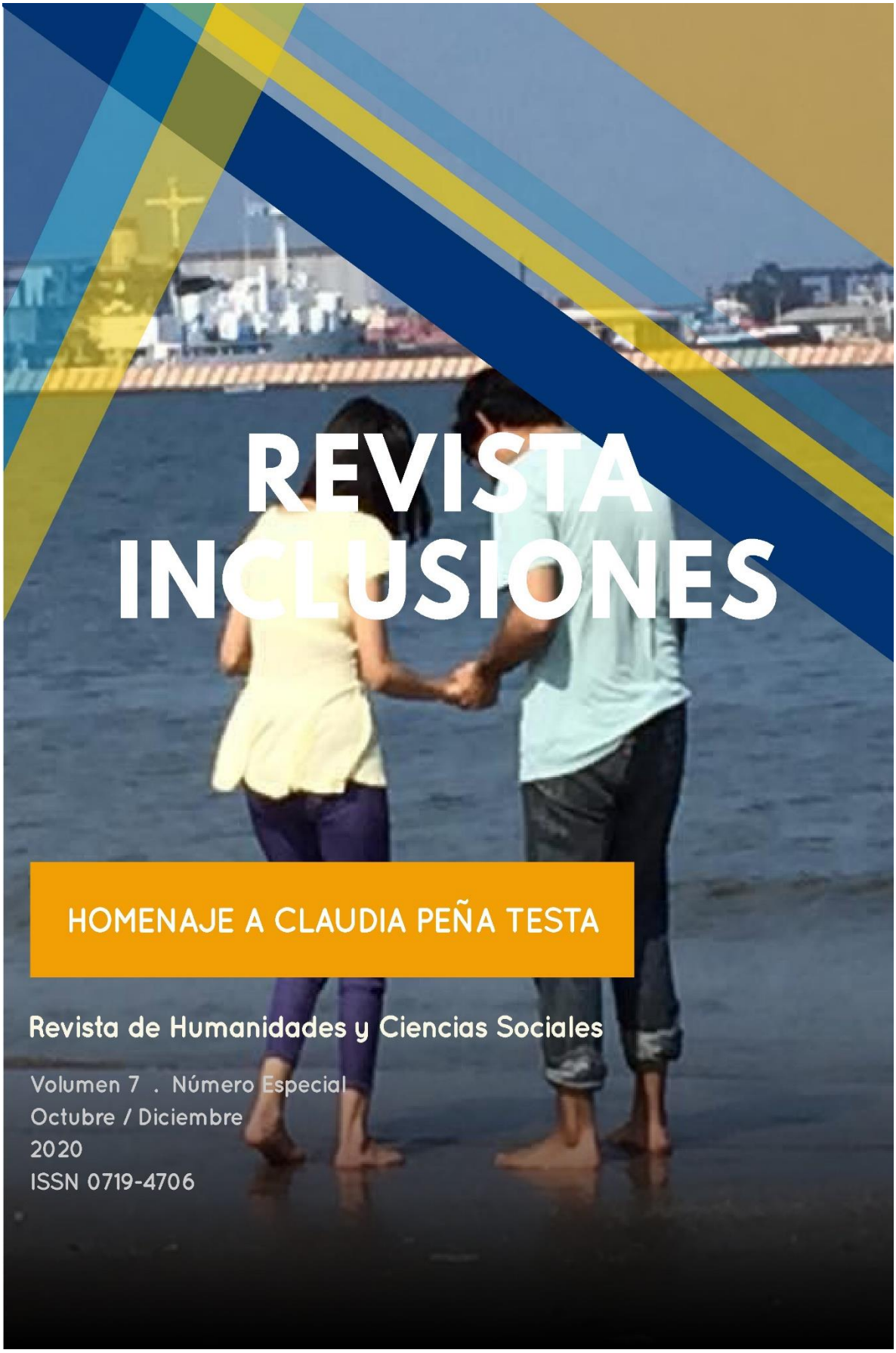

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INFORMATION TOOLS: OPPORTUNITIES OF BI PLATFORM TO EVALUATE EDUCATION QUALITY

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Abstract

This work is aimed at determination of opportunities of BI platforms as a tool of quality evaluation of higher education. Main results. This article determines the trends of application of BI platform as an information tool to evaluate education quality. It has been established that BI provides uniformity of metadata for all tools and unified user-friendly methods of searching, acquisition, saving, reusing, and publication of metadata objects. OLAP enables end users to analyze data by means of rapid requests and predictions, whereas the simulation and Data Mining allow to classify and to rank information on the basis of regulations. As exemplified by separate BI platforms, the BI opportunities are analyzed, as well as comparative criteria of various platforms, and the trends are revealed to use BI platform as information system of decision making for managers in educational sphere.

Keywords

Business Intelligence – BI platform – Data storage – Multivariate data analysis – Data mining

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Introduction

The problem of research. Accumulation of abundant data exerted its impact on development of innovative technologies allowing to apply data for comprehensive analysis of relevant processes, revealed trends, quality control and other important indicators[1]. Modern requirements resulted in transformation of simple search and statistic data processing into complex analysis of accumulated information. Such analysis was aided by development of analytical tools, such as Business Intelligence (BI) tools, the main aim of which is provision of end users with procedures of structuring abundant data, analysis of company activities in real time, arrangement of reports of any level of complexity.

These software tools can be applied for evaluation of education quality in higher schools. On the basis of the obtained indicators, using any BI platform, it is possible to visualize ready reports, to develop multidimensional analysis of the predicted indicators, to compile various user reports without involvement of IT experts[2].

Literature review

Researchers characterize education quality from various perspectives (Table 1).

№	Approach	Specification
1	as political category	accumulates fundamentals of state educational policy at certain stage of its development and main strategic lines of development of national education system in the context of world trends[3]
2	as social category	reflects social ideals of education regulatory defined and legally fixed in state standards[4]
3	as managerial category	determines strategies of influence on certain functional indices of educational system and selects possible ways to vary its development[5]
4	as educational category	is a quintessence of the following: 1) essence of concept; 2) diagnostic procedures; 3) analysis of phenomena and properties of education subjects. In this regard it should comply with: a) personal and social goals of education; b) political strategy of its development

[1] J. V. Stepanova; I. M. Tararin; N. V. Kudryashova; D. I. Stepanova y V. V. Velobragin, “Visualization technologies in the study of computer science by university students: improvement of educational success”, Revista Inclusiones Vol: 7 num Especial (2020): 602-614 y E. Medkova, “Analysis of Semantic Approaches and Perspective of Cultural Codes in Teaching Education in General”, Utopía Y Praxis Latinoamericana Vol: 25 num Extra 5 (2020): 163-178.

[2] C. Del Sordo; R. Orelli; E. Padovani y S. Gardini, “Assessing global performance in universities: an application of balanced scorecard”, Procedia-Social and Behavioral Sciences Vol: 46 (2012): 4793-4797

[3] L. Schindler; S. Puls-Elvidge; H. Welzant y L. Crawford, “Definitions of Quality in Higher Education: A Synthesis of the Literature”, Higher Learning Research Communications Vol: 5 num 3 (2015): 3-13.

[4] J. Parri, “Quality in higher education”, Vadyba/Management Vol: 2 num 11 (2006): 107-111.

[5] J. Cullen; J. Joyce; T. Hassall y M. Broadbent, “Quality in higher education: From monitoring to management”, Quality Assurance in Education Vol: 11 num 1 (2003): 5-14.

		in the context of Russian and global trends; c) regularities of education management at various levels[6]
5	as result	Is quality of a person fixed by the following categories: educated person, competent person[7]

Table 1
Various approaches to the notion of education quality

J. Biggs[8] believes that the objects of study of education quality can be students, teachers, educational entity. Each of these objects should be provided with its own parameters (criteria), methods, and measuring mechanisms, on the basis of which different results are obtained. Moreover, such results are not combined and not compared with each other. Existence of such results is not a basis of management of education quality: analysis of results is based on their comparison with predefined targets. K.-L. Krause[9] believes that provision of optimum conditions (professional, research and procedural, material, financial, legislative, sanitary and hygienic, etc.) is common for the quality of education at different levels of management as well as for fully featured operation and continuous development of educational system and educational entity, which influences significantly education quality. P.T. Knight[10] stresses that improvement of education quality is the obligatory condition of improvement of living conditions, the basis of economy upgrading, development of culture of innovative thinking, declaration of fundamental values of human existence.

Aiming at management of education quality, as stated by J. Cullen, B. Hassall[11], it is necessary to develop the following management structure: data acquisition from possible social customers; formulation of social order; selection of education paradigm; definition of parameters to evaluate the results of education; forecasting of educational results of each student; comparison of required results with actual ones and mode of higher school activity; comparison of the acquired results with diagnostically formulated targets, thus, determination of education quality.

All aforementioned issues can be implemented using BI software and platforms[12].

According to the researchers' opinion[13], BI is a set of theories, procedures, architectures, and technologies converting input data into meaningful and useful information

[6] L. Schindler; S. Puls-Elvidge; H. Welzant y L. Crawford, “Definitions of quality in higher education: A synthesis of the literature”, Higher Learning Research Communications Vol: 5 num 3 (2015): 3-13.
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[9] K.-L. Krause, “Addressing the Wicked Problem of Quality in Higher Education: Theoretical Approaches and Implications”, Higher Education Research and Development Vol: 31 num 3 (2012): 285-297.
[10] P. T. Knight y M. Yorke, “Employability and Good Learning in Higher Education”, Teaching in Higher Education Vol: 8 num 1 (2003): 3-16.
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[13] A. A. Mohamadina; M. R. B. Ghazali; M. R. B. Ibrahim y M. A. Harbawi, “Business Intelligence: Concepts, Issues and Current Systems”, International Conference on Advance Computer Science Applications and Technologies (2012): 234-237.

for business aims. An important property of any BI platform is capability to solve wide range of problems: whether it is a complicated report or nonstandard plot, nonstandard arrangement of system interface or supplemental options, data integration and much more[14].

BI is the basis of modern Decision Support System (DSS). Such systems are often denoted as DSS/BI or just BI. While developing such systems, any company should be concerned about such subsystems as Data Warehouse, OLAP: Online Analytical Processing, Data Mining, and others[15].

According to the classification by D. Hedgebeth[16], the BI software is based on functional tasks, where software of each class executes predefined set of functions or operations using specialized technologies.

I. M. Nofal and Z. M. Yusof determine BI software as follows[17]:

- in wide sense (conventional determination), it is a set of procedures, processes, architectures, and technologies converting input data into meaningful and useful information which is used to make efficient decisions regarding strategy, tactics, and company activities;

- in narrow sense, the definition of BI stipulates consideration for two segments: data preparation and data usage. Therefore, in the narrow sense BI is a set of procedures, processes, architectures, and technologies, which use the result of information management for analysis, reporting, efficiency management, and information delivery.

Herewith, in university environment BI is a working tool for officers of all levels: deans adopting strategic solutions; heads of faculties adopting tactical solutions and managing educational process; ordinary analytics preparing solutions in local spheres on a daily basis[18]. Provided that neatly all university staff operates with BI systems, visualization and simplicity of report compilation are very important[19].

In general, promising trends of development of analytical constituent of BI product marketing are aimed at speed of data processing. In the case of future growth of data amount, the use of BI accelerators is allowed[20]. These accelerators can coexist with regular BI platforms on expanded service-oriented architecture. BI accelerator software is installed on highly efficient devices in order to satisfy demands from numerous active users upon request processing.

[14] V. Trieu, “Getting value from business intelligence systems: A review and research agenda”, Decision Support Systems Vol: 93 (2017): 111-124.
[15] R. S. Sharma y V. Djiaw, “Realising the strategic impact of business intelligence tools”, The journal of information and knowledge management systems Vol: 41 num 2 (2011): 113-131.
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[20] H. Chen; R. H. Chiang y V. C. Storey, “Business Intelligence and Analytics: From Big Data to Big Impact”, MIS Quarterly Vol: 36 num 4 (2012): 1165-1188.

This article is aimed at analysis of capabilities of BI platforms as a tool of evaluation of higher education quality.

The research objectives are as follows:

- comparative analysis of BI platforms;

- analysis of main capabilities of selected software products.

The research hypothesis is as follows: BI platforms as a tool of information management can be used for evaluation of higher education quality.

This article is comprised of Introduction, Methods, Results, Discussion, and Conclusion.

Methods

The research was carried out from August 1, 2020 to September 20, 2020.

In order to compare BI platforms, a list of the most important criteria was arranged.

Taking into consideration that more than twenty BI platforms are available at the market, on the basis of preliminary analysis[21] we selected six BI platforms for comparison: SAP BusinessObjects, Tableau, Oracle**,** Microsoft Power BI, MicroStrategy, IBM Cognos.

At the first stage, the published analytical data in the considered field were studied.

At the second stage, the questionnaire was developed including questions concerning functional peculiarities of BI platforms, opportunities of their use in the education sphere.

At the third stage, the experts were interviewed online according to the developed questionnaire. The survey was carried out in the Russian language on September 15, 2020.

The main analytical method was expert survey in the considered sphere. The experts were asked to fill in the semi-formalized questionnaire on a voluntary basis. Thirty-five experts participated in the survey: employees of IT companies involved in implementation of BI technologies, as well as university staff more than for 5 years implementing digital technologies into management of higher schools. All participants in the survey were informed about the aims of the survey and about intention of the organizers to publish the results in generalized form.

Results

According to the experts' opinion, three forms of digital academic entrepreneurship with participation of students are distinguished (Table 1).

[21] C. Olszak y J. Zurada, “Information Technology Tools For Business Intelligence Development in Organizations”, Polish Journal of Management Studies Vol: 12 num 1 (2015): 132-142 y A. Sabanovic y K. S. Søilen, “Customers’ Expectations and Needs in the Business Intelligence Software Market”, Journal of Intelligence Studies in Business Vol: 2 (2012): 5-20.

The results of comparative analysis of the selected BI platforms are summarized in Table 1.

Comparative criterion	SAP BusinessObjects	Tableau	**Oracle**	MS Power	MicroStrategy	IBM Cognos
Platform specifications						
Russian localization	+	-	+	+	-	+
Russian website	+	-	-	+	-	-
Russian community	+	+	-	+	+	+
Free demo version	+	+	+	+	+	+
Operation in private cloud	+	+	+	+	+	+
Linux servers	-	-	-	-	+	+
Support of mobile devices	+	+	+	+	+	+
Russian language courses	+	+	-	+	-	+
Expert appraisal by five-point scale						
Technical support	5	5	5	3	4	3
Scalability	5	4	3	4	4	4
Big Data support	4	5	3	5	4	4
Customer access	5	5	5	2	5	5
Interface	4	4	4	3	2	4
Integration	4	5	4	3	4	4
Visualization	4	4	4	4	3	4
Simulation and analytics	5	5	2	4	4	3
Administration	4	5	4	4	3	4
Development environment	5	4	5	5	4	3
OLAP support	5	5	2	4	5	5
Expert subjective appraisal by five-point scale						
Implementation opportunity	5	5	4	3	2	2
System complexity	4	5	4	4	4	2

Note: on the basis of expert survey.

Table 1
Comparative analysis of BI platforms

On the basis of the comparative analysis of the seven BI platforms, two leading platforms were selected for more detailed discussion and analysis: 1. Tableau; 2. SAP BusinessObjects.

Discussion

Let us consider the main capabilities of the selected software.

At present, among the considered BI platforms, Tableau BI is the most successful in simplification of user access to data analysis. It is based on the following technologies.

Tableau is comprised of the tools which allow to develop reports and to combine them into dashboards, to implement the reports into other network applications, to make forecasts and to arrange trends of development of educational entities. Tableau provides simultaneous operation with data from several DBMS, it can be integrated with tools for operation with Big data[22].

According to the experts' opinion, the Tableau platform is characterized by the following advantages:

- it provides well implemented data visualization,

- it has one of the most convenient user interfaces to develop reports with drag-and-drop option,

- it can process and analyze huge data arrays (billions of lines).

Concerning disadvantages of Tableau, the experts mentioned incomplete support of Russian, unavailability of embedded ETL solution.

SAP BusinessObjects BI (hereinafter: SAP BI) proposes wide range of verified completed BI solutions, including products for data integration and quality, as well as text analysis. All SAP BI products are transformed to common platform in order to increase safety and improve administration, integration of various products, provision of convenient exchange of metadata and conversion from one product to another. At basic level, SAP BI is comprised of BI platform and arrangement of business warehouse (SAP BW)[23].

SAP BI provides technical infrastructure required for services in the mode of analytical data processing, development of application for planning and management of data acquisition. The infrastructure is comprised of the following tools:

- analytical processing of online data and data for prolonged period in real time (OLAP). OLAP is the mechanism allowing to obtain extracts and fragments of these data (multidimensional analysis);

- Metadata Repository makes it possible to obtain access, to use and to generate reports on metadata (data details) related with data of warehouse and its objects;

- business planning and simulation (BW-BPS) is a characteristic module of planning, which allows to create planning scenarios covering overall enterprise using web application aiming at rapid development of reports;

- analysis process designer (APD) is aimed at combination of data from different sources, it reveals hidden regularities in data;

[22] J. Pablo y Z. Salgador, “Data Analytics with Tableau: The Trend Lines Models”, SSRN Electronic Journal (2018): 1-18. Available at: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3282727

[23] SAP BusinessObjects Business Intelligence Suite Document Version: 4.2 Support Package 4 – 2018-11-15. Available at: https://help.sap.com/doc/4f6c0512515d48e884444d0671980060/4.2.4/en-US/webi42sp4_user_guide_en.pdf

- Reporting Agent allows to arrange list of selected reports created in background mode;

- business warehouse (BW) provides data access and allows to convert them into useful information;

- administration workbench (SAP AW) provides management of infrastructure[24].

SAP BI server includes the so-called staging machine which controls data loading and processing, as well as SAP BI databases, where the main data, variables and metadata are stored. In order to transform data into suitable for storage form, it is required to prepare the data using extract, transform, and load processes (ETL).

SAP BI platform has been mentioned by the experts because at present, SAP is one of the leading developers of BI products which are applied upon solving the most complicated problems. The experts believe that a user of SAP BI, by means of requests to data, can create really complicated reports and forecast large number of indicators. SAP BI has its own embedded ETL tools operating with data, which, on the one hand, accelerates the process, however, imposes some constraints onto efficiency. SAP BI mobile applications have wide range of options and are supported by iOS and Android. The experts participating in the survey highly evaluated the SAP BI interactive dashboards. Module architecture of SAP BI and large number of add-ons make it possible to individualize flexibly each solution according to formulated tasks.

Therefore, the experts point out that in BI systems, in order to evaluate education quality, the following main categories of functions should be obligatory implemented:

- possibility of integration: BI infrastructure, metadata management, development, work flows, and collective work;

- data presentation: reporting, information panels, nonplanned requests, integration with Microsoft Office;

- data analysis: OLAP, expanded visualization, forecasting simulation, resulting protocols.

The main trends of BI development in the sphere of education, according to the experts' opinion which in general agrees with the conclusion by the researchers[25] though with certain differences, are as follows:

1. cloud computing (Cloud-BI): suppliers provide their own sites for development of analytical applications, administration of the system and, when required, its scaling-up;

[24] Building Reports with the SAP BusinessObjects Web Intelligence. Available at: http://centervideo.forest.usf.edu/boe/boe03.pdf

[25] E. U. Ilaltdinova; G. A. Paputkova; I. F. Filchenkova; I. B. Bicheva y T. F. Krasnopevtseva, “Comprehensive Readiness Exam of Bachelors of Pedagogical Education in the Structure of the Independent Assessment of the Quality of Education”, Universal Journal of Educational Research Vol: 8 num 8 (2020): 3381-3386.

2. open-source BI: such BI systems have the same advantages as other open source systems, starting from lower initial costs and more flexible support to integration opportunities;

3. nonrelational in-memory BI: the tools not requiring DBMS, they use their own mechanism of data processing based on in-memory principle and assuming data loading into RAM with subsequent processing of analytical requests in real time.

Conclusion

New strategy of higher education should be based on improved quality and efficiency of training. As a consequence, backgrounds are developed to increase competitiveness among universities, hence, to improve education quality.

This article determines opportunities of BI platform to evaluate education quality. It is established that BI provides uniformity of metadata for all tools and unified user-friendly methods of searching, acquisition, saving, reusing, and publication of metadata objects. OLAP enables end users to analyze data by means of rapid requests and predictions, whereas the simulation and Data Mining allow to classify and to rank information by setting regulations.

As exemplified by separate BI platforms, the BI opportunities are analyzed, as well as comparative criteria of various platforms.

The obtained results have confirmed the hypothesis that the BI platforms as a tool of information management can be used for evaluation of higher education quality.

It would be reasonable to devote further studies to detailed testing of existing BI platforms as an analytical constituent of management of educational entities.

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