



**УНИВЕРЗИТЕТ „ГОЦЕ ДЕЛЧЕВ“ - ШТИП
ФАКУЛТЕТ ЗА ИНФОРМАТИКА**

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2014
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2014**

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VOLUME III

**GOCE DELCEV UNIVERSITY - STIP
FACULTY OF COMPUTER SCIENCE**

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Апстракт. Во ова ера на големи податоци училиштата и универзитетите собираат безброј информации. Но, голем дел од тие податоци се чуваат на начин што ги прават тешко пристапливи за наставниците и менаџерите. Обично пишаните извештаи кажуваат само една приказна или само еден дел од собраните информации. Многу образовни установи користат Moodle во процесот на учење и кога станува збор за поголем број на корисници и учесници се разбира станува тешко да се следат нивните активности во курсевите. За да се направи учењето поефикасно, важно е да се овозможи персонализација врз учесниците, врз основа на нивната активност, можност да се анализира нивната активност во различни курсеви, да се предвидат резултатите на учесниците и подобро да се истражат активностите на учениците. Целта во овој труд е да се опише процесот на селекција и добивање на податоци од базата на податоци на Moodle со употреба на техники за податочно рударење и да се креира работна табла – веб базирана апликација која ќе комуницира со Moodle и ќе обезбеди пристап на повеќе нивоа и практично ќе го подобри пристапот кон евалуација на поголеми групи на учесници во процесот на учење и ќе овозможи наставниците да дознаат повеќе за тоа како учат учениците.

Клучни зборови: далечинско учење, е-учење, едукативно податочно рударење, Moodle, едукативни контролни табли, извештаи во повеќе нивоа

BIG DATA FOR EDUCATION DATA MINING, DATA ANALYTICS AND WEB DASHBOARDS Zoran Milevski¹, Elena Gelova², Zoran Zdravev²

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Abstract. In this era of big data, school and universities are gathering tons of information. But much of that data is stored in ways that make it difficult for teachers and managers to access it. Usually written reports tell only one story or display just one piece of information. Many educational institutions use Moodle as educational environment in the process of learning and when it comes to a bigger number of users and course participants it becomes hard to follow their activity in the courses. To make studying more effective, it is important to supply personalization of the participants, based on their activity, an opportunity to analyze their activities in different courses, predict the results of the participants and get better survey of the activities of the students. The goal of this work is, by the use of data mining techniques to describe the process of selection and acquiring data from the Moodle database, and to create dashboard - web based application, that would communicate with Moodle and supply multilevel approach, and practically improve the approach to evaluation of larger groups of participants in the learning process and will help teachers to learn more about how students learn.

Keywords: Distance Education, E-learning, Educational data mining, Moodle, Educational Dashboard, Multilevel reports

1. Introduction

Interest in the material to be learned is the best stimulus to learning, rather than such external goals as grades or later competitive advantage. It is very important how this material is presented, whether it motivates us to explore and whether it will be available in the future if we need to remind ourselves of what we have learned and want to go deeper into the details for the field of interest.

There are many systems for so-called electronic learning used by many teachers for easier presentation of learning materials in front of their students. The usage of this web-based educational systems has increased rapidly in the past few years. Many universities even offer courses for e-learning and ensure quick, easy and effective study of a given material. The impact on this trend comes from the fact that neither teachers nor students are limited any longer to be at the same time on the same location.

In this paper we use Moodle (Modular Object Oriented Developmental Learning Environment) as an educational system that is well known and widely used because it is open code, and it is also simple to use both for the teachers and the students as course participants [1], [2], [3].

Moodle stores great amount of data in its database that is very important when analyzing the students conduct and represents a gold mine of educational data. Many online activities and communications occur during the online learning process. Although Moodle, as well as the other systems of this type, offers tools for reports and view of the more important activities of the course participants, when it comes to a bigger number of students it becomes hard to follow their activity in the courses. To make studying more effective, it is important to supply personalization of the contestants, based on their activity, an opportunity to analyze the participants in different courses, prediction of the results of the participants and better survey of the activities of the students. A promising area, when it comes to fulfilling this goal is data mining, and in this case it is educational data mining with the Moodle database [3], [6].

Educational data mining means selective extraction of the kept data of large databases, their processing with the use of several educational techniques of data mining such as classification, clustering, statistics, regression etc. and acquiring the processed data that would improve the approach to larger groups of participants in the learning process [7]. The processed information can be useful for teachers but also for the students. Teachers receives reports for the advancing in the learning of the students, and the students gets feedbacks from the teachers for their activities that would improve their learning.

The goal is to make one web-based application so called dashboard that will work in several levels of approach as: manager, teacher and student role. All these previously mentioned feedbacks and reports, well organized are contained in this dashboard. The idea is to build one application that will not work as plugin, but will represent independent application because have more futures that are easy to use, without any further training. Maybe this complex to use plugins and various techniques for mining was a barrier for many teachers to use Moodle as modern tool in the learning process and harnessing the potential of Moodle in terms of getting different reports with a few clicks about when and how students learn.

Whether implemented in primary or secondary education or university this dashboard gives excellent reports that Moodle does not as such. In our previous work we explore the efficiency in the usage of e-learning Moodle in the process of education in high school and educational data mining with Moodle 2.4 and using that research we see the need of building useful reports and alerts which will provide organized data on multiple levels in the organization such managers, teachers and students. [13] [14]

2. Preparing the data

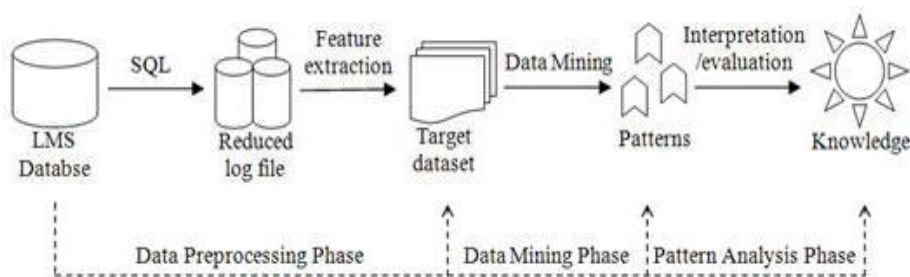
Educational data mining is an interactive process in which not only the processed data can be acquired, but it can also be filtered so that a certain decision can be made. The process consists of gathering information about the students' interaction within the process, than data processing so that they can be transformed into a relevant format to be mined. Data mining is applied, i.e. algorithms are used that provide and summarize the acquired interests about a certain user (teacher, student, manager etc.). Finally, the results are interpreted, evaluated and represented [2], [6].

Moodle doesn't keep the records as text, but keeps them in relational MySQL database. Moodle database has around 145 related tables, but all of them are not necessary to implement educational data mining.

Figure 1 illustrates the data preparation and analysis procedure of this study. First we use SQL (Search Query Language) to get data from the Moodle database, and then save the data in another separate database as warehouse. The data preprocessing phase was performed to reduce the redundant data.

To get certain reports it is important to analyze several tables from the database so that a summary of the system activities can be provided, to get user-friendly results scheme. That is the aim of this research, with which we consider that system users (all within their own role) will get view in their activities.

While researching about all this idea of making simple, but rich with reports dashboard, we ask ourselves about the most needed indicators or learning outcomes of students in an online learning environment. That helps us in better approach in analyzing server logs to understand student behaviors and then improved the web-based learning environment accordingly.



Слика 1. Процес на претподготовка и анализа на податоци

Figure 1 Data Preparation and Analysis Process

In the process of data collection in the Moodle database we create variables that we fill with needed data and transform them into table fields assigned with proper data attributes. All data fields were organized with tables and formed a rational database.

Table 1 shows a list of some variables from the logs taken from the Moodle MySQL.

Табела 1. Пример на некои поважни променливи од записите на Moodle

Table 1 Example of some variables from the Moodle logs

Variable name	Description
\$korisnik_id	User ID
\$vkupno_logini	Total user logins in the system
\$korisnik_vk_pominato_vreme	Total time spent in the registered courses
\$korisnik_broj_kursevi	Number of courses enrolled by user
\$vkupno_rez_dokum	Total resources in the user courses
\$vkupno_aktiv_forumi	Number of forums in the courses
\$korisnik_br_najavuvanja	Total number of logins last month
\$korisnik_lastaccess	When was the last time accessed course materials

Just from these variables we present the dashboard users reports with processed data from the original database.

For example in the figure 2 we show the user a view of the placed resources in all courses or in specific course (if the user is teacher or student, the list of courses contains only courses where they are enrolled).

Another report obtained by the values of the previously mentioned variables shows the time spent in the system. If we want to check if the user is active or inactive user in the courses, or something similar, we need to use some of the mining techniques that are explained later in this paper.

It's only matter of SQL queries in order to another report shown in figure 3, figure 4 and figure 5.

In figure 3 the shown table gives information about all teachers and course creators with data for teacher name and placed resources like pages, documents, URL's, assignments, polls, forums, discussions in forums and quizzes.



Слика 2. Страница на ресурси во работната табла
Figure 2 Resources page in the dashboard

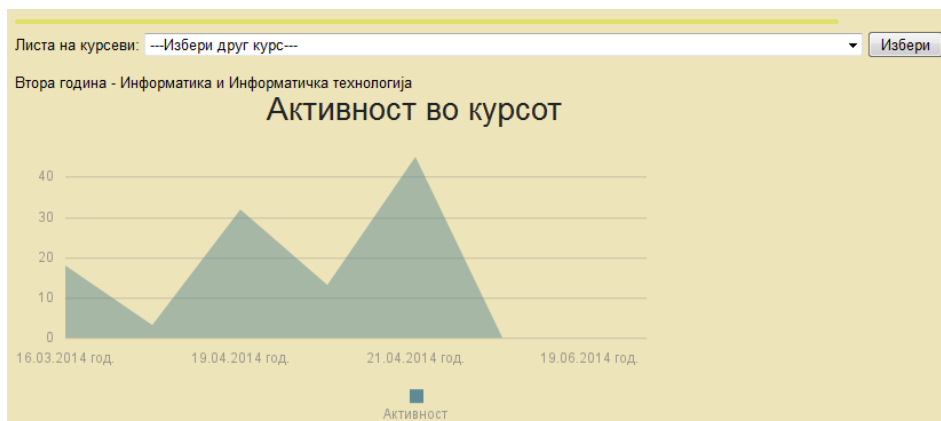
The variable identification from table 1 not only provides observation parameters but also leads to the construction of a predictive model, which enables instructors to predict students learning performance through real-time data mining analysis.

Ресурси											
Табеларен приказ на курсеви, ресурси и активности во курсевите											
Катег.	Име на курс	Име на наставник	Презиме на наставник	Страници	Документи (.doc, .pdf)	Линкови (URL)	Домашни задачи	Анкети	Форуми	Дискусии во форуми	Квизови
Втора година	Информатика и Информатичка технологија	Миле Милевски		12	48	5	6	1	2	11	18
Втора година	Национална географија за II година	Ане Аневски		0	0	0	0	0	1	0	5
Втора година	Социо-географски карактеристики на РМ	Блаже Блажевски		0	0	0	1	0	1	0	0
Втора година	Историја – II година	Јован Јовановски		0	0	0	0	0	2	1	4
Втора година	Социологија	Златка Златковска		0	0	0	0	0	1	0	5
Втора година	Биологија за II година	Маја Мајовска		0	0	0	0	0	1	0	5
Втора година	Физика за II година	Кате Катевска		0	0	0	0	0	1	0	10
Втора година	Латински јазик за II година	Блага Благевска		0	1	4	2	0	1	0	0
Втора година	Биологија за II година	Маја Мајовска		0	0	0	0	0	1	0	5
Втора година	Музичка уметност 2	Драган Драгановски		1	1	4	4	0	2	0	0

Слика 3. Табеларна презентација на курсеви, ресурси и активности во курсевите
Figure 3 Tabular presentation of courses, resources and activities in courses

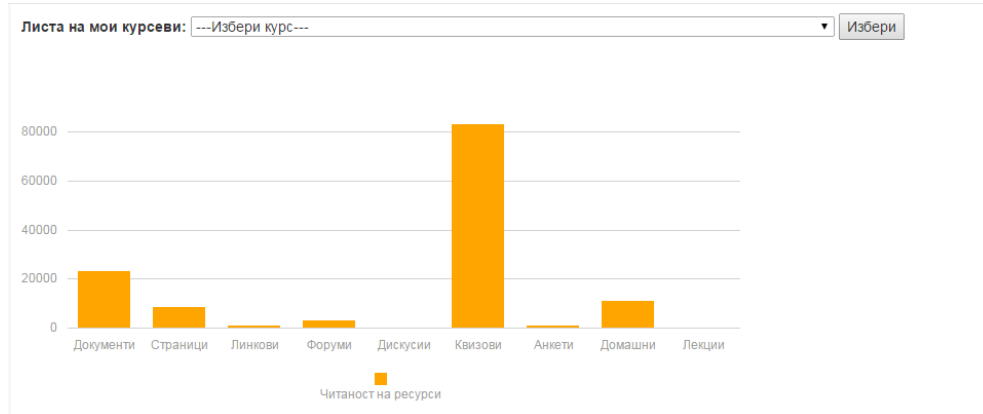
For example, the teacher may build a predictive model with data collected in the first month and then to be able to identify the students that need assistance in learning the material previously learned. With the information from all this reports teacher may change strategy even during the school year if he notice that the learning material is difficult to the students, or otherwise, the learning material is easy to the students and may decide to go into details for the learning subject.

In the figure 4, the graph illustrates the activity of the enrolled participants given by days.



Слика 4. Активност по денови во даден курс
Figure 4 Activity by days in given course

Another report, that is shown in figure 5, gives preview of the activity in the resources and participant activities in given course.



Слика 5. Активности и ресурси и нивни преглед во даден курс
Figure 5 Activities and resources and their preview in given course

3. Use of data mining techniques

Besides analyzing the data in the Moodle database, it is very important how the data will be grouped in order to achieve the required effect.

For that purpose we hold up on data mining and we use some of the known techniques that can provide us all necessary information and data in the effort to give the teacher simplified view on the processed knowledge.

In e-learning systems clustering can be useful for finding similar characteristics students clusters, revealing the user conduct and grouping the students into several groups: students who are active in the system, discuss in forums, send homework, spend some time in the system in checking different contents etc. [6].

In this research we will divide students into three clusters as follows: cluster 0 (inactive), cluster 1 (very active), and cluster 2 (active course participants). Cluster 0 is characterized by students who haven't sent homework, have read only few messages, took only few quizzes and spent very little time in checking the resources, activities and forum participation. Cluster 1 is characterized by students who have sent at least one message in the forum, have read at least three messages, have passed successfully at least half of the quizzes and have finished less than half of them unsuccessfully and have high score and grades. Cluster 2 is characterized by students who have lower score than students in cluster 1 and more than the students in cluster 0. In this way the teacher can use these information so that he can divide the students into groups of different type of students for example at least one student from cluster 1 and students from the other clusters or a group of students from cluster 1 who would work on problem assignments of higher degree than the others [6], [12].

Classification of participants is used to discover potential students with similar characteristics for a definite specific pedagogical strategy, to predict the final results for a group of students, even to identify the students who need motivation to get better results.

We divide the students into bad, good and excellent by generating decision trees that involve certain classification rules. Our goal is to classify students in different groups depending on their activity in Moodle. Table 2 represents the knowledge by decision tree with if-else rules. This process goes on until all data are classified perfectly or we run out of attributes. Students with lower number of passed quizzes are classified as weak students, students with bigger number of quizzes are classified as excellent and the students with an average number of quizzes as good and of course taking into account the total time spent on resources and activities, the number of sent homework assignments etc. [6], [9], [11].

Табела 2. Множество правила генерирани од одлучувачко дрво

Table 2 Rule set generated by Decision Tree

```

if(n_quiz=low) then mark=bad
else if(n_quiz=medium) then {
  if(total_time=low) then {
    if(view_resource=low) then mark=bad
    else if view_resource =medium) then {
      if(forum_post=low) then mark=bad
      else if(view_resource=medium) then {
        if(total_assignments=high) then mark=good
        else if(overall_core=high) then mark=excellent
      }
    }
  }
  else if(total_time =medium) then {
    if(view_resource=low) then mark=bad
    else if(view_resource=medium) then mark=good
    else if(view_resource=high) then mark=excellent
    if(overall_score=good) then
      if(forum_post==good) then
        mark=excellent
  }
}

```

4. Conclusion

Data mining techniques are powerful tools for discovering hidden knowledge. In this paper we give analyses of the raw data from the Moodle database, their potential in receiving useful conclusions for the activity of all roles in the system. Also we give a look at the results from the data mining with the use of several techniques applied on the application that works with several levels of approaches. It is very important to integrate the data mining tools in the e-learning environments which is the goal of this research, because in this way all these data mining techniques will be applied in a single application and the feedback and the acquired results will be directly applied on the e-learning environments [17]. Here are several data mining techniques that can be used for acquiring processed results and reports in the process of learning, and they are not complicated to be used by the teachers. That is why this approach of creating dashboard – web based application, which is user-friendly and give better control when it comes to larger groups of students when the standard reports reduce the control clarity and the ability to evaluate their results at the end of the course [3], [5], [17]. Nowadays, data mining tools are too complex to be used by the educators and their futures go beyond the scope of what educator might to do. By creating a dashboard that would communicate with the e-learning system Moodle, the teachers can easily evaluate web activity in order to get more objective feedback, and find out more about students capability in successfully passing the exam. Also this dashboard will directly solve the teacher's problems in supplying support in dealing with various kind of algorithms. It could also be oriented towards the academics and administrators responsible in order to obtain parameters about how to improve site efficiency and adapt it to the behavior of their users, have

measures about how to better organize institutional human and material resources and their educational offer, enhance educational program offers, etc.

Further ideas, implementations and improvements are planned to be integrated in this Moodle dashboard that are important for the goal to be fully achieved. For example building alerts where the managers or the teachers can see which user has not signed up for some time, mark for courses that have no content and courses where the resources are not read by the participants.

All previously transformed data using educational data mining are stored in a warehouse, separate database and will be available for additional research in order to improve the work of the teachers and the way that students learn their material more efficiently.

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