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EDUCATING CRITICAL THINKING IN DESIGN RESEARCH

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ABSTRACT
This paper presents a study done in 2010 as part of a course named *design critics* that integrates the curricular year of a Design PhD program in a Portuguese University that works according to the Bologna Convention. The main aim of the course (that had 21 students) was to provide PhD students with the competences of critically framing theory in their research projects. Therefore, the course offers an ample perspective of design based upon a holistic humanistic/social sciences approach that relies on knowledge coming from areas such as design theory, design history, design criticism, anthropology and sociology. Nowadays, in all the cycles of design education (undergraduate, master and PhD) research has gained expression especially through the teaching of courses related with research methodologies and methods. The problem is that it is hard for the students to capture the way information can be selected, interpreted and used in a way that it really contributes to expand knowledge in this domain area. Being so, one of the modules of the course is dedicated to critical information management and is supported by the development of an exercise done with a research paper. The activity comprehends the training of both analysis and synthesis competences, the understanding in practice of deductive, inductive and abductive reasoning, the application of both rational and hermeneutical processes. Among the parameters to be evaluated in this exercise the abilities of establishing fluxes between theory and practice, of relating phenomena, of having a qualified speech and communication and of building new information are decisive to accomplish the desired critical thinking in design. As a result of this work students developed their own tools allowing them to efficiently and critically select, classify, organize and operationalize the use of information. A survey conducted among the students one year after the course evaluated the retention of the contents given as well as the learning effect, i.e. the use of the methods proposed.

Keywords: Critical thinking, design research, information management

1 INTRODUCTION

At the present time research in all design areas is in clear expansion as can be derived from the significant growth of Design PhD programs all over the world and from the number of conferences, publications and journals that appeared over the last 10 years. Education in Design, especially in Europe is organized in cycles corresponding roughly to the classification of: undergraduate (3 to 5 years) master (1 to 2 years) and PhD programs (3 to 5 years).
Research is seen as essential in the education area not only as a way of growing in knowledge but most of all as a way of making that knowledge useful for society.
Critical thinking is essential to research since as Kurfiss [1] defines it "Critical thinking is the mental work involved when we investigate complex questions." To reflect about how the critical thought teaching/learning process might occur we present in the following pages an argument that starts with literature review as the training context, a critical information system as a method to develop those skills and the summary of a survey done with students after experiencing critical thinking training.

2 CRITICAL THINKING IN DESIGN RESEARCH

2.1 Literature review – a context for critical thought's training

According to Hart's [2] definition, literature review is 'the selection of available documents (both published and unpublished) on the topic, which contain information, ideas, data and evidence written

from a particular standpoint to fulfil certain aims or express certain views on the nature of the topic and how it is to be investigated, and the effective evaluation of these documents in relation to the research being proposed' (1998, p. 12).
When considering this definition it is clear that there are some procedures that must be ensured with effectiveness such as: selection, classification, evaluation of information. Therefore, we can see literature review as a complete task in terms of the training to be done by critical reasoning. The literature review is one task that calls the reader to have an active approach pursuing the goal of uncovering meaning and assuring understanding about the information he/she analyses. As proposed by Kurland [3]critical reasoning requires a complex combination of skills that include: a) rationality, b)self awareness (in order to be able to recognize our own prejudices, assumptions and biases), c)open-mindedness (so it is possible to consider multiple viewpoints, to consider alternative interpretations, accept new explanations etcetera), d) judgment (consideration of the extent and weight of evidence) e) discipline (so it is possible to one be precise, exhaustive and meticulous avoiding snap judgments). Also to consider is the ability a person has to retain and recall information since that is quite relevant while dealing for a long period (the time to conclude the thesis) with a vast and complex system of ideas, concepts, facts etcetera.
As Buzan [4] shows one has more recall of things that are associated or linked and of things that are outstanding or unique. For that reason when developing a system to help PhD students to manage information in a way that it can support critical thought the association and linkage of information is a key issue as well as detaching and making good use of unique and outstanding facts that can serve as a reference points to 'build' a reasoning net.

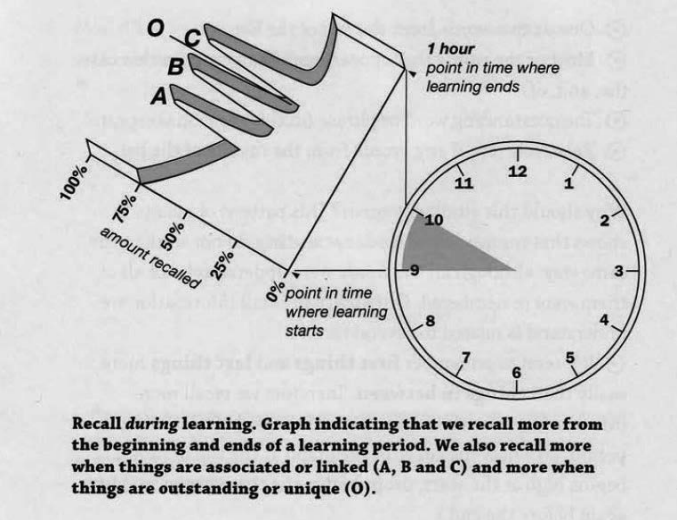

Figure 1. Recall Information Graphic. Source Tony Buzan, 2007, p.110

2.2 Creating a critical information system (CIS)

Training critical thinking and reasoning in the design research domain is crucial and hard to implement since usually, in Portugal, students at PhD level are practitioners that scarcely have a consistent contact with research processes and methodologies, particularly with those that are related with the immersion and reflection in the theoretical field. Being so, one of the modules of this course is dedicated to a practical exercise devoted to critical information management, to be developed in two sessions of 3 hours each (with the presence of the teacher) and to be complemented with home work that accounts for 12 hours.
The exercise included the analysis of a text from Snodgrass and Coyne [5] entitled "Is designing hermeneutical?". The choice of the text meets a few criteria, namely:

1. The text should address a design topic – in order to be representative of the majority of documents that students would need to read for their research work;
2. It should come from the theoretical/historical/epistemological field - So it gave students the possibility to train the ability of exploring philosophical and complex theoretical thinking;
3. It should present at least two perspectives on the subject - 'forcing' the students to understand and explore the multi-perspective approach on the subjects and to go deeper in order to choose

one side;

4. It should be rich in references not only from the present but also from the past - so students can understand the diachronic and synchronic knowledge dimensions of phenomena;
5. It should present similarities with the structuring of design thinking in research – meaning it should pose a question and propose an argument.

These criteria were chosen according to the goal of having the possibility of exploring different competencies necessary to critical design thinking.

The basis for the construction of a method to support critical thinking was derived from the idea of a personalized 'Critical Information System' (CIS). Such a system should facilitate the organization of information that supports a research project in multiple aspects: going from the basic references list to the construction of a critical corps of text related with the subject being addressed. Since we were dealing with designers the option was made of working with visual diagrams to structure the CIS as well as the process of analysis/synthesis of the text. As Gray and Malins state [6] "Unlike many other disciplines, where formal logic and serial thinking are predominant, artists and designers are usually visual, lateral thinkers"(p.40). The proposed method included two distinct phases:

1. Mapping the text contents according to the central theme's diachronic and synchronic dimensions;
2. Linkage of the diagram (resultant from the text's contents mapping activity) with a critical database that would allow students to easily access different information as well as to make use of it in an efficient way in writing the thesis document.

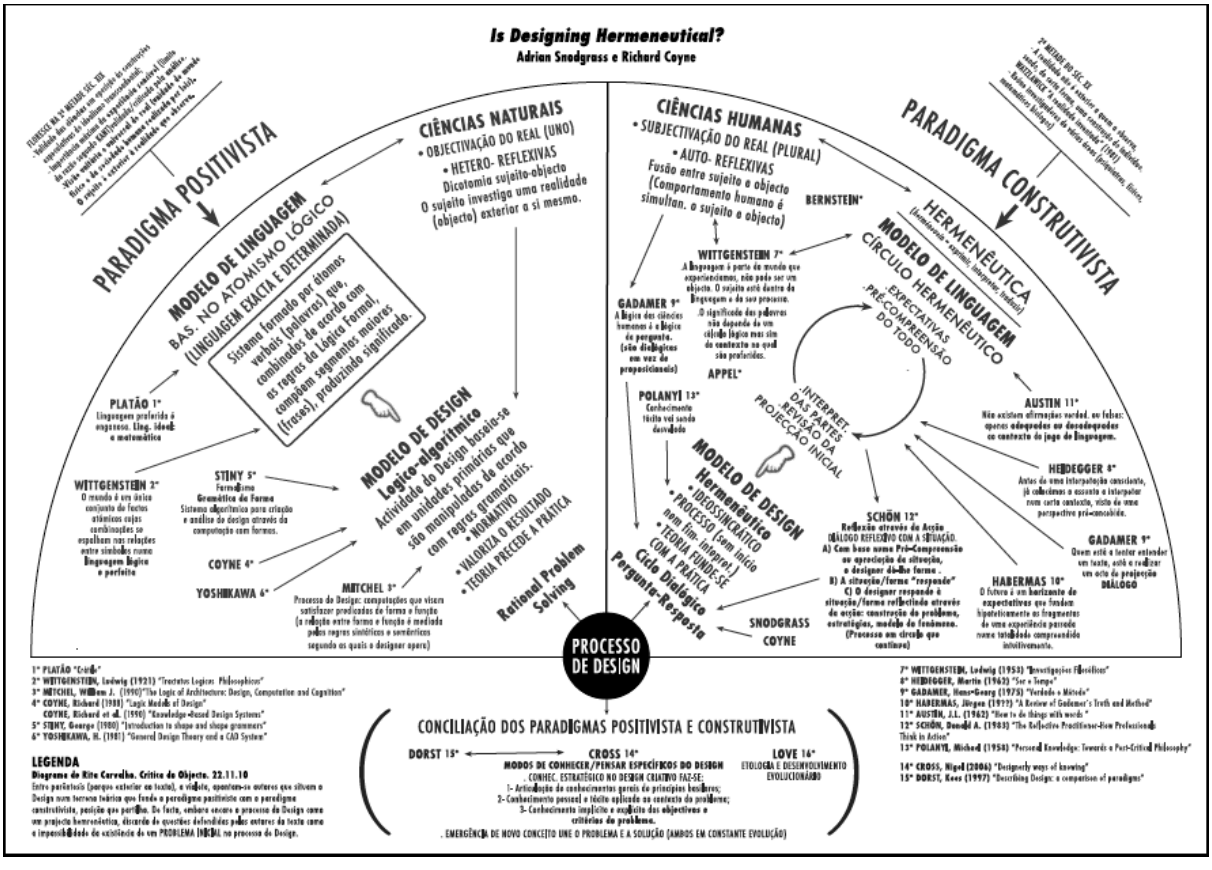

Figure 2. Example of a student's diagrams based on Snodgrass & Coyne paper's analysis

In Figure 2 an example of a student's analysis is presented. From this Figure we can understand that the student did the mapping of the information according to two axes – a vertical one dedicated to the diachronic analysis and a horizontal one dedicated to the synchronic one. It is also clear that there are two distinct approaches to the issue being discussed – the design process – and both perspectives are explored in terms of the main concepts and main authors. There is still a third perspective in the diagram that proposes to concatenate the other two views (placed in the middle down area of the diagram). It is also visible that the authors and their arguments are numbered and that has to do with the connection to be done with the database system to be created in the second phase of the exercise.

The database system allows students to access distinct data according to the criteria defined previously. Being so the student can sort lists of notes and their different authors or s/he can prefer to have quotations related with different themes that s/he has defined previously, ors/he can have a table with different perspectives on a theme to which the authors and dates related, etcetera.
Table 1 presents an excerpt of one table resultant from a database made by one of the students. The columns correspond to (1) the numbering of the notes; (2) the authors, having a colour that associates them with the perspective they have and that corresponds to the colour code in the diagram; (3) the page in which one can find the information in the paper; (4) the note made by the student which implies his/her critical judgment about the information, and (5) finally references and relevant bibliography being the last one shaded in grey.

Table 1. Excerpt of a table from a student's database

nota	autor	Pgs	notas	Referências do paper / bibliografia relevante
1	Platão	2-3	Base do positivismo. A linguagem ideal é comparável à matemática.	"A linguagem corresponde a um único grupo de factos atómicos."p2
2	Ludwig Wittgenstein	3 -4	O *tratado lógico filosófico* vem como a bíblia do positivismo lógico. O domínio da experiencia concreta não pode conter significados subjectivos.	"o *tractatus* define então o mundo em termos de um grupo de factos atómicos que podem ser expressos em proposições logicamente independentes".p3 *Tractatus Logico-Philosophicus*. Trans. D.F. Pears and B.F. McGuiness.London, Routledge and Kegan Paul, 1961.
3	William J. Mitchell	1-2	No design compara elementos gráficos a palavras que devem ser "manipulados de acordo regras gramaticais". Aqui as palavras são correspondentes a objectos e devem ser assemblados segundo regras de lógica formal.	"... the rules of such grammars encode knowledge of how to put together buildings that function adequately. Thus the relation of form to function is strongly mediated by the syntactic and semantic rules under which a designer operates. " p2 *The Logic of Architecture. Design, Computation, and Cognition*. Cambridge,Massachusetts, MIT Press, 1990.
4	Ludwig Wittgenstein	4	Contrapõe em Investigações filosóficas o que anteriormente tinha defendido. A linguagem só pode ser entendida quando inserida num contexto que não pode ser dado segundo regras positivistas.	"what one acquires here is not a technique; one learns judgments. There are also rules, but they do not forma system, and only experienced people can apply them right. Unlike calculation rules."p5 *Philosophical Investigations*. Trans. G.E.M. Anscombe, New York, Macmillan, 1958.

2.3 Survey on Student's evaluation of the exercise

One year after the exercise in class was done an electronic questionnaire was sent to the students that had participated in it. The reason for surveying students after such a long time was that we wanted to capture the student's perception of the usefulness of the method after they had experienced their own thesis' literature reviews. It is important to note that the number of students (10) filling out the questionnaire does not allow us to make generalized conclusions. Instead we are facing a qualitative study that requires the use of other methods of inquiry/research to ensure reliability of results.
In Table 2 the results of the survey are summarized.

Table 2. Synthesis of the Questionnaire results

Questions	Options	Score avg
1. Classify according to the degree of importance (1 more important**; 5** less important**) the main difficulties that you face when doing literature critics**	Identification of relevant papers	**1,80**
	Selection of information in the chosen papers	**1,80**
	Establishing priorities of paper's contents	1,20
	Content's synthesis	1,20
	Articulation of gathered contents in a coherent narrative	**1,80**

2.The method of using a diagram to map the paper's contents according to a diachronic and a synchronic dimensions proved to be useful in your literature critics process?	No	20%
	Yes	**80%**
2.1If you answered **Yes**, on the previous question, why and how?	A - It reduces the sensation of being lost in complexity; B - facilitates mental organization; C - it puts in perspective the diachronic perspective with the synchronic one simultaneously; D - improves the ability of synthesis; E – it puts in relationship in a logical and efficacious way different categories of information; F - it diminish the risk of losing information.	
3.Do you consider the method of linking a diagram associated with a table/synthesis (database) of information on the papers useful to the creation of critical thinking?	No	0%
	Yes	**100%**
	Maybe	0%
3.1Justify your previous answer	A - Easiness to access the papers in a quick and efficient way; B - better visualization of what is missing in terms of knowledge production; C - it is fundamental to organize and classify large amount of information and complex one ; D - it allows to add information and to place it 'in the big picture'; E - it permits confrontation of theories and its objective dissection; F - it stimulates critical thought along the process of reading and writing	
4. In your research process do you still make use of this method learned in class?	No	20%
	Yes	**80%**
4.1Justify your previous answer	A - It proportionates a good work's organization; B - it permits mapping not only existing texts but ones that we want to write; C - it allows reducing time in the entire process of concatenating information.	
5. If you still use the method did you made any adaptation(s) along the time?	No	20%
	Yes	**80%**
5.1If you answered **Yes** please report which adaptations were done.	A - Extended the general organization to the files in computer related with the thesis; B - make use of the checklist tables and the diagrams' reasoning in case-studies; C - improved the way information is inserted so it can be directly used in the thesis's text.	
6. Which are the criteria that you use to select information on a paper?	A - Main concepts and ideas identification; B - relevance of the theories/perspectives presented; C - referenced authors and their fields of knowledge; D - thematic approach and relationship; E - relationship of the topics with the thesis one; F - ideas that intuitively show relevance; G - degree of relevance of data (in relationship with the thesis topic).	
7. Which are the parameters used by you to classify the information collected on those papers?	A - identification of the theme; B - relevance of the content; C - new authors to consider; D - content's argument; E - main conclusions; F - information to be confirmed/expanded ; G - information that calls for a counter-argument	

In a short analysis of Table 2 it becomes evident that developing critical thinking depends heavily on quality information and the ability to make it meaningful through a flexible, creative, 'open to expansion' system that can support PhD students in their long and complex process of creating new knowledge.

2.4 Conclusions

Teaching and training critical thinking in Design research implicates a coordinated work among different disciplines. However, it is possible to address the topic through the competences and tools that should and can support this task. Acquiring competences also depends on student's characteristics, but the tools can be adopted, adapted or personally created, and that should be done with student's participation since they will be the final users of it. The competences to be worked with the students include the five ones focused by Kurland [3] as mentioned before, namely rationality, self-awareness, open-mindedness, judgment and discipline. The use of diagrams proved to stimulate in the students the training of all the areas in a very fruitful way. On the other hand the linkage of this mapping technique with a database system ensures that this visual overview can be translated in tables to which other data can be added, linked and crossed.

The critical thinker must argue based on evidence and sound reasoning. To accomplish that task s/he must have the control over its own and others' critical performance. More than developing clarity, accuracy and precision in their critical thinking mode they must guarantee relevance, depth and breadth of their assessments. To be able to guarantee such accomplishments it is important to have a supporting system that helps structuring the information in a way it can be used in its full potential.

It is also important to make this in a way that fragmentation and detailed categorization of information do not occlude the ability one has to understand the 'big picture' engaging in a continuous process of checking the whole and the parts efficaciously.

The creation of a mixed method including a visual diagram that rules the critical overview of a paper together with a database that details, categorizes and allows the concatenation of different data was perceived by students as efficient and useful in many different aspects: going from time saving to the growth and consolidation of one's ability of critical thinking.

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