The Appliance of OLAP and Microsoft SQL Server Analysis Services in the Analysis of User Behavior Patterns

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***Abstract* – This paper describes the use of OLAP and Microsoft SQL Server Analysis Services in the analysis of behaviour patterns. The research was conducted at the Technical Faculty in Cacak. The aim of research is the adaptation of traditional teaching and the concept of e-learning by the students patterns of behaviour. The future work relates to the obtainment of detail information about students' behaviour in the learning management system.**

***Keywords* – Olap, Microsoft SQL Server Analysis Services, e-courses, behaviour patterns**

I. INTRODUCTION

Analytical solutions are quickly becoming mission critical for many organizations. Recently in educational environments, e-learning solutions have been growing and developed rapidly. A critical problem facing e-learning is the lack of relevant and timely information. As information cost money, it must adopt innovative approaches to attain operational efficiently [1]. Nowadays, most universities, colleges and high school are vitalizing their teaching through e-learning platforms benefiting from their many advantages.

E-learning can be used on all levels of education and are used just as well in the combination with the traditional teaching as in the distance learning. That is why the knowledge about the users of electronic courses is essential for understanding their ways of learning and their learning approach. In order to obtain this, it is of essential importance to discover and analyze their patterns of behavior.

Analysis of users' behavior patterns can be used for new model designing that can be of high importance for understanding of users' behavior in virtual environment. E-learning systems accessible through the Internet are intranets that represent self contained versions of the data warehouses and human behavior found more broadly across the Internet [2]. In this study were used OLAP for extracting useful information and evaluating of user profiles. In addition here are used Microsoft SQL Server Analysis Services.

In [3] OLAP was applied to get information for learners observing interactions with the system. According to paper [4] data mining and warehousing are the two most important techniques for pattern discovery and centralized data management in today's technology. In [4] is defined e-learning model while stressing the importance of data mining in e-learning. In [5] is shown how to create OLAP cube and the operation with the cube. A concrete example of the cubes in this paper was applied to data relating to the online learner.

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II. OLAP AND MICROSOFT SQL SERVER ANALYSIS SERVICES

Microsoft Analysis Services are a collection of Online Analytical Processing (OLAP) and data mining services supplied in Microsoft SQL server. Analysis services provide managers the possibility to explore a cache of collected and current data, define business trends and patterns and mine data to make discerning business decisions. Clients communicate with Analysis services using the public standard XML for analysis (XMLA), a SOAP-based protocol for issuing commands and receiving responses, exposed as a Web service. Data mining presents analysis of observational data sets with the purpose for detection of undetected links and data summing in a sophisticated manner, understandable and useful for data owner. The relations and summings that are obtained by the data mining process are defined as models or patterns. Microsoft Analysis Services is part of Microsoft SQL Server, a database management system. Microsoft has included a number of services in SQL Server related to business intelligence and data warehousing. These services include Integration Services and Analysis Services. Analysis Services includes a group of OLAP and data mining capabilities. Analysis Services provides managers the possibility to explore a cache of collected and current data, define business trends and patterns and mine data to make discerning business decisions. Microsoft SQL Analysis Services (MSAS) relies on Windows accounts for granting access to cube data as well as for administrative tasks such as processing cubes, altering server-wide configuration settings and modifying dimensional objects.

A dimension is the major analytical object. Dimensions have attributes, and they have relationships with facts. Their reason for being is to add qualitative information to the numeric information contained in the facts. Figure 1 shows Analysis services architecture.

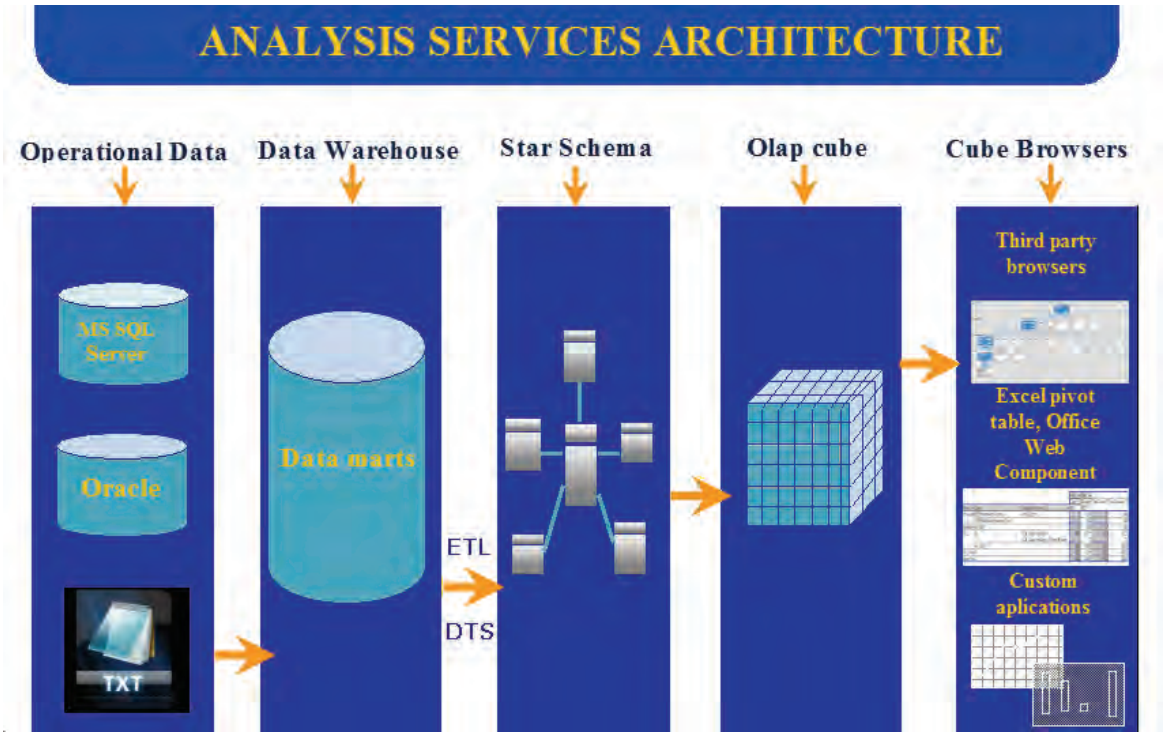

Fig. 1. Analysis services architecture [6]

III. Purpose of the Study

A learning management system (LMS) is a software application for the administration, documentation, tracking, and reporting of training programs, classroom and online events, e-learning programs, and training content [7]. However, LMS doesn't allow detail monitoring of the users' activities. In order to consider the complete teaching process that includes the usage of electronic courses within a specific LMS, a thorough analysis is a must. OLAP and Microsoft SQL Server Analysis Services are used in this study in the purposes of analysis of users' patterns of behaviors.

The objectives of the research:

- Data pre-processing: clean and prepare the Web server log file
- OLAP analysis: design a multidimensional structure in which the main factors under analysis:(year, month, day, time, minute, course, and modul activity) will be taken as dimensions and later build OLAP cube in order to analyze the recorded data.
- Pattern evaluation: determination of behaviour patterns based on obtained reports and their evaluation

The goal of the research:

- Professors will have an insight in students' patterns of behaviour and according to them thy will have a chance to organise their classes by using other concepts such as concept of e-learning.

The goal of research: Professors will have an insight in students' patterns of behavior and according to them they will have a chance to adapt their classes

Hypothesis: The activity of students in electronic courses on different modules varies during different days of the week

IV. Methods, Participants, Tools and Procedures

In order to detect and analyze behavior patterns, OLAP (On Line Analytical Processing) have been used in this study. In addition to OLAP were used Microsoft SQL Server Analysis Services.

The study was conducted at the Technical faculty in Cacak. In this case, traditional method of teaching is being combined with e-learning with the assistance of Moodle LMS (http://itlab.tfc.kg.ac.rs/moodle). This Moodle system and e-courses are designed to provide teaching material to students, and activities that provide collaborative learning.

System registered 1789 active users. One hundred of courses have been created within the system, and these courses are being used by students and/or teachers as well.

For purposes of this research are used Microsoft Visual Studio 2008 and Microsoft SQL Server 2008.

The procedure suppose that is used data pre-processing (clean and prepare the Web server log file), and OLAP analysis (design a multidimensional structure, and later build OLAP cubes in order to analyze the recorded data). After that, in

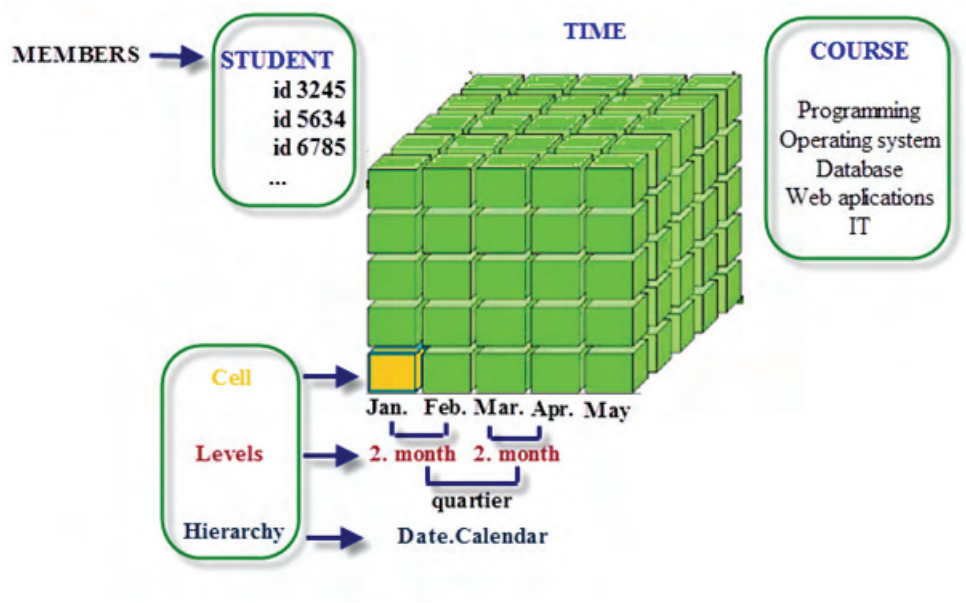

Fig. 2 Olap cube

Microsoft SQL Server Management Studio is prepared reports. To determine the activity of students during the different days of the week, all data were randomly selected for two weeks. After that are created the dimensions and cube.

Creating dimensions and cubes leads to the final phase of work in Microsoft Visual Studio 2008. Figure 2 shows the Olap cube. This phase involves deployment solutions. Deployment solution passes several phases, and the result is to be successfully completed deployment to continue the work within SQL Server Management Studio.

V. Results and Discussion

In this section are given the result of the research. Visualization of results is done in Microsoft Excel 2003.

Figure 2 shows the activities of the modules during the day of the week. Numbers from 1 to 7 indicated seven days a week and this Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday, respectively. On the x-axis is shown the actual number of activities or access logs of a given module. According to this figure, it can be concluded that students, for example, this week, had a different activity in various modules in the course.

Figure 3 shows the activities of the modules during the day of the second selected week. Numbers from 1 to 7 indicated seven days a week. On the x-axis is shown the actual number of activities or access logs of a given module. According to this figure, it can be concluded that students, for example, this week, had a different activity in various modules in the course.

Both of these figures confirm initial hypothesis. The activity of students in electronic courses on different modules varies during different days of the week. Results indicate the need for adaptation activities in the courses depending on the day of the week.

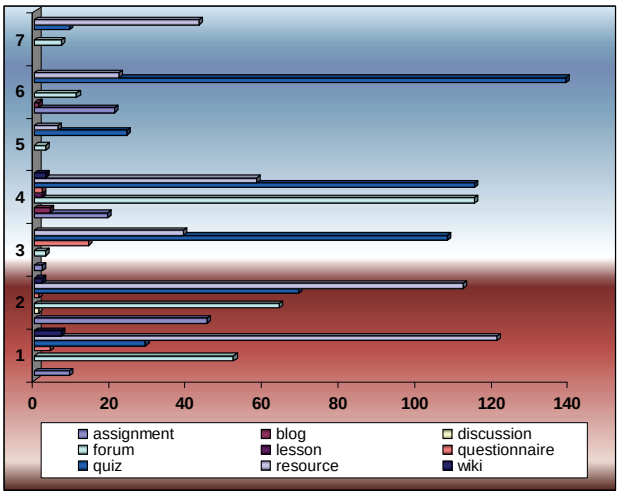

Fig. 2. Actions by modules in the day of the week

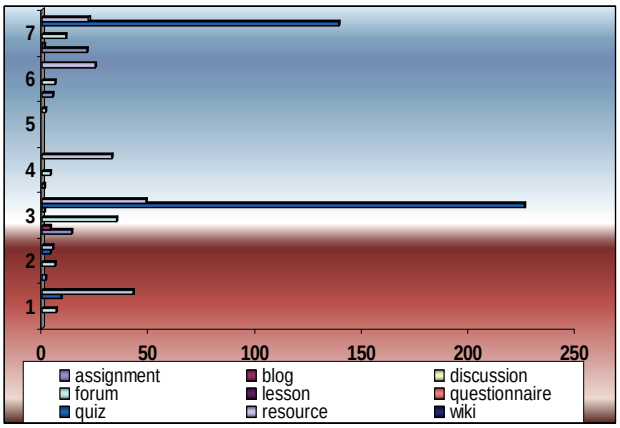

Fig. 3. Actions by modules in the day of the week

VI. Conclusion

There are number of techniques for evaluation of user behaviour patterns. Techniques used in this paper supported initial hypothesis. .

Similar in [8] here is made the learner distribution over time, but with one difference. In [8] is given distribution over time of day.

Benefits of using OLAP and Microsoft SQL server analysis services is the accurate and efficient processing of a large number of records in log files and highly accurate evaluation features user behaviour patterns.

The future work relates to the obtainment of detail information about students' behaviour in the learning management system.

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