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## DESIGN ACADEMIC RESEARCH IN RIO GRANDE DO SUL: APPLICATION OF DATA MINING TECHNIQUES AS A CONTRIBUTION TO SYSTEMATIC REVIEW

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### ABSTRACT

*A profile of academic research in Design in the state of Rio Grande do Sul, Brazil, is provided by techniques from Knowledge Discovery in Database (KDD). Data collection focused on the analysis of 173 theses from three Master's graduate courses in Design in the above-mentioned state. Data mining techniques retrieved a systematic analysis and often corroborated relationship with results identified by descriptive statistics or identified relationships which were not always evident in the descriptive statistical analysis.*

*Keywords: Academic research. Design Research. Systemic analysis. Data Mining.*

### 1 INTRODUCTION

Similar to Engineering, Design is the result of practice, or rather, designers started to develop their own solutions as problems emerged (DORST, 2008) and its theory was constructed on reflections triggered by design practice. According to Dorst (2008), any scientific discipline must describe its object, the activity's agent, context and process. Since the above does not occur in the case of Design, the term and its activities become rather difficult to understand. Such attitudes detach the discipline from its scientific characteristics and fail to bring about its maturity and acknowledgement as a science (NEWBURY, 1996).

The need for greater scientific rigor is not a recent issue. The first Conference on Design Methods in London in the 1960s launched design methodology as a field of investigation and triggered a relevant movement for design methods. Although it was a highly important occasion for research in Design, the consolidation of research occurred only in the 1980s with the publication of the first scientific journals such as Design Studies, Design Issues and Research in Engineering Design. Henceforth, Design experienced a significant growth in the dissemination of research results published in books, conferences, journals and productions in graduate programs.

Teaching also provided maturity to Design programs. According to CAPES<sup>1</sup>, the academic formation in Design in Brazil established itself together with the evolution of Design activities in the main urban centers of the country. In fact, the first courses in Industrial Design started in the 1950s and the rise of institutions for the development of research in Design occurred in the 1970s.

Although undergraduate courses in Design arrived later in Brazil, their expansion was fast. Growth also favored the rise of Master's programs in Design and, consequently, of a deeper research methodology. The first graduate program in

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<sup>1</sup> Document (2009) at the CAPES site, available at <<http://qualis.capes.gov.br/webqualis/principal.seam>> on 28/6/2013.

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Design took place at the *Pontifícia Universidade Católica* (Pontifical Catholic University) in Rio de Janeiro and started in 1994. The 1990s saw the beginning of new graduate programs throughout the country. This is especially true in the southern state of Rio Grande do Sul, currently exhibiting three Master's programs in Design, with more than 180 theses published between 2009 and 2013.

The dissemination of research was foregrounded on computer technology whilst the digital era made the storage and organization of information feasible (HOLLIS, 2000; FALLEIROS, 2003). Globalized and connected society access research made available on line by the scientific community (PINHEIRO, 2012).

The significant amount of stored information in such environments brought about the emergence of knowledge extraction techniques from big databases (GOLDSCHMIDT; PASSOS, 2005) formalized in 1989 under the title 'Knowledge Discovery in Databases' (GOLDSCHMIDT & PASSOS, 2005; AMARAL, 2001).

This paper, comprising a quantitative and descriptive research, describing true phenomena and establishing relationships between variables, aims at providing a profile of academic research in Design in Rio Grande do Sul, Brazil, by analyzing Master's theses between 2009 and June 2013 using data mining techniques and statistic and descriptive analyses. The paper is divided into five sections. The first section describes the relationship between research and Design and provides the teaching scenario of Design in Brazil, based on the academic methodological concern in design. Knowledge discovery in databases, its characteristics, tasks and aims follow. The third section deals with the methodology used in the study and the results collected in the current study are presented in the fourth section. The fifth section provides the main conclusions of the research presented here.

It should be noted, finally, that this work served mainly as a proof of concept, that is, an exploratory work in order to test and spread the use of data mining techniques for design research.

## **2 DESIGN, RESEARCH AND TEACHING**

Scientific research starts when an issue or a doubt is identified (KERLINGER, 1980 *apud* RIBEIRO, SILVEIRA, BISCONSIN, & ZABADAL, 2011) and this is very close to what happens in the process of Design. The search for an approach between research and Design from the 1950s ensued and even today conflicts are rife. According to Bonfim (1997 *apud* MEYER, 2008), research in Design tries to build its own field of knowledge. Since it is an all-comprehensive discipline, it absorbs and combines knowledge from several disciplines. Reaching the standards of scientific teaching is not an easy thing (BONSIEPE, 2011).

According to the International Council of Societies of Industrial Design (ICSID)<sup>2</sup>, Design may be defined as:

(...) a creative activity whose aim is to establish the multi-faceted qualities of objects, processes, services and their systems in whole life cycles. Therefore, design is the central

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<sup>2</sup> Site of the International Council of Societies of Industrial Design (ICSID). Available at <<http://www.icsid.org>>. on 11/2/2014.

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factor of innovative humanization of technologies and the crucial factor of cultural and economic exchange. Design seeks to discover and assess structural, organizational, functional, expressive and economic relationships, with the task of (a) Enhancing global sustainability and environmental protection (global ethics); (b) Giving benefits and freedom to the entire human community, individual and collective; (c) Final users, producers and market protagonists (social ethics); (d) Giving products, services and systems, those forms that are expressive of (semiology) and coherent with (aesthetics) their proper complexity. [...]. Therefore, the term designer refers to an individual who practices an intellectual profession, and not simply a trade or a service for enterprises (ICSID, [n.d.]).

According to the above ICSID definition, the practice of Design develops within a series of theoretical knowledge as that underscored by Bonsiepe (2011). The Conference at Birmingham, called The Design Method, established a common basis between the scientific method and the method of Design so that Design as a science could be established. If, on the one hand, there was an effort to interpret Design as science, on the other hand, divergences became more than evident (CROSS; NAUGHTON; WALKER, 1981).

Dorst (2008) acknowledges that Design is strongly involved in practice and it is still a fledging discipline, lacking strictness in its methodology. The above makes the construction of its theoretical basis such a difficult task. The issues mentioned by Dorst (2008) may be explained by an idea proposed by Ryle (1949 *apud* CROSS et al., 1981) who believes that there are two forms of knowledge: (a) knowing that and (b) knowing how. The former is a type of explicit knowledge which may be formulated and taught; the latter is tacit knowledge which is difficult to transmit and is only acquired through experience. Design is rife with tacit abilities and knowledge and the formation of a body of explicit theoretical knowledge is somewhat difficult.

Growth in the scientific research in Design is notorious in spite of great difficulties in bridging an approach between research and Design. According to the Area Document by CAPES<sup>3</sup>, increase in Master's and Doctoral theses, growth in postgraduate programs and the constant publication of scientific papers in Conferences and Brazilian scientific journals prove this fact (TURKIENICZ; VAN DER LINDEN, 2010). The strife lies between design and the disciplines that produced it, such as Engineering, Arts and Architecture. Indeed, it lacks its own knowledge system (CALVEIRA, 2006).

The first initiatives in Brazil to introduce courses in Industrial Design occurred in the 1950s. There are currently 338 technological courses in Design, comprising Fashion, Internal Home Environments, Products, Graphics and other, coupled to 301 undergraduate courses (MINISTÉRIO DA EDUCAÇÃO<sup>4</sup>). This high expansion extends itself to graduate programs at Master and Doctoral levels.

The first graduate program in Brazil started at the Pontifícia Universidade Católica (Pontifical Catholic University) in Rio de Janeiro in 1994 (COUTO, 2011) and other programs were introduced throughout the country in subsequent years. The GEOCAPES<sup>5</sup> database shows 14 Master's graduate programs in

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<sup>3</sup> Area Document 2009 at the CAPES site, available at <<http://qualis.capes.gov.br/webqualis/principal.seam>>. on 28/6/2013.

<sup>4</sup> Site of the Ministry of Education, available at <<http://emec.mec.gov.br>> on 25/5/2013.

<sup>5</sup> GEOCAPES tools available at <[http://geocapes.capes.gov.br/geo\\_capesds/#](http://geocapes.capes.gov.br/geo_capesds/#)> on 28/6/2013.

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Design in Brazil and three Doctoral programs (TURKIENICZ; VAN DER LINDEN, 2010). There are three Master's programs in the state of Rio Grande do Sul which produced approximately 180 theses during the last decade. The first graduate program at the Universidade Federal do Rio Grande do Sul (UFRGS)<sup>6</sup> started in 2007.

The fast expansion of graduate programs reveals research dissemination which has been triggered by the computer era due to easy access to millions of information and research sites. Due to the worldwide web, the scientific community makes available all of its discoveries and provides information to anyone looking for it. This great amount of information pushed forward the rise of automatized techniques which were formalized in 1989 by the so-called Knowledge Discovery in Database (GOLDSCHMIDT & PASSOS, 2005; AMARAL, 2001).

### **3 KNOWLEDGE DISCOVERY IN DATABASE**

Data pattern analysis has been available since the 6th century BCE. Authorities in Ancient China and Greece used quantitative analyses to govern their countries (GOODMAN, 1968 apud NISBET; ELDER; MINER, 2009). Recently, the use of the computer has enabled the storage of millions of data within digital environment, which, evidently, requires new techniques to extract knowledge and search for statistical standards and analyses (NISBET et al., 2009; HAIR et al., 1998) from data stored in an unorganized way (GOLDSCHMIDT; PASSOS, 2005).

According to Goldschmidt & Passos (2005), the analysis of huge volumes of data may be highly complex, especially for the human mind. Consequently, machines are a great help. According to Pinheiro (2008), operational data may be strategically useful for people, entrepreneurs and organizations, with high assets. Information technology which makes data storage available is currently assisted by the 1989-coined term Knowledge Discovery in Database (KDD) (GOLDSCHMIDT; PASSOS, 2005; AMARAL, 2001). KDD is defined as the process of knowledge search within a series of data (NISBET et al., 2009; AMARAL, 2001). In other words, it is a process that identifies patterns that have not been perceived yet from a determined number of data (FAYYAD et al., 1996 apud GOLDSCHMIDT; PASSOS, 2005) coupled to Mathematics, employed to discover patterns through the process of information extraction (NISBET et al., 2009).

The process of knowledge discovery starts with a great amount of data and a proposal of what one intends to discover. So that the process may be understood, the difference between data, information and knowledge must be clarified. Obtained by operational processes, data, the basis of the whole process, reveal very little (GOLDSCHMIDT & PASSOS, 2005; PINHEIRO, 2008). The analysis and treatment of these data produce information, whereas knowledge only occurs through the acknowledgement of information (FÁVERO et al., 2009; GOLDSCHMIDT; PASSOS, 2005).

Data mining is inherent to the KDD process. Its focus is the application of statistical techniques and artificial intelligence (PINHEIRO, 2008). Although it is an automatic process, it requires that the researcher finds useful information

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<sup>6</sup> Site of the Universidade Federal do Rio Grande do Sul – UFRGS, available at <<http://www.pgdesign.ufrgs.br>>. on 22/6/2013.

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(HAN; KAMBER, PEI, 2006; NISBET et al., 2009). Consequently, data mining is the extraction of potentially useful information hailing from the systematic analysis in generally noisy and unknown great databases to produce a greater understanding, find non-discovered patterns and collaborate towards choices with greater awareness (AMARAL, 2001; GOLDSCHMIDT, PASSOS, 2005; HAN et al., 2006; MCCUE, 2007; NISBET et al., 2009; PINHEIRO, 2008).

For the knowledge discovery process to be easily available, all steps involving several decisions should be complied with (AMARAL, 2001). Although each author presents different proposals, in the current analysis, four processes of four different authors have been investigated. The subsequent comparison verified similarities and divergences, which led to the definition of the stages suitable to the proposal of the current research.

STAGES ACCORDING TO AMARAL (2001)	STAGES ACCORDING TO GOLDSCHMIDT & PASSOS (2005)	STAGES ACCORDING TO CARVALHO (2005)	STAGES ACCORDING TO PINHEIRO (2008)
1. Preparation -Defining Target -Targeting data -Data cleaning and Pre-Processing -Reduction and Projection of Data	1. Pre-Processing -Data Selection -Data Reduction -Data cleaning -Codification -Enrichment	1. Identification of the Problem -Definition of the Target	1. Understanding the Problem -Comprehension of targets and needs
2. Data mining -Selection of Tasks and Definition of Target -Selection of Algorithm -Mining and search of Patterns -Interpretation of Patterns -Consolidation of Knowledge	2. Data mining -Discovery of Association -Classification -Regression -Clustering -Summarization -Detection of deviants -Discovery of Sequences	2. Discovery of Knowledge -Discovery of Relationships	2. Extraction of Data and Target Data
	3. Post-Processing - Elaboration - Organization - Simplification - Conversion	3. Analysis of Discovered Relationships - Connecting Relationships Discovered with the identified problem	3. Cleaning and Pre-Processing
		4. Use of Discovered Relationships - Decision-taking - Reaching Target	4. Data reduction
		5. Assessment of Results - Evaluation whether problem was solved or not	5. Selection of Mining Method -Identification of the best technique: Verification or Discovery
			6. Interpretation of Results

Table 1 – Comparison between KDD stages by Amaral (2001), Goldschmidt & Passos (2005), Carvalho (2005) and Pinheiro (2008).

The analysis of the stages in Table 1 shows that, despite some differences among the authors, they approach the whole process in a very similar way. In fact, some deal with the issue in more details; others, more comprehensively.

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The understanding of the process enabled the definition of the adequate steps, namely, Identification of the Problem, Preparation, Data Cleaning and Reduction, Codification, Knowledge Discovery, Interpretation of Results and Knowledge.

The next section comprises the description of each step in detail so that the aim of the current study may be reached.

**4 METODOLOGY**

The methodology of the current research comprises a systematic review foregrounded by data mining techniques. Systematic review is the integration of data and results from a great number of studies (SAMPAIO; MANCINI, 2007). Results may be conflicting or coincident and opportunities may be identified.

A great volume of data may conceal information and interesting relationships which are often found by specific software for the discovery of knowledge in databases (CARVALHO, 2005). The interest of this study is to demonstrate the possibility of using data mining techniques to discover patters in large design data, such as papers and theses. This paper used a methodology based on the analysis of knowledge discovery in databases stages described by Amaral (2001), Goldshmidt & Passos (2005), Carvalho (2005) and Pinheiro (2008), provided below:

**4.1 IDENTIFICATION OF THE PROBLEM**

The stage Identification of the problem defines what the researcher wants to discover (AMARAL, 2001; CARVALHO, 2005; PINHEIRO, 2008). The identification of the profile of academic research in Design in the state of Rio Grande do Sul is intended and the problem was identified by defining the aim of the research. The theses of three Master’s graduate programs in Design available on their respective sites were investigated so that the aim of the study could be attained. It is also limited to the 173 theses published between 2009 and July 2013, according to the distribution provided by the higher institution.

UNIRITTER	UNISINOS	UFRGS
18	48	107

*Figure 1-Dissertations published between 2009 and July 2013*

**4.2 PREPARATION, CLEANING AND DATA REDUCTION**

According to Amaral (2001), Goldschmidt & Passos (2005) and Pinheiro (2008), the so-called Data Preparation stage comprises the establishment of a series of target data which will be used for the analyses of knowledge discovery. Due to the great number of data, Data Cleaning is provided for keyboard mistakes, lack or excess of graphic accents, double words and others which may occur during



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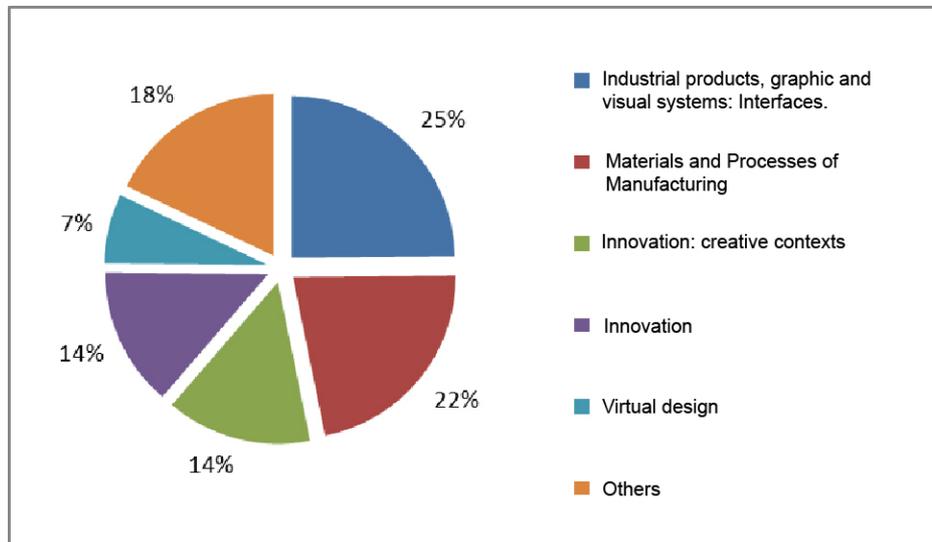
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the collected data. In the case of the RapidMiner software, possible concealed relationships were deemed to be discovered by applying the Association of Rules and Standards task which was highly adequate due to the type of data collected and to its relations with the specific target of the present investigation, or rather, seeking patterns and co-relationships among the Master's theses of graduate programs in the state of Rio Grande do Sul. Results obtained will be discussed in the following section.

### **5 RESULTS**

The results described below are presented as a proof of concept of the feasibility of using data mining techniques to continue this study to a national level. And also, demonstrate that it can be a great contribution to the design research regarding the systematic review.

Through the descriptive statistical analysis and the use of Rules and Standards Association technique was possible to present an overview of the postgraduate programs in Design in Rio Grande do Sul, Brazil, which are quite recent. This feature affects the general result of the analysis. In other words, the oldest Design Master's program at the Universidade Federal do Rio Grande do Sul (UFRGS), Porto Alegre, Brazil, ends up influencing the other programs - given the highest number of master's theses, to its great number of professors and also because it is a public university. The first analysis refers to the most predominant research areas. Graph 1 shows the five most recurrent research areas within the entire **Survey** (the three higher institutions analyzed). The two research areas with the highest percentage belong to UFRGS, followed by Unisinos, which is the second Master's program to be established in the state.



ph 1-The five most predominant research areas

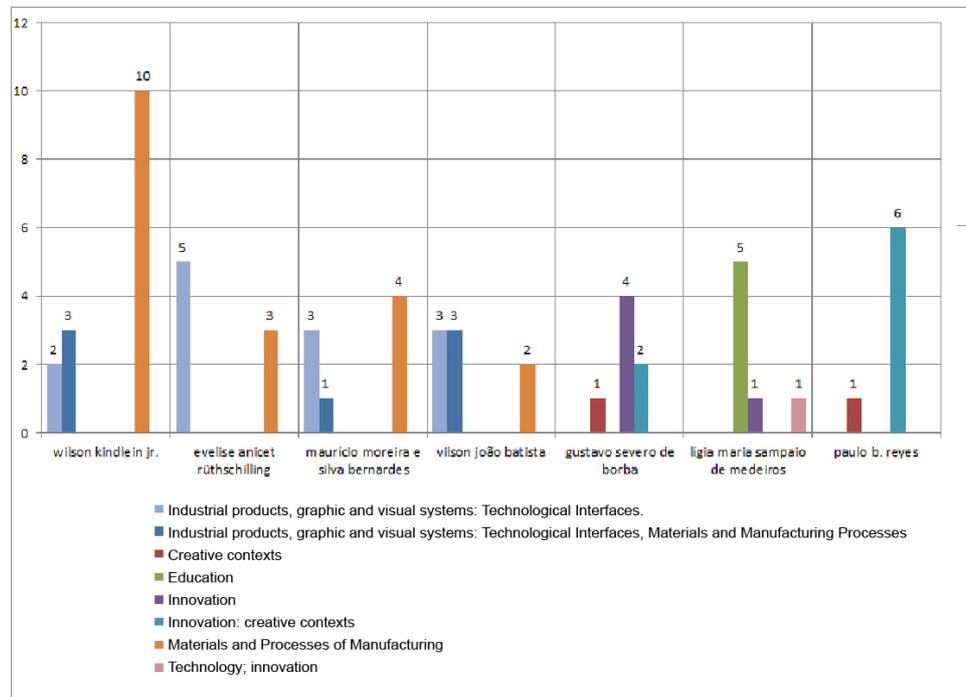
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The above predominance may be related to the supervisors and, according to what has been underscored at the start, to the period of installation of each program. For instance, four out of the seven professors shown in Graph 2 belong to the UFRGS program, with forty theses out of the 60 specifically analyzed in the graph. This boils down to the fact that the researchers of the oldest program or with the highest previous experience in supervising Master's theses or with the greatest number of students are underscored in the general **Survey** of the research areas. This information may seem unnecessary, given the number of analyzed programs that are recent in Brazil as mentioned by CAPES, however, the Brazilian educational system considers that the Master's thesis reveals what the research groups and their lines study are producing, based on the supervisors of the master's program.



Graph 2-Relationship between supervisors and predominance in research area

However, a specific analysis of each program shows that the predominant research area at UFRGS is Industrial products, graphic and visual systems: Technological Interfaces, whereas the Innovation research area is predominant at Unisinos. The later actually ranks fourth in a general classification but with high relevance in the classification per higher Institution. Education and Innovation are the most predominant research areas at Uniritter, with no underscoring in a general classification.

This study also identified 30 methodologies by the analysis and categorization of the theses. Some of them are a combination of two or more methodologies, such as **Case Study** and **Experimentation**, which are a new classification

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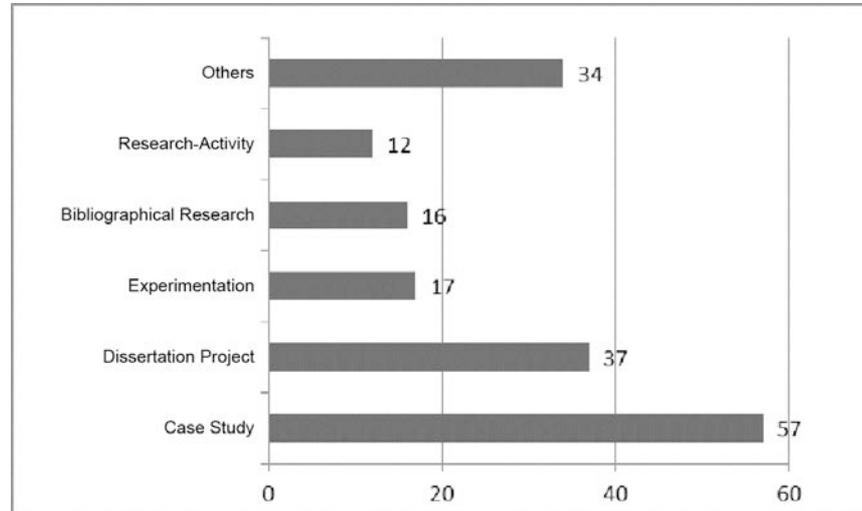
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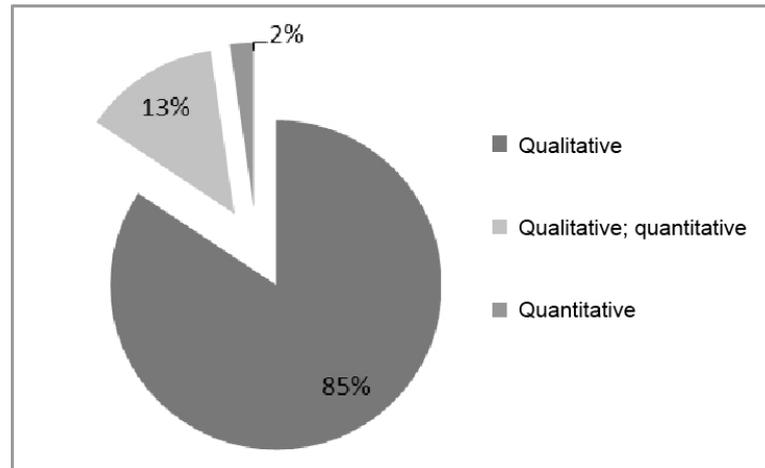
Graph 3-The most employed methodologies

according to the statistical descriptive analysis. Graph 3 provides the five most employed methodologies in Master's theses.

The most employed methodologies are **Case Study** and **Thesis Project**. The **Dissertation Project** (or **Thesis Project**) methodology is quite common in the areas of Design, Architecture, Computing and Engineering, as a way of generating specific knowledge through the implementation of a project. From there, you get often specific technical knowledge, being common as validation filing a proof of concept or prototype. The individual analysis of the Master's programs shows **Case Study** methodology is also the leader, although each program has been limelight in other methodologies. For instance, the methodology Theses Project at UFRGS was given the same emphasis as the **Case Study**, with 29% each. Further, **Experimentation** and **Bibliographical Research** were more in the limelight than the next ones. The methodology **Case Study** at Unisinos was foremost but the Research-Activity was

underscored even though second place. It should be emphasized that the methodologies **Thesis Project**, **Experimentation** and **Bibliographic Research** featured a high percentage. **Case Study**, followed by **Bibliographic Research**, with 17%, predominated at Uniritter.

Another relevant characteristic of academic research is the Data Analysis. The quality technique was highly underscored in the general **Survey** and in specific analyses. Graph 4 provides a general overview.



Graph 4-Most employed analysis techniques

Only four theses employing quantitative analysis technique could be found within a total of 173 under analysis.

Some standards that indicate the profile of academic research in Design in the state of Rio Grande do Sul were identified by the task Association of Rules and Standards, the data mining technique that aims at discovering a set of activities that occurs simultaneously and insistently in a database (GOLDSCHMIDT;

PREMISE	CONCLUSION	CONFIDENCE	SUPPORT
qualitative	UFRGS	64%	54%
UFRGS	<b>Thesis Project</b>	85%	20%
UFRGS	<b>Case Study</b>	52%	22%
<b>Experimentation</b>	UFRGS	70%	9%
2009	UFRGS	92%	14%
2011	UFRGS	66%	18%
2012	UFRGS	55%	15%

PASSOS, 2005). The table below gives some of these rules.

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<b>Case Study</b> , Innovation	UNISINOS	83%	14%
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The first rule shows that 64% of all qualitative theses hail from UFRGS; the same rule repeats itself in 54% of all theses catalogued in the database. Percentages are actually high within the context of the number of analyzed data in the current study.

Further, the predominance of the methodologies Project thesis and **Case Study** may be perceived in the second and third rules. The above information has already been detected by the statistical descriptive analysis although lacking the precision of support and confidence percentages provided by their standards. Rule 2 suggests that 85% of all the theses published by UFRGS employed the **Thesis Project** methodology and this rule is valid for 20% of all listed theses.

Despite not having any important number of recurrences in the general **Survey**, Rule 4 is very interesting for the UFRGS **Survey**. In fact, 70% of all theses employed the methodology **Experimentation** despite the fact that only 9% of the theses comply with the rule.

Percentages of rules and standards generated by the software Rapid Miner are different from the graphs produced for the statistical descriptive analyses. This is

Table 2-Identified rules and standards

due to the fact that, first, methodologies, even when combined, are analyzed separately; second, theses with combined methodologies form a new category.

Further, 92% of all the 2009 theses were produced at UFRGS and 14% of all listed theses complied with the rule. The above feature is a normal thing since the UFRGS program was the first to be installed. In 2010, UFRGS contributed with 53% of the theses, or rather 11% of all the theses listed. The publication of theses at Unisinos, characterized as the second program installed, occurred in the same year. In 2011, 66% of all the theses hailed from UFRGS and 18% complied with the rule. Similarly in 2012, 55% of the theses were published at the UFRGS, with 15% of total theses listed in the database of the current study.

The software provides the following rule for Unisinos: 83% of the theses that employed the methodology **Case Study** and which adopted the Innovation research area belonged to Unisinos. The rule represents 14% of the theses within the general **Survey**. Despite the low support percentage, the relationship between the methodology and the research area should be underlined. The standard is actually difficult to assess by statistical descriptive analysis and the rule is relevant for the number of data collected in the study.

Rules with the highest relevance provided by the software were provided above even though others were presented with low support percentage which made the rule somewhat uninteresting. The software did not generate any rule or standard for Uniritter, probably due to its very late installation date and to the small number of theses published. As mentioned earlier, it is important to remember that this study demonstrates that the use of data mining techniques may reveal even more interesting patterns, just by collecting a bigger number of data, for example, a national data collection.

**6 CONCLUSIONS**

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The current analysis identified a general **Survey** of academic research in Design in the state of Rio Grande do Sul, Brazil, with 173 Master's theses complying with criteria described in section 4. The results of the current study have been affected by the great number of Master's theses in the oldest program in Design in the state when compared to the others. In fact, UFRGS's graduate program in Design has the largest number of theses between 2009 and July 2013. Graduate programs have actually been established quite recently and comparison between 2009 and 2013 shows a natural growth.

Data mining techniques and tasks confirmed knowledge generated by descriptive statistics. In fact, 18 relevant rules could be underlined by the task Association of Rules and Standards.

A qualitative nature characterizes academic research in design in the state of Rio Grande do Sul, Brazil, and totals 85% of all the theses between 2009 and July 2013. For instance, in 2010, 90% of the theses had qualitative characteristics, similarly to 2012, when 87% of the theses had qualitative characteristics.

Only UFRGS and Unisinos programs provided theses with purely quantitative characteristics. Since they constitute a small number, they do not form a rule by data mining. The above is actually a relevant information to describe the academic research in Design in the state of Rio Grande do Sul, proving to be a state geared more to the concept and project than for statistical and large volumes of data.

**Case Study** and **Thesis Project** were identified as the most employed among the thirty methodologies listed after the reading of the theses.

**Experimentation, Bibliographic Research** and **Research-Activity** became relevant methodologies due to their growth between 2009 and 2013.

Predominance in the general **Survey** is due to research areas related to Innovation and Technology.

Table 3 shows the results of the current research study more clearly:

	GENERAL SURVEY	UFRGS	UNISINOS	UNIRITTER
Number of Theses	173	107	48	18
Year	2009-2013	2007	2008	2010
Analysis technique	Qualitative (85%)	Qualitative (87%)	Qualitative (83%)	Qualitative (72%)
Research Methodology	<b>Case Study</b> (33%) <b>Dissertation Project</b> (21%)	<b>Case Study</b> (52%) <b>Thesis Project</b> (85%)	<b>Case Study</b> (44%) Research-Activity (16%)	<b>Case Study</b> <b>Thesis Project</b>
Research area	Industrial and graphic Products and visual systems: interfaces technologies and Materials	Industrial and graphic products and visual systems: technological interfaces;	Innovation; Creative Contexts;	Education Innovation

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	Manufacture processes - both research programs of the UFRGS program.			
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Table 3-Synthesis of results

Knowledge described above refers to the general **Survey**, as it was predicted by the general aim of the current study. Besides, the results obtained by analyses, database and data structure may be of great help to other researchers in Design, not only in the state of Rio Grande do Sul, but also nationwide.

The task Association of Rules and Standards was selected because standards could be found in a relatively small amount of data. Knowledge generated by such analysis may be very useful for an institution to obtain knowledge on its own data and transform such knowledge in activities for the growth and analysis of research in Design.

A volume of data greater than that in the current study such as, for instance, a study at national level, may be interesting, coupled to the use of other data mining tasks to obtain richer information and knowledge.

The present research may be a proof of rank with regard to the use of data mining techniques for the contribution towards systematic review. Text mining will be feasible with a greater number of theses and might enable the discovery of a greater richness in details.

Finally, this current research may be considered as proof of concept, with regard to the use of data mining techniques for contribution to the systematic review. Certainly, text mining would be feasible with a greater number of theses and would make it possible the discovery of a greater richness in the details.

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