Visualization of Educational Patterns in Distance Learning

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Abstract

The Visualization of Information is used to help the understanding of different social, cognitive and behavioral aspects of the students who attend the distance courses. In this sense, different works use visual structures such as scatter plots, bar graphs, graphs, spirals and Venn diagrams, among others, to represent data stored in distance learning environments [Silva, 2006].

The present work proposes the use of information visualization techniques as a support tool to verify the number of students who finish the course and manage to finalize their thesis. The use of these techniques aims to make possible the analysis and consequent evaluation of educational standards.

For this study the data provided by the Institute Superior Técnico of the Master Course MISE.

Keywords
Visualization Information, educational patterns, data analysis, interaction

Introduction

Today there is a growing technological advancement in communications for data manipulation, as well as the growing development of the Internet.

This effect has caused people to be able to understand and transmit this data clearly and accurately. Without realizing it, we have all used data from the earliest times of man to build knowledge of the world.

But not all data the user gets is equally important or relevant or useful to them. Too much information translates into a problem in terms of understanding and / or analyzing the results obtained. In order to facilitate the analysis of the massively growing and understanding data, it is necessary to use Information Visualization techniques.

Information Visualization consists of “the use of interactive, computer-supported visual representations of abstract data to enhance cognition” (Card, 1999).

The uses of visual representations have been used as a communication tool since the dawn of humanity. With the advent of science, visual representations come to embody a meaning increasingly governed by conventions, mathematical graphs and cartographic charts. Typically, these representations are intended to communicate an idea that already exists. However, in order to take advantage of the special characteristics of human visual perception to solve logical problems, a second possible approach is to use visual representations to create or discover one’s own idea.

It is not intended to discover an idea of its own, but to take advantage of what technology has provided with regard to distance learning. According to Romani, 2006, with the most effective use of technology teachers became knowledge sharers, exchanging and building knowledge for and with students.

The number of students enrolled in classroom or traditional and online education has been increasing in recent decades. For university education globally, the student attendance rate grew by 10%. As for online teaching, the creation and popularization of MOOC (Massive Open Online Courses) in which students from all over the world can participate has contributed to an exponential increase in students. With this growth began to popularize the use of CMS (Course Management Systems) and LMS (Learning Management), tools used and designed to assist the class and move teaching online (Kay, 2013).
The distance education modality introduced new ways of mediating communication between participants, thus introducing new ways of building the teaching and learning process.

Given this scenario, the need arose to provide faster and standardized results and grades of assessment activities made by students, enabling the identification of students with low academic performance still in the school stage.

With this we will describe the contextualization of the theme describing the importance of various models of information visualization, as well as the problematization that provided the development of this study.

Therefore, starting from this context, this research is structured around the following problem: will there be any software that can help to visualize various types of information flexibly, so that the user chooses the information to view and can view patterns with the available data?

**Material and Methods**

In order to answer the question formulated for our study and in order to achieve the objective, we began by looking at the significant bibliography for the accomplishment of our work.

Through bibliographic search we find reference articles, regarding the visualization of information, both in the use of various models as techniques.

The article by Jordão, Vilma (2014) refers to a tool that allows the visualization of educational standards information, the EduVIs. This tool utilizes multi-layer and multi-matrix visualization, providing interactive comparison and filtering mechanisms.

In the article by Trimm (2012), information visualization was presented through a two-axis system and through a two-dimensional representation to differentiate colors, that is, they made a color blending approach.

Webber, Carine (2013) uses numerical data extracted from the geometry problem solving steps for information visualization and represents them using RadVi techniques, polar coordinates and Survey plots for the different dimensions and their classifications.

Throughout the research, a graphical tool, GISMO, emerges, which allows the visualization of data collected from LMS platforms. This tool is simple and functional as it offers a visualization of information that specifies the various parameters in a more readable way.

Finally dashboards show information in a more appealing and user friendly way as they are a simple and functional diagnostic tool with the ability to communicate complex amounts of information quickly and intuitively.

**Results and Discussion**

In order to find a solution we asked the MISE course coordinator to provide us with the data that would be used after processing to reach our goal.

Data refer to student code, curriculum year, assessment, semesters, school year, and course edition. Using this data, we built low-fidelity prototypes to evaluate the design and flow of navigation.

Through these prototypes we explore the different ideas of information visualization, such as the force graph, parallel coordinate visualization, Cartesian axis representation and dashboard.

Figure 1 shows us the low fidelity prototype.
The construction of prototypes allowed us to get an idea of a possible tool that would meet our goal, Qlikview. This tool is the market leader in following Business Intelligence (BI), because it allows you to create a large file with all associations between data, data cloud and also the visualization of information can be made through the most diverse tables, graphs, dashboards and scorecards. It is an interactive multidimensional analysis tool. Figure 2 shows us the attributes and dimensions of the model.
In this case the attributes relate to the student assessment data and the dimensions will be the subjects, semesters, edition, gender, student code and school year.

Using the Qlikview tool, we obtain information visualization of the data obtained, as shown in the following figures.

Figure 3 shows the tool overview.

![Figure 3 – First layout](image1.png)

Note that there was a need to create filters, as we have two school years, two editions, and fourteen subjects.

For example, if we apply a filter to the AOSI discipline, the end result would be as shown in figure 4.

![Figure 4 – Apply the filter to the AOSI discipline](image2.png)
Figure 5 illustrates a bar graph with the information on the average of class scores and standard deviation in the upper right corner.

To validate this tool, we resorted to the construction of a set of tasks that were representative of the functionality and usability of the tool. These tasks were presented to 20 users who expressed their opinion in terms of importance.

Figure 6 represents the table with tasks and average importance assigned by users to each task.

<table>
<thead>
<tr>
<th>Task</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) How many semesters are represented?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3.75</td>
</tr>
<tr>
<td>(2) Overall, which two chairs have the most students?</td>
<td></td>
<td></td>
<td>9</td>
<td></td>
<td></td>
<td>1.95</td>
</tr>
<tr>
<td>(3) What is the set of chairs involved in more positive standards in the second semester?</td>
<td></td>
<td>1</td>
<td>9</td>
<td>10</td>
<td></td>
<td>2.45</td>
</tr>
<tr>
<td>(4) Which chairs are related to the USI chair in the 2nd semester?</td>
<td>2</td>
<td>11</td>
<td>7</td>
<td></td>
<td></td>
<td>1.25</td>
</tr>
<tr>
<td>(5) Considering the students who took AOSI and USI in the 1st semester, what are the other subjects in which they were also successful in the 2nd semester?</td>
<td></td>
<td></td>
<td></td>
<td>5</td>
<td>15</td>
<td>3.75</td>
</tr>
<tr>
<td>(6) What are the common chairs for those who did AOSI in the 1st semester and failed the IM in the 2nd semester?</td>
<td></td>
<td></td>
<td>11</td>
<td>9</td>
<td></td>
<td>3.25</td>
</tr>
<tr>
<td>(7) Considering the IP chair in the 1st semester, although it is one of the subjects with the lowest standards associated, is this the chair with the least students in this semester?</td>
<td>2</td>
<td>11</td>
<td>7</td>
<td></td>
<td></td>
<td>3.25</td>
</tr>
<tr>
<td>(8) Application presented a user-friendly interface and good ease of use?</td>
<td></td>
<td>4</td>
<td>14</td>
<td>2</td>
<td></td>
<td>2.9</td>
</tr>
</tbody>
</table>
Analyzing whether the values found, users attributed a high degree of importance to tasks (1) and (5), respectively, the number of semesters represented and the success achieved by students in the 2nd semester due to the subjects they did in the 1st semester. Tasks (6) and (7) revealed to be important because they are tasks of curricular comparisons. Just as important, task (8) refers to the interface and ease of use of the tool, ie it is important without being very important for a tool.

As for tasks (2) and (3), users were indifferent to them, that is, they did not find it important to know whether the number of students or the number of subjects involved in more positive standards.

Unimportant was what users of the task (4) found, which subjects were related to the USI subject in the 2nd semester.

**Conclusion**

In short, the overall goal of the survey has been achieved as the Qlikview tool shows us a consolidated view of student assessment information, allowing its users to analyze large volumes of data in a user-friendly and interactive manner.

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