

On the Possibilities of Applying Dashboards in the Educational System

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Abstract – Dashboards are widespread model for data visualization in business and are now a mandatory feature of all business systems. At the same time, there is no widespread perception and application of this feature in the educational system. In this article, we look at the features of the dashboards and the opportunities for their perception and application in the educational system - in decision-making, as well as in the educational process. An analysis of the adaptation and implementation of the information dashboards in the Bulgarian universities has been made. The main aspects of the successful implementation of dashboards are extracted.

Keywords – Visual pattern, dashboard features, implementation aspects.

1. Introduction

In the current stage of ICT development, the search for easy and fast transformation and revealing the 'hidden' information is essential for making decisions about improving the quality of information exchange both within the organization and between organizations. Undoubtedly, the processing and transfer of information flows and the associated information congestion require the search for better selection and visualization approaches to improve information values and to reveal implicit links in the information presented.

One suitable option is the information dashboards. A dashboard is a visual pattern that provides access to many different sources of information or represents different aspects of a single data source. Data visualization is an intensive computational process. There are many approaches to speeding up the calculations so that the visualization of a large amount of data is less CPU greedy. In order to maintain the best performance and perception, some might consider reducing the precision of the calculations based on the perception thresholds and the constraints on visual rendering [1]. Proper data visualization can help managers or employees make decisions and perform the necessary actions. Data visualization should highlight the answers to already-known questions. They are dynamic, interactive, and are not limited to just one piece of information. They provide a single look at key information. Developing dashboards as part of enterprise or academic/educational web applications can be a long and difficult process. Today, there are several services on the market that offer dashboards, so we can talk about the dashboard as a service [2].

The process of developing the dashboard is data-driven and repetitive. We can distinguish between the following steps: refine the questions that a dashboard needs to answer, get data, transform data, and visualize. Dashboards are a must-have part of any enterprise software system like ERP, CRM, SCM, and so on. Every manager is tempted by up-to-date and easy ways to retrieve information, but dashboards do not replace old-fashioned reports – they develop and complement them.

Although dashboards are very popular in business, they are not widely used in education. However, they can be successfully applied in the educational systems at different levels of analysis and visualization: (1) education management; (2) management of the educational process; (3) accreditation, assessment and inspection of the institution; (4) realization of inter-institutional relations at different levels; (5) promotion of community-based activities and educational services. In this paper, we look at the features of the dashboard and the possibilities for their adoption and

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application in the processes that require full visualization and improving awareness.

2. Dashboard Types and Features

There are studies that draw attention to the various possibilities of systematization and subsequent classification of the main types of information dashboards according to different principles, which most often direct the attention to the possibilities for obtaining information and the purpose that determines it. St. Few gave the first official definition of the Dashboard in [3]. According to that definition, “A dashboard is a visual display of the most important information needed to achieve one or more objectives; consolidated and arranged on a single screen so the information can be monitored at a glance.” An improved version of this definition focused on the interactivity of the dashboards was proposed by O. Yigitbasioglu and O. Velcu in [4]. According to them, a dashboard is a “visual and interactive performance management tool that displays on a single screen the most important information to achieve one or several individual and/or organizational objectives, allowing the user to identify, explore, and communicate problem areas that need corrective action”. This definition emphasizes their interactivity and refines its purpose. In terms of visualization, the boards can be static or dynamic. Static dashboards are often like printed reports and only give information for a certain amount of time. Dynamic dashboards (mostly web dashboards) visualize live data from data warehouses, making them interactive and user-friendly.

Regarding the designation again in [3] St. Few distinguishes three main types of dashboards, determined by their purpose – analytical, operational and strategic dashboards.

In the system of pre-school and school education and in higher and university education operational dashboards can be used as a tool to obtain timely information on the ongoing implementation of processes in the organization that allows for a partial assessment of the effectiveness. These dashboards should be designed in such a manner as to visualize the data in real-time so that immediate monitoring of the process dynamics can be realized in a short period of time.

The analytical type of dashboards should be given the opportunity to process large amounts of data as they are extracted. Their analytical information makes it possible to take into account trends in terms of achieving results in different directions. In the analytical dashboards, the information is of a more global nature, its updating can be realized in longer

periods of time and they are consistent with specific types of requests.

Strategic dashboards provide the opportunity to monitor only the key management-relevant process indicators in the particular institution. They make it possible to set both short and long-term goals related to updating and improving the quality of the processes at different levels of the institution.

Although the desirable functions of the interface of the information dashboards are known, however, some of the basic principles in the implementation of the dashboard are often violated. Each type of information panel has common features that can be summarized in Feature Oriented Domain Analysis [5] (or FODA) chart (see Figure 1).

The design of the user interfaces on the dashboard is one of the major challenges. It includes analyzing how to sort out huge amounts of information on a single screen in a way that is meaningful and informative to the user. This is perhaps the most important feature of the entire dashboard system. If the user interface fails to show the information in an effective way, then it will remain unattainable, and the dashboard as a means of supporting decision-making would be useless [6].

As already mentioned, the most common option for the implementation of information dashboards is the web-based one, as it allows a much more flexible and customer-independent realization. Web Dashboard is a visual template that is data-loaded in real-time, or upon user request or at scheduled timespans. Upon request, the client decides when it needs specific information and interacts with the dashboard to obtain it by expanding or refreshing it. Real-time data appears on the dashboard as soon as the server (or service) sends the new data batch to the client. Both scenarios can be mixed at a given time in order to obtain a different perspective or precision of the visualized data. With the introduction of Web Sockets technology [7] real-time web applications implementation become groovy.

Dashboards visualize different types of data, so they need to support at least some of the basic data presentation methods, including geo-spatial, hierarchical, categorized, correlated, time series and distributions. Each of these presentation formats is suitable for visualizing a particular type of data. These methods are related to basic types of graphics such as maps, breakdowns, gratings, scattered lines, lines, and histograms. Of course, there are other types of graphics that are used in more specific areas or duplicate the ones listed. In order to provide the best appearance, perception and interaction with the data, appropriate types of graphics should be used in dashboards, applying certain visual principles such as gestalt, metaphor, etc. With the introduction of HTML5 canvas [8], various graphical visualizations

of the diagrams and their transformation has become a much easier process.

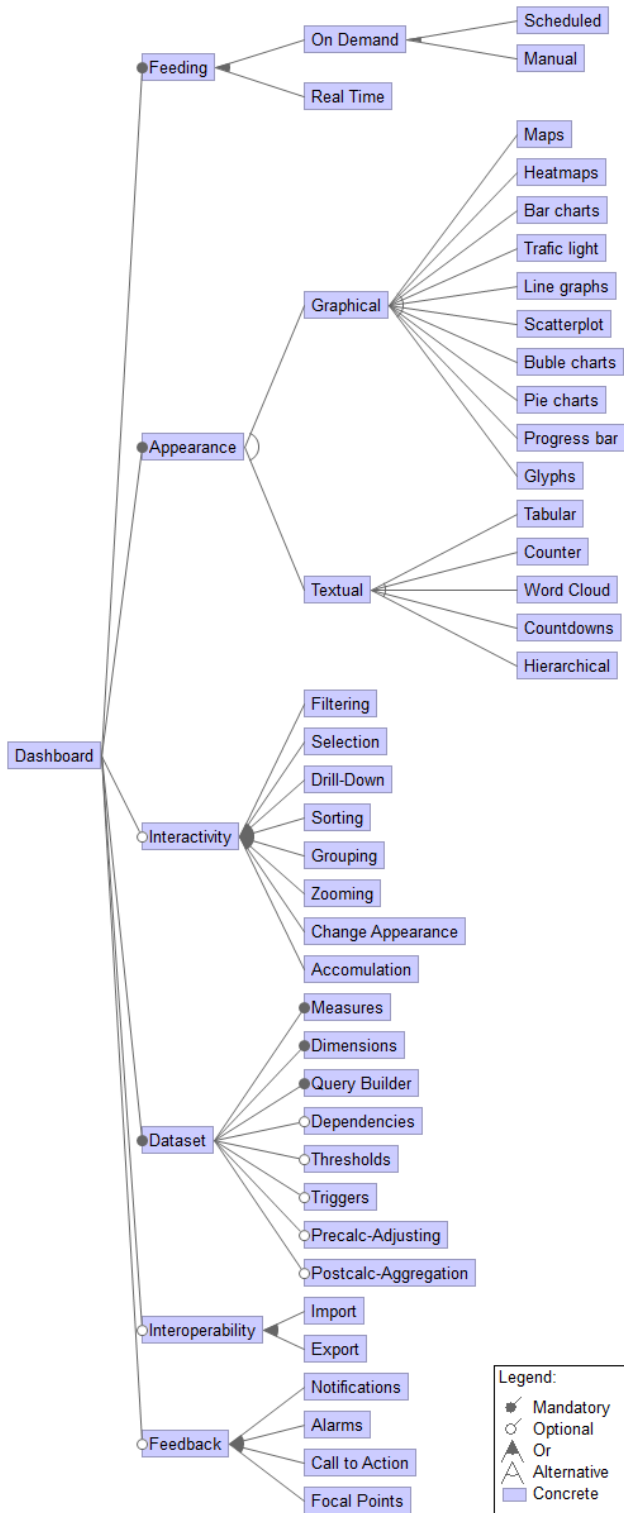


Figure 1. Dashboard Features Diagram

The main groups of visual principles listed in Table 1 are derived from R. Pettersson [9], and are relevant to the creation of dashboards with a view to their full application.

Charts themes can be exploratory with high interactivity and explanatory without interactivity. In order to provide users with control over different data

representations, appropriate interactive controls should be used. Interactivity, in the sense of self-service for users, allows you to dynamically interact with the data and visualize a different view of data or different data that affect specific user requirements.

Table 1. Visual Principles

| Area | Principle |
|----------------|---|
| Functional | 1) Defining the problem, 2) Providing structure, 3) Providing clarity, 4) Providing simplicity, 5) Providing emphasis, 6) Providing unity. |
| Administrative | 1) Defining the problem, 2) Providing structure, 3) Providing clarity, 4) Providing simplicity, 5) Providing emphasis, 6) Providing unity. |
| Aesthetic | 1) Harmony, 2) Aesthetic proportion. |
| Cognitive | 1) Facilitating attention, 2) Facilitating perception, 3) Facilitating processing, 4) Facilitating memory. |

At the same time, users must have access to their dashboards regardless of the physical location. Therefore, the dashboards must be adaptable to a different screen size to provide mobile access to any data source. The simultaneous use of current and accumulated data is important in order to allow analysis of the changes (deltas), trends and possible change of metrics or scale.

In [2] some of the main objectives of the dashboards are outlined as follows:

- Information dashboards require consistency. They can show information from different units in a single view of uniform metrics;
- Information dashboards allow monitoring performance and load;
- The dashboard can be used in strategic planning;
- The dashboard can be used to communicate with important stakeholders.

D. Parmenter in [10] identifies four types of indicators in the business sector:

- The Key Performance Indicators (KRI) give a comprehensive overview of the way the organization operates;
- Result indicators (RI) show leadership how teams combine to deliver results;
- Performance Indicators (PIs) tell management what is delivered by the teams;
- Key Performance Indicators (KPIs) tell management how the organization performs

its critical success factors and, by watching them, the management is able to dramatically increase productivity.

In the education system, key performance indicators are the success and motivation in the learning process, the scientific achievements and the realization of projects, etc.

3. Areas of Application of Information Dashboards in Education

Many governments around the world are opening their data as part of their commitment to open government strategy. These data become an extremely valuable source for analysis. The opening of the data is also valid for higher/university education, and for now it is more typical of American universities. A good example of the application of dashboard technology is the University of California (see Figure 2).



Figure 2. University of California Dashboard (source: <https://www.universityofcalifornia.edu/infocenter/>)

The reorganization of education systems in different countries and the search for opportunities for the integration of different information systems also draws attention to a number of studies related to the applications of educational dashboards. A study conducted for Romanian universities describes management dashboards as a finishing element in the design of the university portals [11].

D. Kabakchieva, in [12] notes that information dashboards are poorly represented, and the information is often collected in a short notice mainly in reporting format. Globalization processes require academic management to take operational decisions based on aggregated information entering online mode by monitoring trends.

At the national level in Bulgaria, the only dashboard available in the field of university education is the Rating System of the Universities in Bulgaria and its data is updated on an annual basis.

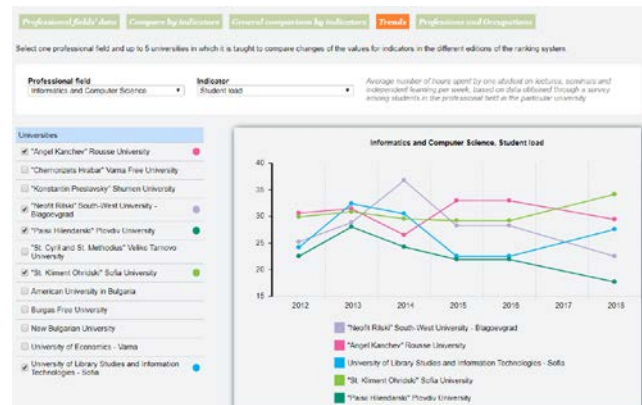


Figure 3. Dashboard of the Universities Rating System in the Republic of Bulgaria (source: <https://rsvu.mon.bg>)

The information dashboards would find appropriate application in the applied system of criteria for institutional accreditation [13] of the Bulgarian universities, regarding the Quality Assurance Standard according to the criteria related to the availability of a documented, publicly announced, official status and accountability policy as a part of the strategic management of the educational institution in the interest of the public needs. The data processing of the information at the universities homepages is facilitated by its straightforward and cohesive organization, which, however, only provides basic awareness of the characteristics of the academic and educational environment [14]. Such an application can also be found on the criterion of the existence of a developed policy for the provision of qualitative academic staff, which is part of the institution's development strategy, in the visualization of the profile and qualification of the teaching staff, as well as in the academic staff research. Dashboards will also be used to cover the level of awareness of the Learning Resources and Student Assistance standard, especially in the Information Management standard, where information on the activities of internal structures for the development and implementation of quality assurance policy is collected and analyzed, involving external stakeholders as well. The creation of a public information system with different levels of publicity can be successfully based on dashboards where universities publish information on their activities, including programs, which is clear, accurate, objective, up-to-date and easily accessible. This model of external accountability, using dashboards for management, means that universities set their performance indicators for public control.

The short survey among ten Bulgarian universities reveals the following picture, which requires a more in-depth study. Most of the universities surveyed claim to use dashboard for visualization and management, but in most cases they are related to the IT infrastructure management. With regard to the educational process and information provision to students, there are mainly dashboards for the admissions campaign and partly in the electronic learning platforms. In the research sector (publications and citations), the dashboards are partially applied, and in most cases the data feed is not automated. Significant is the fact that in the meetings of the management and operational working groups, mainly tabular reports and PowerPoint presentations are used, with sporadic use of dashboards, which are mostly static. There is also a clear tendency for the development of information dashboards to be part of the information and management strategy.

4. Toward a Successfully Implemented Dashboard

Dashboards are a visual design pattern that combines components (dashlets) that can be interconnected or self-contained. The dashboard is powered by data from different sources via a hub (service), with which the components (dashlets) exchange synchronously or asynchronously, delayed or in real time. Interactivity can be defined at both levels – individual dashlet and dashboard. The latter is based on the dependencies defined between the components. The data that you visualize can be processed both in the hub and/or during visualization.

There are also dashboard implementations as stand-alone systems in the organization's information infrastructure. For the successful implementation of a dashboard in an infrastructure, whether as a stand-alone element or as part of a particular software solution, the following aspects should be considered:

- Data Adaptation – very rarely a dashboard displays data from a single source. Adaptation to the different formats is necessary for data to be processed for visualization.
- Adaptation of the visualization – the variety of visuals often makes it difficult to choose the right presentation. Adaptation implies evaluating variants that are available for visualization, which again reflects on the data format.
- Navigation Adaptation – Interaction in a dashboard can be divided into two groups - the first in terms of the data defining the set of actions available with the dashboard at a time, and the second in view of the manner in which

it can be implemented. Dashboard navigation is an intensive process in terms of computing and communication (through dashboard hub down to the data sources).

- Supporting context – The context of the dashboard is determined by the selected sources, the current users, the selected indicators, and the navigation actions performed so far. Maintaining a complex context directly affects cognitive integration. By means of it in the different components (dashlets) on a dashboard, the various aspects of the related data are interpreted and visualized.
- Managing complexity – To successfully implement a dashboard in management processes, it is essential to manage complexity that has several major dimensions:
 - Economical graphical visualization through a small number of symbols and notations;
 - Semiotic clarity through unambiguous compliance and clear use of graphic symbols and metaphors;
 - Dual presentation/encoding of information – textual and graphical – when it is not possible to easily extract information from the graphical data presented, the possibility to display it and the text option is important. It will not always be possible for the data to be sufficiently "contrasting" in their perception;
 - Perceptual discrimination – the ease of distinguishing between different visual elements;
 - Semantic transparency – the extent to which the meaning of a symbol can be determined by its appearance;
 - Visual expression – the number of visual elements and parameters that build the visualization;
 - Cognitive fitness – Adaptability of visualization considering the type of audience/users;
 - Visual detail – the drill-down feature in the details is only an opportunity that is needed when it can reveal more information. Maintaining the optimal level of detail will reduce the information noise.

5. Conclusion

The search for opportunities for the full management of information in the education system and rich visualization for its timely use, as well as the possibilities for continuous encoding and decoding form a process that will be directly related to the

quality assessment in the educational institutions. The need to access information conveniently, quickly and cost-effectively through a variety of IT management systems makes it essential to develop and use new technologies to create, manage and use databases in educational institutions at different levels. The dashboard as a technology solution makes it possible to create, maintain, retrieve, and instantly provide up-to-date information on the right place, at the right time, at the lowest cost for use in decision-making of varying order, as well as in various procedures related to quality assessment or publicity of information.

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