inclusive Learning. *Disability Solutions: A Resource for Families and Others Interested in Down Syndrome and Related Disabilities*, 5(5), 3-16

- Nussbaum, B. (2011). Design Thinking Is A Failed Experiment. So What's Next? Retrieved from <http://www.fastcodesign.com/1663558/design-thinking-is-a-failed-experimentso-whats-next>
- Nussbaum, B. (March 2013). *Creative Intelligence: Harnessing the Power to Create, Connect, and Inspire* [Kindle Edition]. Harper Business
- Oelwein, P. (1995). *Teaching Reading to Children with Down syndrome: A Guide for Parents and Teachers*. United States: Woodbine House.
- Phillips, D. C. (1989). *Philosophy, Science and Social Inquiry*. Oxford: Pergamon Press.
- Popper, K. (2005). *Unended Quest: A remarkable document of intellectual history* (4th ed.). London and New York: Taylor and Francis e-Library.
- Porter, D. (1998). Internet Culture. *Learned Publishing*, 11(3), 171-178.
- Ritchey, T. (1991). Analysis and Synthesis - On Scientific Method based on a Study by Bernhard Riemann. *Systems Research*, 8(4), 21-41.
- Senge, P. M. (1990). *Seeing the World Anew*. New York: Doubleday.
- Shea, A. (2012). *Design for Social Change*. New York: Princeton Architectural Press.
- Singh, A. (2008). Meeting the Needs of Children with Disability in Malaysia. *Medical Journal Malaysia*, 63(1), 1-3.
- Thoring, K., & Muller, R. M. (2011). *Understanding Design Thinking: A process model based on method engineering*. Paper presented at the International Conference on Engineering and Product Design Education, London.
- Tufte, E. R. (1990). *Envisioning Information*. Cheshire, Connecticut: Graphic Press.
- Vianna, M., Vianna, Y., Adler, I. K., Lucena, B., & Russo, B. (2012). *Design Thinking Business Innovation*. Rio de Janeiro: MJV Press.
- Wisniewski, K. E. (1990). Down syndrome children often have brain with maturation delay, retardation of growth, and cortical dysgenesis. *American Journal of Medical Genetics, Supplement: Trisomy 21 (Down Syndrome)*, 37(s7), 274-281.