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Analysis of eLearning Courses with the help of a Learning Analytics Tool

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Analysis of eLearning Courses with the help of a Learning Analytics Tool

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Abstract

The topic of learning analytics acquires especial significance in the general context of rapid growth of the eLearning offers, MOOCs etc. Its aim is improvement both of the learning offers and of the success of the students, based on the conclusions drawn from the analysis of the behavior of the users. In this paper, we present our results obtained from comparative analysis of different eLearning offers. For this purpose we have applied the specially designed Open-Source Learning Analytics Tool LeMo which offers to the teaching stuff a variety of analytic characteristics and their visualizations, e.g. usage in time, frequent learning paths, an activity graph and test performance. Here we underscore that visualization of the collected and processed data, taken alone, does not substitute the didactic analysis of the learning offers. At the same time, it can help the faculty stuff to perform didactic assessment of the courses which they teach and in this way to identify the merits and shortcomings of the learning process.

Key Words: eLearning, Learning Analytics Tool, Visualization, Didactics

Introduction

ELearning plays very important role for the learning providers. This form of education offers to its participants many advantages which cannot be attained through traditional methods of learning: it is time- and place independent, all learning materials are permanently available, the learning context is interactive etc. At the same time, it possesses certain disadvantages, which should be taken into account while starting this form of learning: the success assumes a certain self-discipline of the students; sometimes it may happen that some participants of Online Seminars withdraw from the learning process and stay passive, whereas in the conventional class everybody is forced to take part in the learning. Therefore, continuous observation of the learning process, assessment and evaluation of the behavioral and navigational patterns of the learners in the learning management system are crucial for the success of students.

Learning in digital environments generates a big amount of useful data which can benefit the providers, the lecturers and the learners themselves. Assessment of those data helps to identify the merits and shortcomings of the learning offers and can serve to their modification and improvement. Obtaining and evaluating different data from the learners constitutes the task of the research field "Learning Analytics" which has been defined as " … the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs" [Siemens, 2011]. Evaluation and visualization of the user data does not yet automatically improve the quality of the teaching offers. Observation and analysis can, for example, identify collective trends in dealing with the learning material, provide an immediate feedback to the running learning process, carry out self-evaluation of the offer by the lecturer and so on. In the long run, all this, taken together, can contribute to the improvement of teaching and learning.

One of the concrete ways to apply the Learning Analytics is the Tool LeMo (abbreviation for "**Le**arning process **Mo**nitoring") which has been developed in the framework of a joint research project of three Universities of Berlin [LeMo]. Altogether, it includes visualization of 14 different modes of analysis [Elkina, 2013], [Merceron, 2013], [Merceron, 2012] which can be grouped into three categories:

- Usage of the learning offer
- Learning paths
- Performance

The first category includes visualizations which, in different ways, characterize the behavior of the students; amount of accesses to the learning objects serves as a measure for evaluation. The next category "Learning paths" can be divided into two subcategories: navigation patterns and frequent learning paths, respectively. The first one discloses the learning objects, between which the navigation was especially intensive, as well as the order of consequent calls to these objects and direction of motion between them. The mode "frequent learning

paths" shows the most frequent successions, in which the students have accessed the learning materials in their course. Visualizations of the third category characterize the performance of the learning process: they present the results of the students in separate tests, tasks and Scorm-materials and enable comparison of the average achievements of the learners.

Below, we describe a Case Study in which some of the evaluations and visualizations of the tool LeMo have been employed.

Case Study

During three consecutive semesters we followed several courses with the help of the tool LeMo and analyzed the data obtained both from the conventional teaching in the class and from virtual and distance learning courses. Not all results were amenable to immediate interpretation, not always we could draw conclusions on the improvement of teaching offers, and not every expectation of the teaching stuff concerning the usage of learning materials and activities of students was confirmed. Nevertheless, we obtained new insights on the behavior of the students. In this paper, we concentrate on two courses: the course "Introduction to Informatics" of the virtual bachelor degree program and the course "Programming and software development" of the conventional bachelor degree program. The first course is conceived for the independent activity of the students who access the learning material over the internet, have to accomplish three tasks during the semester and submit them to the lecturer via the learning platform. After the acceptance of all tasks, the students are admitted to the final written examination which takes place at the end of the semester at the University (i.e. not online). During the semester, four meetings in the class and four web-conferences (vie Adobe-Connect) are conducted, with the purpose to discuss the solutions to the homework tasks and to review the topics of the module. Typically, the participants of such courses possess the job experience of several years (often not along the lines of their current studies) and are learning in their free time. The second course is the standard course of the traditional learning program with weekly lectures and seminars. During the semester several tasks are formulated, to be solved by the students in the class, either independently or in small groups. The grades of written examination at the end of the semester serve as a performance indicator.

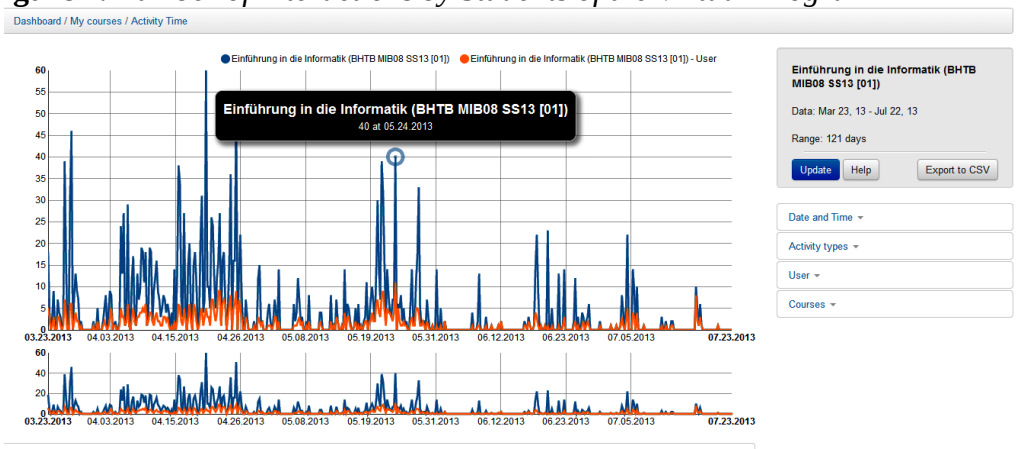
In both courses the forums and exchange of messages are used for communication among the students as well as between the students and the teaching stuff. Moodle is used as a Learning Management System (LMS).

Course of a Virtual Learning Program

The analysis mode "Activity/ Time" (see Figure 1) provides an overview of intensity with which the learning material is accessed at different moments of time: for example, at which moments the posts in the forums have been created and read, the tests or the tasks are being solved, the files with learning materials are being looked upon, etc. The analysis is implemented with the Line-Chart. The

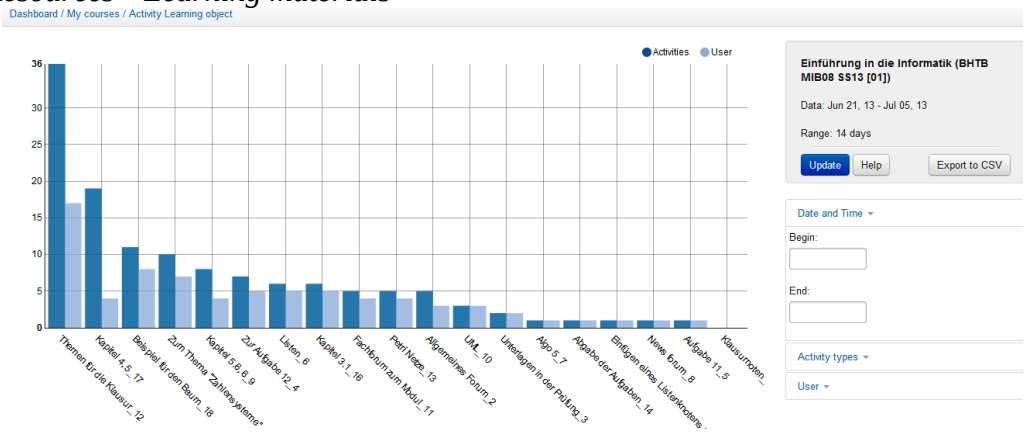
blue line displays the number of activities; the orange line indicates the number of users who started those activities. If the cursor goes over the line, the Tooltip shows the precise number of activities, the exact number of users and the exact time. The scale of the axis is adapted to the current value range. The user can partially deactivate the lines of the diagram in order to obtain the more detailed overview. For the same purpose it is possible to select through the mouse click and the drag with the pressed mouse key the desired time period on the lower diagram and to have it displayed in the upper diagram in enlarged form. We immediately notice that the students are very active at the beginning of the semester, then, after a short pause, they become active again, whereas, regrettably, before the examination at the end of the semester both the activities and the number of active participants display a visible decrease. Since the data are treated anonymously, there is no direct way to sort the students according to the results of their examinations. However, the lecturer who conducts the course is aware that not all students who enrolled for it, and also not all students who successfully accomplished the first and the second tasks, take part in the examination. According to Figure 1, the number of active students (orange curve) has decreased in the course of the semester as well. The same tendency is reproduced in other semesters. With the help of LeMo we attempt here to investigate in details the behavior of the students.

Figure 1. *Number of Interactions by Students of the Virtual Program*



Results of the investigation in Figure 1, filtered with respect to the type of the learning object "Learning material file" have indicated the file "Topics for examination" as the most frequently used one: this file was accessed by every student, on the average, 3.5 times within the short time interval. Regrettably, the files with extended information, composed by the lecturers, were looked upon during the semester and before the exam not by all students. A positive message has been delivered by the study based on "Frequent path" and "Activity/Learning object" which has disclosed that all these components were used during the preparation to the exam.

Figure 2. *Number of Interactions by Students of the Virtual Program with Resources <Learning materials>*

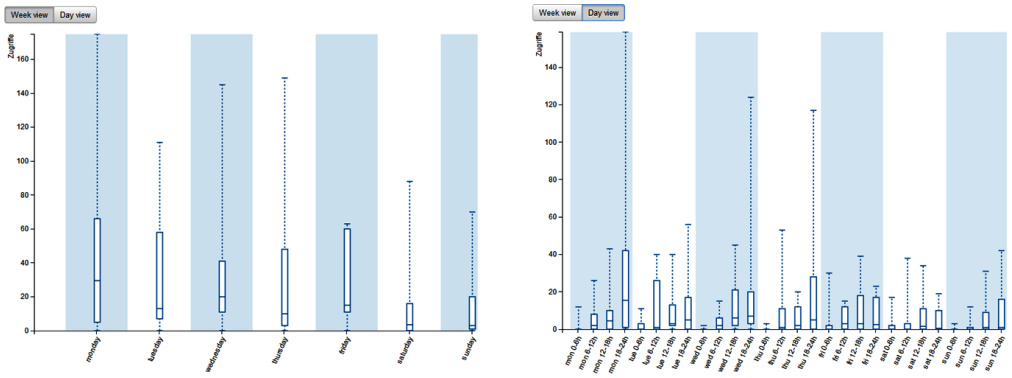


The visualization in "Activity/Learning object" (see Figure 2) can also indicate which learning materials were used only seldom or not at all. The reasons for this poor usage can be found out only by the lecturer of the course her/himself; depending on the outcome, the didactic approach can and should be modified. Sorting of activities in accordance with the object type "Task" has identified three peak periods which exactly correspond to three deadlines for sending in the accomplished tasks. Since the tasks were discussed in the forums, the same peak values have been registered in the forum activities. Typically, the discussions were spontaneously initiated by the students. Results of the analysis demonstrate that the numbers which characterize the forum activities, as well as the number of students which participate in these activities, is unexpectedly high. Regrettably, the tool cannot distinguish between the access with writing and the access during which only reading occurs. Nevertheless, a manual comparison of the number of posts in the forums with the number of accesses to these forums and the number of active participants indicates that all contributions have been read by all participants. This means that all students can be reached and stimulated to active participation with the help of the forums. Unfortunately, starting from the middle of the semester, the forum activities go down as well. The questions, whether exactly at this moment the involved didactic methods should be checked and modified, whether for example a new discussion in the forum should be initiated, or the deadlines for solving and submitting the tasks should be changed, cannot be answered by a learning analytic tool. However, as soon as such modifications are undertaken, their impact on the dynamics of the course can be immediately assessed and visualized. Surprisingly, during the preparation to the exam there are not too many activities. It appears that the examination marks are not really important for the participants of the online degree course: probably, they are more oriented towards professional aims, since they are mostly studying in the free time left by their jobs.

The analysis mode "Cumulative time of activity" (see Figure 3) reflects the intensity of the work with the learning objects: it measures at which weekdays and at what time the highest usage takes place. It turned out, that the most intensive work takes place on Monday afternoon and in the evening, albeit the activity of the students remains relatively high during the other days of the week, except for

the weekend. Noteworthy, the learning materials are relatively frequently accessed during the working hours as well. In accordance with these observations, it seems reasonable to put the deadlines for submitting the tasks, and for the examinations on Tuesday, in order to enable the students a better chance for preparation without interfering into their conventional rhythmic patterns "job/family/learning".

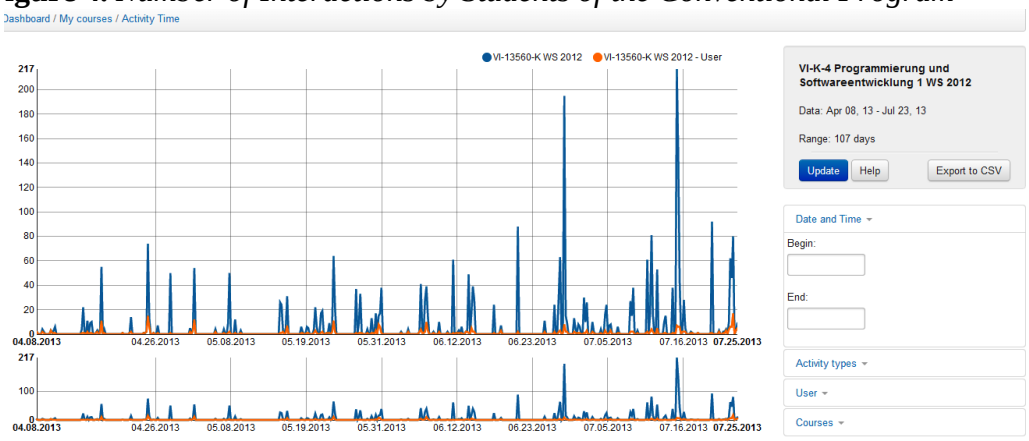
Figure 3. *Cumulative Number of Interactions by Students of the Virtual Program: Week View (Left Panel) and Day View (Right Panel)*



Course of the Conventional Learning Program

The overall picture of activities during the conventional learning program is presented in Figure 4. The distribution is, in its weekly rhythmus, nearly uniform, with the peak values pointing precisely onto the day of the lecture.

Figure 4. *Number of Interactions by Students of the Conventional Program*

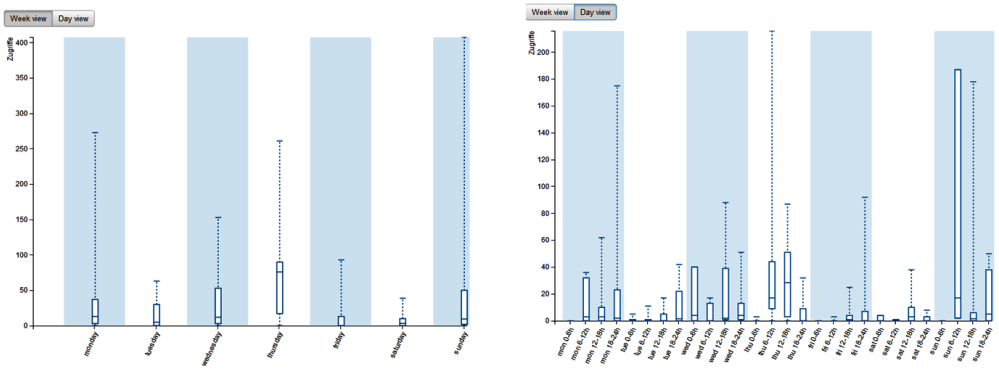


The activities attain maximal values during the preparation to the examination at the end of the semester, which can be interpreted as an indicator of high significance of the examination mark for the students of the bachelor program. Further investigations with sorting in accordance to the type of the learning object did not disclose a higher frequency of accessing the files with learning material at the end of the semester, if compared to the access values during the semester. In order to find out, which activities have provoked this overall increase at the semester end, the analysis mode "Learning object/Activity" has been conducted

within the two last weeks before the examination. The results have unambiguously shown that the highest rate referred to the tests for self-checking which were placed by the lecturer at the disposal of the students at the beginning of the semester. This result might have been interpreted as a success of the didactic approach; unfortunately, the additional studies have disclosed that only about 20% of the students had used those tests for the preparation to the exam. This means that although the statistical assessments and their visualizations can be helpful in order to follow the behavior of the students in an online learning platform, the numbers alone, without a comprehensive analysis, can be misinterpreted.

There are remarkable differences in the behavior of the students of both learning courses during separate weekdays and intervals of time. The analysis mode "Cumulative time of activity" (see Figure 5) reflects the typical intensity of work with the objects. Whereas the online-students are active during the entire week and most active on Mondays, the students of conventional course are active only before and during the lecture days. The lecture day (Thursday) is easily recoverable from the data. Resolving the activities within the day discloses the further difference between both studied groups: the students of the conventional (fulltime) course are learning mostly in the morning, especially on Sunday morning, whereas the students of online course are typically active in the evening time of the working days of the week, and take a rest at the weekend.

Figure 5. *Cumulative Number of Interactions by Students of the Conventional Program: Week View (Left Panel) and Day View (Right Panel)*



At this point it should be mentioned that the forums as a communication basis stay almost unused by students of conventional course, who prefer face-to-face communication.

Conclusion

We have described the results of the studies which were conducted on the base of the Learning Analytics Tool LeMo. These results, while confirming the

expected behavior of the participants of the eLearning courses, provide new insights into the merits and shortcomings of the learning offers. For example, in the course of the virtual program, described above, the key topics should be positioned in the first half of the course, since it corresponds to the highest activity of the students. In case of the other course, in the end of the semester the students should be reminded on all tasks and tests which can be helpful for the preparation to the exam.

Within this approach, it is difficult to judge how the activities of the students influence their success, since LeMo works only with anonymous data and cannot resolve correlations between the behavior of separate participants and their examination marks. However, in both courses it has been established that not all students use the learning material, tasks, test etc. during the semester and while preparing to the exam, although the overall access rate for this learning objects is rather high. The questions, whether the proportion of active students can be increased, which didactic methods should be employed for this purpose, and whether the general conditions should be altered, are objects of separate investigations for each of the courses.

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