Visualising the interest in nutrition in Portugal

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Abstract

Nowadays, people are growing more concerned about what they eat and the desire to know further information about food and healthy lifestyle has increased. The Directorate-General of Health (DGS) is trying to get population informed about nutrition through their websites, the problem is that is not easy to understand if they are following the right strategy. We develop a visualisation named FoodVis, following iterative and incremental paradigm, using data about the users’ views and searches from two websites related to nutrition from the DGS, with the goal to allow them to understand the interest in nutrition in Portugal and provide to the population even better content, adapted to their needs. We have performed usability tests and case studies to validate FoodVis, which showed us that it represents a tool with a lot of potential in its context, having good values of usability and utility, fulfilling its goals.

Keywords: Information Visualisation, Websites metrics, Nutrition, Health

1. Introduction

Food-based chronic diseases are already the leading cause of death and disease in Western societies [10]. To counter this situation, the DGS is trying to make available to the Portuguese population tools that allow them to improve their health. But how do the population nowadays feed their growing interest in health, wellness and nutrition? They search for information on the web. Taking this into account they created two websites that frequently update with credible information which could promote better daily choices. However, they have difficulty in realizing if they are achieving their goals and reaching the population.

For our work we chose to focus on understanding the interest in nutrition in Portugal taking into account the data collected from two websites from the DGS. Having the data how could we get an overview of the interest of Portuguese people about nutrition or even find relevant data patterns on their visits and searches on these websites? The solution for this problem may be to apply the techniques of Information Visualisation (InfoVis). It is characterised as the area that, through the application of interactive computer graphics techniques, helps in the analysis and understanding of a significant set of data [20].

The main objective of this work is to study ways to visually identify the relevant data patterns in data collected from two websites from the DGS, focusing on users’ views and searches, allowing the DGS to understand the interest in nutrition in Portugal and helping them to improve their strategy.

In order to fulfill our goals, we created a visualisation which makes complex data easy to digest and accessible to all, more concretely the data related to statistics of those websites, collected since their creation. That way we are able to provide accurate information in an understandable way. During the development, an iterative and incremental paradigm was followed receiving feedback from DGS in each stage, with the goal that in the final they are allowed to understand the interest in nutrition in Portugal and provide to the population even better content, adapted to their needs. After the final visualisation was achieved, it was validated by a set of users to ensure that our visualisation has a good usability and meet users needs.

This paper is organised as follows, in Section 2 some results of the research done to the literature related to information visualisation in a nutritional context, followed by its discussion. Then in Section 3, the description of the implementation process will be described. The evaluation process and its conclusions are available in Section 4. The paper ends up with the main conclusions regarding all the work done, the results achieved and suggestions for future research, in Section 5.

2. Related Work

Much work has been done regarding the visualisation of nutritional data but there were not made a
lot of studies are made regarding the visualisation of metrics related to nutritional websites. Our work will focus on those metrics but since they are related to nutritional websites with nutritional information we decided to research about this area.

2.1. Web Analytics Tools
Nowadays, every company need to use tools to understand the performance of its websites. That is why there are a large number of web analytics tools available. Most of these web analytics tools are part of hosted web analytics services offered by several companies such as Google, IBM, and Yahoo.

Google Analytics \(^1\) is a free service offered by Google that provides digital analytics tools to analyse data from websites for a better understanding of the user experience.

In order to understand every step of the customer journeys, IBM has a product named Watson Customer Experience Analytics \(^2\) which is a software as a service (SaaS) solution.

Flurry Analytics \(^3\) is a software that is integrated into the Yahoo Developer Network suite of products. As a web analytics tool, it provides resources for the user to gain a deep level of understanding about your users behaviour in their apps.

Also Adobe has an Analytic Tool called Adobe Analytics \(^4\), that solution uses the data to get a real-time understanding of the business and it is specially good for large enterprises that rely on driving large numbers of end users.

Another solution is Piwik \(^5\), that tool can tackle every users’ move right is and it is very similar to Google Analytics, although unlike Google’s tool, you have to host the analytics on your own server.

2.2. Nutritional Information
All packaged foods include a label with details of the food content and composition. That information can affect lifestyle decisions and health status, but it is not easy to deal with it. Another problem is that we also consume non-packaged food and that food may not have labels. To solve those problems and to better understand what is in our food we may apply some visualisation techniques so we can explore the nutrient content of common foods through the visualisation of a nutritional database.

Nutrition Understanding Tool (NUT) by Dawson et al. \(^6\), is an example of a web application \(^5\) that uses bar charts to help users in understanding the food through exploration of both nutrients and foods, allowing comparisons between two foods.

Another approach that also uses bar charts is Newtrition by Bush et al. \(^4\), a visualisation which attempts to engage users to think more seriously about their diet choices by providing a more accessible visualisation of what they eat.

A different solution is proposed by Mah et al. \(^13\), fingerprint is a visualisation designed to compare multiple aspects of two products, specifically it is applied to the nutritional data in food items.

2.3. Food Similarity and Correlation
Another studied paradigm allows us to understand how identical are certain kinds of food and also their mutual relation.

An example that studies the similarity between nutrient content of foods and also the correlation between nutrients was developed by Kim et al. \(^11\). It is a network-based approach that can be applied to food and nutrition, which must be studied to design healthy diets.

Other study based on network analysis is FoodMicrobionet by Parente et al. \(^14\). A database which results from seventeen studies investigating the structure of bacterial communities in dairy, meat sourdough, and fermented vegetable products. It was used to analyse nodes and network properties and to build an interactive web-based visualisation.

A different visualisation proposed by Dai et al. \(^5\), Hands-On is a visualisation that is an updated version of the Dust and Magnet visualisation technique \(^19\) for large, multitouch displays that enables the users to simultaneously manipulate multiple magnets. The main goal was to allow multiple users to wade through the data, manipulating both data items and attribute strengths by hand.

2.4. Nutrition and Diet tools
In nutrition, diet is defined by the sum of food consumed by a person or other organism and dietary habits are the habitual decisions an individual or culture makes when choosing what foods to eat \(^16\). There are several tools to help guide our food consumption, and we will present some of those who try to encode the information to help the user.

FridgeNet was created by Lee at al. \(^12\) and it is similar to existing social networking websites where the main goal is promoting communication and social activity among senior citizens, encouraging the sharing of dietary information.

Another study that allows the user to understand nutritional information visually is done by Bayu et al. \(^2\). It is a mobile application using Augmented Reality (AR) technology, that could be useful for diabetes’ patients who need to control calories.

Thinking about children, Riehmann et al. \(^17\) created a different approach for visualising food in-
Information visualisation techniques provide researchers with an opportunity to take insights in an interactive and better way than ever before.

Taking into account the analysis Web Analytics Tools, we conclude that the best approach will be to use a Dashboard, with the graphs that we need, placed in different boxes since all of them also do it well and it fits in our context. That Dashboard should contain an expandable menu at the left side and a top bar with information since this is what all Dashboards that we studied have and will be more intuitive to the user. One problem identified on the Web Apps was that all of them are focused on analysing data from one source at a time, so we will try to solve this issue by providing a system that easily allows to compare data from two websites and understand which one has better results in a brief view.

With our work, we aim to solve the problems found on the visualisation of metrics related to nutritional websites and create a visualisation providing a Detailed View of our metrics, allowing to Compare metrics from both websites, providing Multiple Views of the same data to give different overviews, having Aggregation and also being of course Interactive for the user to explore freely.

To do that, we will take advantage some of NUT [6] principles, but it will be completed with relevant aspects from other studies, like the simple and clean layout used in Sage [7] even allowing multiple views, the simple overview to understand if the best results come from one website or other like we have in Fingerprint [13], and the interactivity allowed in FoodMood [7]. We will also improve those visualisations by providing new features like General Trends and Pattern Discovery methods. Our work will follow some principles of Google Analytics since it was one tool that users already knew, allowing to select a period of time and choose if we want to see this time period by Day, Month or Year, adding a new feature to also see by the Hour. Our software will be free, only with the important information for the users and easy to use by them, that aims to solve the problems found in the other Web Analytics Tools such as being too expensive and too complex.

3. Visualising the interest in nutrition in Portugal

Visualising and understanding data isn’t an easy task, taking that into account, for our work we focus on helping Directorate-General of Health in Portugal (DGS) more specifically the National Program for the Promotion of Healthy Eating (PNPAS). We created FoodVis which applies techniques of InfoVis and provide a set of ways to explore the data from two websites from DGS, individually or together, we can have information about users, searches, search keywords, the region of origin, date and time.

3.1. Initial Idea

In the early stage, our idea was the development of a visualisation using nutritional data to aid users in exploring, understanding, and analysing food data. However, after discussing with Dr. Pedro Pinto and Dr. Rui da Silva from the Order of Nutritionists, and also with Doctor Pedro Graça and Dr. Sofia Sousa from DGS, we realised that nutrient visualisation was something that already had been done by several researchers, and we identified as being more important, and with a higher level of priority, to understand the population’s interest patterns in order to support future decisions of the responsible health entities.

3.2. Understanding the requirements

Once we decided that the most promising approach would be to analyze the data from DGS websites, it was necessary to see what information we could get and what information would be the most interesting and important. We met again at DGS headquarters in Lisbon, this time to know more about the websites and to see what parameters were possible to extract. With the insight of Doctor Pedro Graça, the director of the PNPAS from DGS and Dr. Sofia Sousa, also from the team of the PNPAS, we identified concrete questions and tasks that we expect our visualisation to tackle.

3.2.1 Websites

The PNPAS is the National Program for the Promotion of Healthy Eating and was the first national strategy in the field of food and nutrition. The strategy is based on guidelines proposed by the World Health Organization (WHO), the European Commission, derived from experiences in other countries and also the retrospective analysis of previous initiatives in Portugal [10].

The PNPAS has two sites related to healthy eating: Nutrimento [8] and Alimentação Saudável [9], and it was from these two that we extracted the data for our visualisation.

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7 A public body of the Ministry of Health that positions itself as a reference for all those who think and operate in the healthcare field.
8 http://nutrimento.pt/
9 http://www.alimentacaosaudavel.dgs.pt/
3.2.2 Google Analytics

The data was collected through the Google Analytics tool which is a web analytics service provided by Google that tracks and reports website traffic. We explored it and joined in an Excel file some examples of data that could be collected and would be more important to analyse. For example: Sessions, Users, Average Session Duration, Pageviews, Total Unique Searches, Search Keyword, Geographical Data, Date and hour.

3.2.3 Problem Domain

We concluded that the most important thing would be to see: Search Keywords (view the most searched terms) and Users (number of views, which could give us for example cyclical information). They could be seen in two different granularities: Time (Year, Month, Day, Hour) and Space (Country, Region).

3.2.4 Tasks and Questions

After choosing the aspects that we were going to focus on, we had to decide which concrete questions and tasks we expect our visualisation to answer and validate them with the team of PNPAS. The selected tasks to be supported were:

1. Compare the statistics from both websites to understand if the trends of views are the same and identify the most viewed periods of the year.
2. Realize from what main regions in Portugal are the visitors of the webpages.
3. Present the most searched keywords.
4. Understand if there is some time of the year that one keyword is more searched.
5. View what are the most searched keywords in each region.

3.3. Data Gathering

The next step was get the data, cleaning and processing it. We had to analyse which data supported our tasks, so we had to decide which information from the original dataset (or datasets) we would use. Then we parsed the original data into .csv format to use with D3.js\textsuperscript{10}, chose a strategy for dealing with missing or erroneous data entries, and finally decided an appropriate data abstraction

3.3.1 How

The data is available at Google Analytics so we had to understand how could we get all the data since the beginning of the websites with all the parameters we needed.

We went with Dr. Sofia Sousa, one of the team members PNPAS, to meet with the company responsible for their websites, ActiveMedia\textsuperscript{11}. To extract the data it was necessary to have an authorisation to access the data of google analytics since it is not public and it requires authentication. They did not know exactly how best to extract all the information from the site with the parameters we needed, although they gave us some tips, and the access to the platform so we could explore freely.

3.3.2 Add-on

After searching for different ways to get the data, we realised that the best way to get such data was through an Add-on\textsuperscript{12} available for Google Sheets\textsuperscript{13}. We had to install the Add-on, and there we could create reports specifying what parameters we wanted to get and after that, we ran the reports to generate the spreadsheets with the required information.

One of the problems here is that we have more than two hundred thousand entries but each report has a maximum of ten thousands rows, and each spreadsheet has two million cells limit. To overcome this challenge we had to do different reports for each ten thousands rows. This is done until we have all available rows, taking into account that each spreadsheet can only have seven reports. After all configurations we had to run all reports. A sample of the displayed information about users on the spreadsheets is depicted in Figure 1. To get the data from the other site, all these steps must be repeated only changing the website ID.

![Initial data sample related to Users, taken from Google Analytics Spreadsheet Add-on](image)

After that we finally could join all reports and we get four different Excel files with informations about: Users from "Nutrimento", Users from "Alimentação Saudável", Searches from "Nutrimento" and Searches from "Alimentação Saudável".

\textsuperscript{10}https://d3js.org/
\textsuperscript{11}https://activemedia.pt/
\textsuperscript{12}https://developers.google.com/analytics/solutions/google-analytics-spreadsheet-add-on
\textsuperscript{13}https://www.google.com/sheets/about/
3.3.3 Parsing

To parse the data we used a script written in Node.js that reads a .xlsx file and saves it to a .json file. To obtain only information considered relevant and necessary within the context of our work, we made a Python script. After treating the data, the data sets became much cleaner, containing only relevant information. The datasets about users contain in each line information about the country (in this case there are only data from Portugal), region, year, month, day, hour and number of users. The datasets about searches have the country (once again only about Portugal), region, search keyword, year, month, day, hour and number of search unique.

3.4. Low Fidelity Prototyping (LFP)

Since our development followed an incremental and iterative approach the next phase uses a LFP to sketch our visualisation [8], taking into account the tasks and questions that FoodVis must answer. After sketching the prototype, we had to validate it with the PNPAS team before we skip to the next phase.

3.4.1 Brainstorm Session with DGS

Regarding the number of users who visited the page, the idea was to understand aspects such as: how trends varied over time if the number of visits increased or decreased if there was a month with many more views, the months in which they decreased and the months in which they increased. To apply that idea we presented to DGS two options, a Bar Chart and a Line Chart, as we can see in Figure 2.

![Figure 2: Low Fidelity Prototype - Two different options to represent number of views.](image)

Concerning search data, the idea was to present also the top of searched keywords to understand what Portuguese people are looking for. To achieve such goal, we explored three options: a Wordcloud, a Heatmap and a TreeMap as we can see in Figure 3.

![Figure 3: Low Fidelity Prototype - Three options to represent most searched keywords.](image)

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3.5. Functional Prototype (FP)

Having a notion of the graphical appearance of each visualisation and also the data that we need, we created the first functional prototype. Since we are following an iterative and incremental model, each cycle consists of design, test, measure, and redesign. The evaluation was made by the members of the PNPAS through direct observation and think-aloud technique followed by a briefing about FoodVis. These cycles were repeated until we achieve the Final Visualisation.

3.5.1 First version

At a first stage each visualisation was individually developed and later on incorporated together on a single page. We started to focus on questions related to Users and after with Searches.

The technologies used were: HTML for the pages construction, CSS for its styling, JavaScript and jQuery for overall interactivity across the page, Bootstrap\(^{14}\) to build the responsive page layout, gridstack.js\(^{15}\) a plugin to allow the widget layout with drag-and-drop and resize options which also works with touch devices, SweetAlert2\(^{16}\) a responsive and visually appealing way to do popup boxes, and finally, D3.js a library for manipulating documents based on data for constructing the visualisations.

As we had two dimensions (two websites), we chose to use the colour blending where each different data is represented in a distinct colour and then when we have both of them at the same time, we could use a colour that consists of blending its properties colours. Based on the study made by Gama et al. [9] we choose to blend green and yellow as in Figure 4.

![Figure 4: Colour blending example with chosen colours.](image)

After individually develop the three graphs of Users view we incorporated them together, with each one of them in a different box that we could drag and drop, resize or minimise and the dashboard is also responsive to the screen sizes. We added a feature on the Bar Chart to order the bars from the higher value to the lowest and when we move the mouse pointer over the bars of Bar Chart, the squares of Heat Map or the districts of the Map, details on data points are displayed next to the view.

We start implementing the option of compare districts by clicking in some region on the map which should update the Bar Chart to have stacked bars for each selected district and a list at the bottom of the map with the districts names. At the top of this list, we have the option to remove all selected districts because it is easier when we select many of them but we can also remove one at a time, by clicking again on it. We chose to modify the scale in each interaction because if we kept it and choose some district with low values, we were not able to observe it.

We need to choose twenty colours because we have twenty districts to achieve all the colours we needed we took into account a palette of 12 colours suggested by Ware [21] focusing on: Red, Green, Blue, Pink, Cyan, Orange and Brown, varying the saturation, or saturation and lightness of these colours.

By clicking on a bar of the bar graph, the user will see the data only for the clicked period, the bar graph itself is updated for that period and also the Heatmap and the Map of Portugal. To remove all these filters, we added a button that says Remove all filters by clicking on it, the dashboard changes to present all the available data since the beginning date until the ending date. The default type of view is by month, so if we were in a different type it will be changed too.

![Figure 5: Functional Prototype - First version.](image)

At the end of this phase our prototypes was like Figure 5 and once we were following the incremental, iterative methodology, we felt it was time to schedule a new meeting with the DGS to test this cycle of development, introducing to Doctor Pedro Graça and Dr. Sofia Sousa this first version of the functional prototype.

3.5.2 Second version

Given the feedback received we began to make changes and develop the features that were still...
A bar with information about what data we are viewing, whether we are seeing the number of Users or Searches, the time period that is being presented and still how the data is grouped, was added at the top of the main page. We add the logos on the top bar of the websites that we are analysing, and also added a bottom bar with all requested logos and links.

Now time can be filtered by clicking on the bars or by choosing the start and end date to view through a calendar, available at the top of the page. The date can be entered via a text input or by clicking on the desired day in the calendar.

On our sidebar we have three main options that could be expandable to select what we want: Dashboard, where we can select which dashboard we want to see, if we want the view related to the number of Users who visited or the dashboard of the Searches made; Dataset where we may select which data we want to view, if we want only the website “Alimentação Saudável”, only “Nutrimento” or both; Group by is where we can also select the presentation type of the Bar Chart and Heatmap, if we want data grouped by Year, Month, Day or Hour. Another thing we changed was the green colour to the green used in the DGS logo.

At this moment, we updated FoodVis to calculate always the min and max values according to the view. That means that we always have some element with the colour of darkest green, the one with the highest value and one element with the grey colour which is the one with the lowest value.

Another option was added to the map of Portugal, besides being able to remove all the selected districts (Remover todos), now we can also select all the districts (Selecionar todos) at once. The options of adding/removing only one region by clicking on it remain available, the difference is that we have two quick accesses if we want to remove or select everything.

After that, we met again with the DGS to show the adjustments made as well as the new functionalities before we proceeded with development. In this meeting, we made another formative evaluation to check if this version of the prototype continued to meet users needs and to verify users intentions while using the system. For doing this we used essentially the direct observation and think-aloud techniques. We needed to collect and then make sense of the stream of notes made while watching users in a controlled environment [15].

3.5.3 Final version: FoodVis

After the meeting with DGS, we started to develop wordcloud since it was the only graph missing and that would answer us to the remaining questions. We made a script in Python to process the data, and the first step was to normalize the keywords strings using the method normalize that returns the Unicode Normalization Form of a given string in our case using the Unicode NFKD. This removes all numbers, accents and non-unicode characters and we add an option to also convert all uppercase letters to lowercase, but it is not enough because although it solves the problem of having the same word with upper and lower case, with accents and without accents, for example, it does not solve the singular and plural problem, writing errors and multiple keywords together in one, for example.

So the second step was to find a way to solve our problem, and we thought about two possible solutions: Lemmatization and Stemming, after a search we concluded that Lemmatization would be a better option to our case [1], but we faced another problem: we didn’t find an algorithm to Portuguese words that fits exactly on what we needed because most of them are for other languages. We decided to create our algorithm based on a Lemmatization List, so we created a Dictionary with each correspondence, and our script reads our keyword and finds out in the created Dictionary, what is the Lemma. For the cases that are not predicted by the algorithm, we have chosen to add the correct correspondence manually.

After this we could finally move on to programming the wordcloud. We decided to use the same colour scheme we had in the remaining charts. In all cases the word size is proportional to the number of searches performed, this is a most searched word will have a larger size. As DGS asked us, we inserted an option for the user to choose the number of words that he wants to see each time.

When we pass the mouse over a word we can see the information about what word it is and how many occurrences it has but if we click on some word we may see how the searches of the selected

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![Figure 6: Functional Prototype - Search dashboard.](image)
word vary through the time, as we can see in Figure 7, and all the charts are updated. To remove the selected word, the user just has to click on it again, just as it does with the selected districts on the map. The colour used to highlight the selected word had to be different from the colours used to highlight the select districts because we don’t want to confuse the user, taking that into account we choose to use the Purple colour.

In the Dashboard related to the searches the differences related to the Dashboard of the visits are also that: if we change the period of time the words of the wordcloud are updated to the ones referring to the selected period, otherwise if we select one district, we will see the most searched words in those district. Basically, graphs are synchronized.

At the last meeting, two things that DGS asked us to include were a button to download the graphic, and also to make it more explicit what we were seeing. In this way, we have chosen to add an option to download and now the title is always visible so we do not lose the context, unlike previously that it was only showed when the chart was minimised.

3.6. Architecture

To develop our solution, we used a layered architecture because this approach supports the incremental development of systems, it’s changeable and portable [18]. In Figure 8 we present our layered architecture with three main layers.

Users only interact with the User Interface Layer, which is composed of three layers, the View Layer which is the actual page, the Styling Layer where all style is stored and the Scripts Layer, which stores Foodvis’s idioms management and construction logic. The user starts by accessing FoodVis website from any computer connected to the Internet using a standard browser. For each users interaction, the active visualisations make data requests to the Business Logic’s layer, this layer identifies which data is needed for each request and claims it to the Data Layer. Those files were previously generated from .xlsx files and processed by a Python script. After fetching the required data, information flows backwards, and the visualisation is then created, applied the respective styling and finally rendered to the users visualisation.

4. Evaluation

After finishing the last cycle of development, a set of users tested FoodVis in order to gather quantitative and qualitative usability metrics to ensure that our visualisation meet the users’ needs and our initial goals. The evaluation consisted of two components: Usability Tests and Case Studies.

4.1. Usability Tests

When the final visualisation was achieved, a group of twenty users tested our system, FoodVis. Users were presented with a list of tasks, and their performance was evaluated through quantitative measures: the time it takes the user to do the task, the number of errors made, if any, and the level of satisfaction while doing such tasks.

The evaluation degrees were as follows: a preparation stage where all necessary materials were designed and created, the actual testing following a well-defined protocol, and after, the analysis and discussion of the gathered results was done.

The five questions randomly asked to the users were:

1. During the year of 2016, the month in which the website "Alimentação Saudável" had more visits was the same month in which the website "Nutrimento" had more visits? If so, please indicate which was the month.

2. Compare the visits made by the district of "Lisboa" with the visits made by the district of "Faro" in the website "Alimentação Saudável". In the month that more visits were made by the districts, how many were from the district
of Lisbon and how many from the district of Faro?

3. What is the most searched term on both sites?

4. Considering the searches made on the website "Nutrimento", in what month was the keyword "Sport" most searched?

5. What are the ten most searched keywords in the district of "Faro" on the website "Nutrimento"?

Each task was considered to have a correct result when the user rightly answered to the question, not having any help in its accomplishment, unless the user gets lost for a long time. While the user were performing the task to answer each question, the response time and the number of errors made were noted, and at the end, the SUS questionnaire was answered.

By analysing the test results, we consider that the system’s objectives were achieved. FoodVis allows a quick perception of the data about the population’s interest in nutrition in Portugal and that the interaction is intuitive since in the tests performed the number of errors is low. It is also possible to conclude that the system has a good usability, reaching 91.13 points in the SUS being considered as having an excellent usability [3].

4.2. Case Studies

FoodVis has also been evaluated by two DGS members who are part of PNPAS and who will use the system, Doctor Pedro Graça and Dr. Sofia Sousa. This was made to understand if it was useful, functional and it had a good usability and unlike the previous evaluation, in the case studies we do not measure the time or errors, only comments made aloud were recorded during the free use of the system by the user.

Basically, this test consisted of simulating navigation tasks that will be performed in the use of the system. The task development process consisted of performing the task on the part of the user, following the approach of saying aloud what they are thinking and what they intend to do, commenting on the interactions they were having with the system. This is useful also for us to understand what they thought that is more relevant, and what they found useful in the system.

Dr. Sofia Sousa thinks it is very useful to be able to see the most searched terms, she said, "This is very good! We can see what people are looking for on the last month for example, then we may analyse if we are responding to these searches.”.

Doctor Pedro Graça was also very enthusiastic about the final system, saying: "We have a lot of interesting stuff here! This is like seeing a disease in an organism that is still alive, it is much more interesting to see it in vivo than in vitro”.

They both thought the system was really interesting to them since they had never been able to do anything like this and considered it very important these days. Through FoodVis they can adapt the contents of the websites, understand the interests of the population of Portugal about nutrition and respond to their needs.

4.3. Discussion

Considering all all the described evaluation results, we may confirm that FoodVis was successfully accepted among users, that way we may validate all the work done during FoodVis’s development process. Furthermore, by being able to answer all purpose questions and a high SUS score the evaluation assured this dissertations main goal which was: to study ways to visually identify relevant information about the interest of portuguese population in nutrition, contributing to understanding their needs, and look for possible improvements on the information shared.

5. Conclusions and Future Work

Food is an essential part of our life and it is not easy to understand the nutritional information and what is the best for our health. FoodVis is an information visualisation system that provides information about metrics collected from two websites related with nutrition that belongs to the DGS. It consists in an interactive dashboard with interlinked views that provide to the user different views on the existing data, allowing pattern discovery, compare, get a detailed view and understanding the trends.

In the development of this system, we followed iterative and incremental approach in order to understand if the prototype kept meeting users needs and to verify the users’ intentions while using the system. FoodVis can be accessed from any computer connected to the Internet only using a standard browser without any previous installation, it has a drag-and-drop mechanism allowing the users to change the default dashboard layout and also minimize or resize some graph. All these mechanisms are responsive, automatically adapt themselves while maintaining the current information context and provide to each user a personal and richer experience.

When the final visualisation was achieved, a group of twenty users tested FoodVis. The usability of the system was considered asExcellent. Our case studies verified that FoodVis was in agreement with its objectives, it answered all proposed questions and is easy to use.

Future work includes adding new metrics, the improvement of the back-end to have an easier what to gather the data from Google Analytics and keep
the system up to date. Also, new idioms should be considered to be integrated within FoodViss dashboard. In the Wordcloud a deeper processing of the keywords could be made and new features like searching and groups of terms could be added. It could as well have new ways of decreasing user proneness to error when they had to change between dashboards, as also, improve the top bar finding another way to clarify which data they are seeing and in which dashboard they are, and later carry out new usability testing to validate such research.

References