

## THE POSSIBILITY OF EDUCATIONAL DATA MINING FOR PRACTICAL SKILLS DEVELOPMENT IN LEARNING MANAGEMENT SYSTEM

**Jelena Mamčenko**

**Inga Piščikienė**

**Brigita Šustickienė**

Vilnius College of Technologies and Design, Lithuania

**Irma Šileikienė**

Vilnius Gediminas Technical University, Lithuania

**Abstract.** *The paper presents comprehensive study of applicability of Moodle virtual learning environment to the development of practical skills. The quantitative research involved faculty students and lecturers of Vilnius College of Technologies and Design. Data analysis indicated that currently the most beneficial method to develop practical skills is blended method. This result, however, turned out to be more positive for students than for lecturers, the latter being less willing to employ technology alongside traditional classroom. The article also briefly describes data mining technologies that are often employed to plan study process, as well as depicts data flows and action sequence of the future survey. The study also puts forward recommendations for further research.*

**Keywords:** *Blended Learning, Educational Data Mining, Practical skills, Virtual Learning Environment, Web Mining.*

### Introduction

Modern society is extremely dynamic and receptive to innovation. A contemporary person has to develop ability to memorize new knowledge and information faster than it becomes outdated and old. Former definition of a learning process as transmission of experience by the older generation to the younger is being replaced by a relatively new concept of lifelong learning, where knowledge, qualification, information no longer belong to school and university years, and where individuals must demonstrate ability to remain up-to-date.

Concept of lifelong learning also means that in this day and age an active member of society is required never-ending time investments into self-development. Alas, not many students and working people find it possible to spare any time from their usually busy routine to develop new skills or refresh

old knowledge. Consequently, modern-day educators are seeking for innovative ways to deliver their services to the wider public.

*Distance Learning (DL) is an instructional delivery system that connects learners with educational resources. Distance Learning provides educational access to learners not enrolled in educational institutions and can augment the learning opportunities of current students. The implementation of DL is a process that uses available resources and will evolve to incorporate emerging technologies* (Martin-Blas & Serrano-Fernandez, 2009). E - learning allow students to actively participate in their own learning, gives them the opportunity to interact with their peers, provide peer feedback, and reflect on the status of their personal learning goals and outcomes (Er et al., 2009; Harris et al., 2009; Simonson et al., 2012). Information technologies (IT) and e-learning process are indispensable core elements of Distance Learning.

Vilnius College of Technologies and Design (VTDK) offers blended distance studies with both synchronic and asynchronic learning elements. The College opted for innovative teaching methods due to the growing demands of contemporary students, a large number of whom cannot come to the College on daily basis, as they live and work abroad, study at several institutions at the same time, have a job and do not want to drop out of the working community, etc.

The resulting competition, which exists worldwide, led the higher education community to seriously look into these aspects of the study process, which most affects students' satisfaction with the learning process and generate feedback.

The implementation of the Moodle system made it possible to solve a number of problems, such as electronic material hosting, examination tests, students' knowledge verification and evaluation.

Teaching materials inspection and correction does not end with test training. It is continuous ongoing process during which errors are repaired, taking into account the students' needs and problems. Therefore, the training material elements of quality control must be involved in the same process of distance education. As used herein, students' and tutors are interviewing. The quality of distance education shows subject questionnaires, subject popularity and dynamics and, of course, can help to answer why some students decide to give up continue their studies.

During discussions with students about the quality of the courses, students, defining their expectations and desires, often point out that they want and expect interesting and professionally useful lessons, an objective, fair and transparent assessment, modern laboratories for acquiring practical skills, study materials and additional literature available for all.

Thus, the object of this study is to find out opinion of students and of lecturers on the use of Moodle environment in the study process at VTDK.

### Use of Virtual Learning Elements

One of the most important factors influencing lifelong learning is creating and adaptation of learning possibilities for each individual member in a society ensuring curriculum quality and meeting the learners needs (Volungevičiene & Teresevičiene, 2008). In the context of learning possibility development analysis, distance learning and teaching gains major importance. Teaching/ learning curriculum planning, realization and effective teaching and learning organization issues should be decided during distance teaching/ learning curriculum designing. E-learning platforms are becoming increasingly sophisticated, showing potential as an effective way for improving the learning process (Escobar-Rodriguez & Monge-Lozano, 2012).

Definitions and key words:

*Teaching/learning curriculum* – the consistency and interaction of the main teaching and learning process parameters (objectives, teaching/ learning organization methods, teaching means, and assessment strategy) in a constant development process (Tuijnman & Boström, 2002).

*Designing teaching/learning curriculum* – constant improvement of training program parameters oriented towards a perspective: improvement of existing processes with respect to learning needs' changes, new training programs, etc. (Volungevičiene & Teresevičiene, 2008).

*Blended learning* is a combination of various networked technologies in a single learning package; a synthesis of pedagogic methods enabling to achieve an optimal quality of learning process; a combination of various lecturing technologies together with direct lecturing by an instructor.

*A virtual learning environment (VLE)* is a software system designed to support teaching and learning. A VLE typically provides tools such as those for assessment, communication, uploading of content, return of students' work, administration of student groups, questionnaires, tracking tools, wikis, blogs, chats, forums, etc. over internet (Martin-Blas & Serrano-Fernandez, 2009).

*Moodle (Modular Object-Oriented Dynamic Learning Environment)* is a free e-learning software platform, originally developed to enable educators to create online courses to encourage interaction and collaborative construction of learning content (Amandu et al., 2013, Barge & Londhe, 2014).

Moodle is called learning management system (LMS) or a VLE which is most popular all over the world. Moodle provides tools that can be turned on and off according to the planning established, allowing the definition of learning modules with activities and tasks in collaborative format. Moodle is a great way

for teachers to organize, manage and deliver course materials. From the didactic point of view, the usage of multimedia tools to create attractive activities makes the learning process friendlier for students (Martin-Blas & Serrano-Fernandez, 2009).

Teaching/ learning curriculum planning, realization and effective teaching and learning organization issues should be decided during distance teaching/ learning curriculum designing. The authors the curriculum often do not have necessary competencies to select technological solutions for curriculum realization. They trust the opinion of information and communications technology (ICT) specialists and their recommendations. During distance teaching/learning curriculum designing, three components of distance teaching/learning curriculum can be identified: teaching/learning subject (or study subject), teaching/learning situation (internal and external conditions affecting the success of learning and constantly changing), and teaching/learning organization, that should be characterized by the flexibility criterion, as it directly depends upon the changing teaching/ learning situation (Volungevičiene & Teresevičiene, 2008). However, research into technological e-learning elements, their applicability possibilities, impact on the study results is scarce and not specific. Scientific interest is mostly confined to the results of the use of theoretical and visual material presentation as well as examination in distance learning environment.

As a rule, development of practical skills in the distance learning environment requires complicated technologies and technical resources, such as video material, virtual laboratories, virtual lab management, simulators, training games, etc. Majority of the technology require substantial investment, considerable preparation of lecturers and of students. Hence, it has become common to shift to blended learning, where theoretical material is presented using asynchronous tools (texts, slides, video recordings, etc.) while practical skills are developed in a traditional „brick and mortar“ way in established laboratories. As a result, 37% of all courses at the faculty are available in e-learning management system.

### **The Method of the Survey**

The study set out to examine opinion of academic community at VTDK about the usefulness of elements of Moodle environment while seeking to improve the quality of studies. To achieve this goal a sample of questionnaires were filled in by 85% of full time students and 73% lecturers at Vilnius College of Technologies and Design. Majority of the students were in their second year of the studies, and only 14 % of them were in the first or the third study year.

The data collection of the students and lecturers was completed in the spring semester of 2015.

Although VTDK has been known for the traditional classroom training where lecture attendance is compulsory, the college seeks to meet the needs of an increasingly technology-oriented society, and has started to opt for blended learning, where features of both, traditional and e-learning are merged to improve study quality. Apart from face-to-face lectures, students are provided with a possibility to deepen their knowledge and skills, to participate in forums, to seek consultations in virtual environment. Lecturers can also place their material; assign tasks, forward tests in an online learning environment.

The questionnaires consisted of 15 questions, part of which were open format, others of closed. It ensured better grounded and more credible information. Majority of the questions directed at the students and at the lecturers were the same, and only a few slightly differed. For example, a question for the students *Have you ever taken an exam or a test in the Moodle system?* coincided with a question directed to the academic staff: *Have you ever organised an exam or a test in the Moodle system?* The survey was conducted online. All in all, 120 (85 % visų fakulteto studentų) questionnaires were emailed, and only four of them were not returned.

## **Results**

Even though the results of the survey obtained from the group of students differed from those of lecturers, responses within each group were similar.

Both students and lecturers were asked what type of lectures they would choose given a chance – in the classroom, online or a combination of these both. It appeared that slightly more than half of the respondents in both groups would choose combination of the traditional and virtual learning (54% lecturers, 58% students). Purely virtual lectures did not enjoy popularity - as little as 11% of students expressed desire to study online, and there was not a single lecturer who would like to resort to teaching only via internet. However, face-to-face learning and teaching have lost its appeal with neither lecturers nor students. Almost half of the lecturing respondents are still keen on teaching in a traditional way (46%), and the same answer was indicated by almost one third of the students (31%).

Another question concerned the usefulness of the Moodle system. The answers provided by the two groups of respondents differed significantly. While the majority of the students stated that they found Moodle elements useful (81%), their teachers were less positive. Although not a single teacher defined Moodle as not useful, almost 40% of them indicated having no opinion, and

only a bit more than a half of them found elements of Moodle beneficial to the study process.

A question regarding instruction on how to use Moodle, both groups of respondents answered positively – they all have had a course on Moodle use. However, when asked if they found Moodle user-friendly, lecturers and students presented very different answers. A vast majority of students (73.3%) experience no difficulties, whereas lecturers were of an opposite opinion. 76.9% of them stated that they found Moodle complicated to use.

While surveying the use of different elements offered by Moodle virtual learning environment, an obvious difference was found between highly interactive elements, e.g. personal messages, forums, and those elements that required less interaction, such as file sharing, knowledge assessment, etc. As Fig1 presents, the file sharing function seems to be the most frequently used element among both students (66%) and lecturers (75%). The second common choice for both groups was assignment submission, with slightly less than half of the lecturers and almost 40% of the students using this element.

Other Moodle elements proved to be less popular among the participants of the survey. As the diagram in Fig. 2 presents, calendar is used by only 6% of students and 17% of lecturers, 2% students and 3% lecturers use Moodle for sending personal messages, and neither students nor lecturers participate in the forums offered by Moodle system.

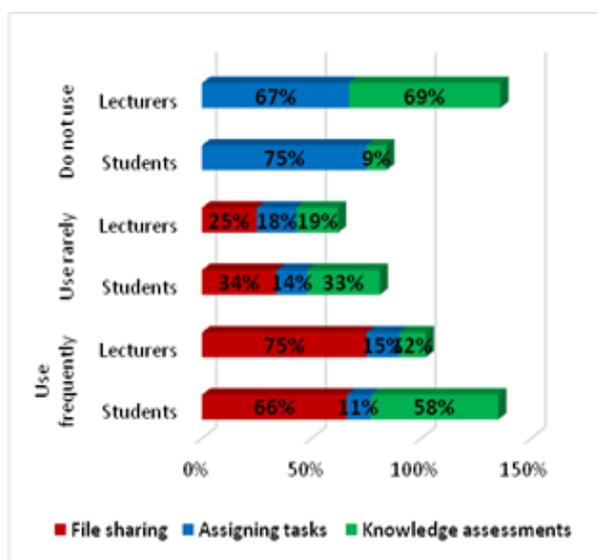


Figure 1 The Use of Moodle Elements in the Study Process

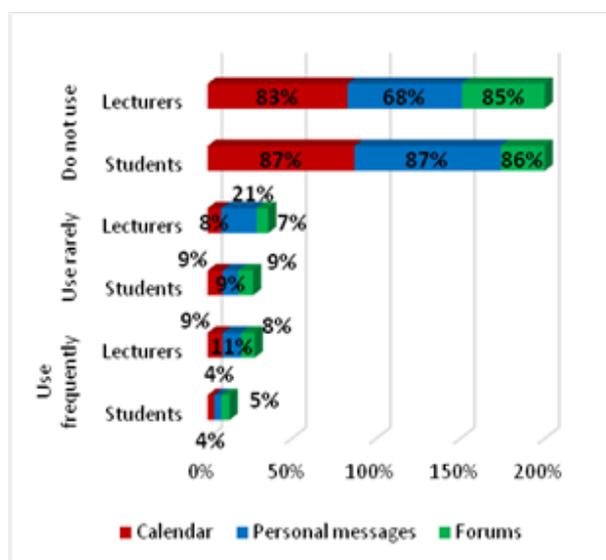


Figure 2 The Use of Moodle Elements in the Study Process

A vast majority of students (89%) stated to have written a test or taken an exam in the Moodle environment and nearly all of them (93%) described the

experience as positive. A large number (84.6%) of lecturers, however, admitted having never organized a test or an exam in Moodle learning environment. Such response of the academic staff implies that lecturers still avoid developing assessment tasks online. Some of the respondents have indicated reasons for such reluctance – time consumption, complicated procedures, lack of computer literacy and skills, difficult interpretation of students’ answers to open format questions.

The opinion of respondents on the usefulness of the Moodle is shown in Fig. 3. Apparently, both groups use the system for various reasons.

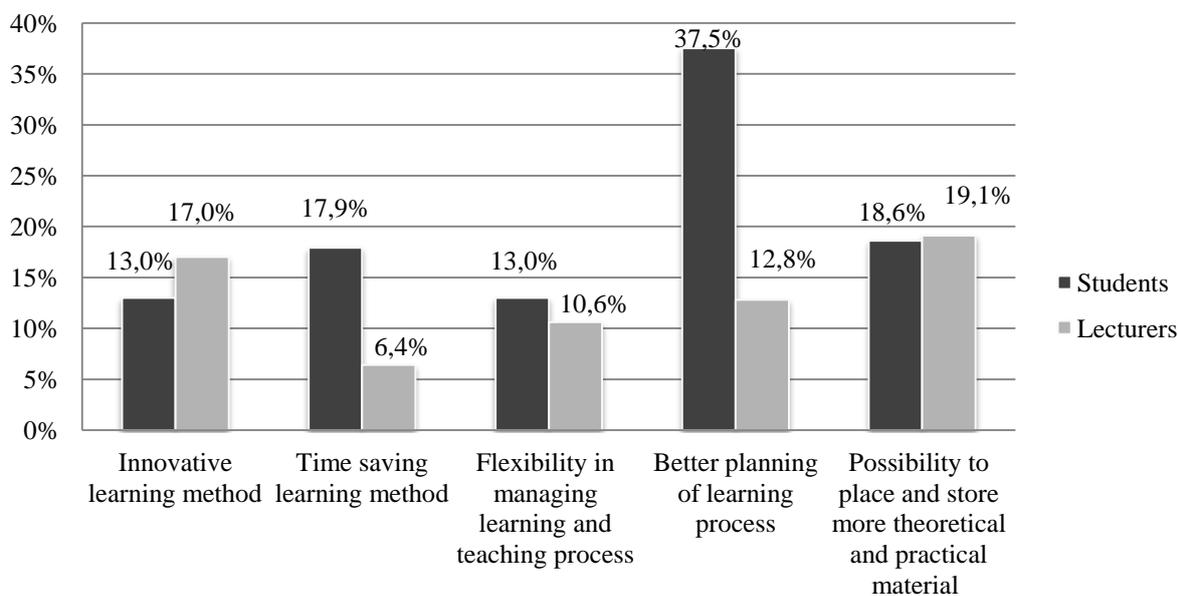


Figure 3 The opinion of respondents on the usefulness of the Moodle

Lecturers, when asked to assess the material they have placed in the Moodle environment, were significantly more critical. None of the respondents described the methodical material as fully completed; nearly half of them admitted the material to be incomplete. (the material is presented in a chaotic way - 45%, a lack of audio, video material - 25%, shortage of self-control tasks and tests - 30%).

Nearly all of the students (95.7 %) were positive when asked about the usefulness of the methodical material prepared by their lecturers. Such students’ approach confirms the validity of the elements of VLE that are used in the blended learning process. Almost forty percent of respondents support an idea that the use of virtual learning environment should become a compulsory part of the study process, about the same number of students and lecturers consider Moodle to be of great benefit for the studies, and nearly one fifth of them have no opinion on the matter.

## **Related works in Data Mining and E-Learning**

The research interest in using data mining in e-learning is constantly increasing. The database of learning management system includes much useful information, which can be effectively used for the improvement of e-learning process (Barge & Londhe, 2014; Simovic et al., 2014) or course adaptation (Papamitsiou & Economides, 2014). Using data mining methods many kinds of knowledge can be discovered (Escobar-Rodriguez & Monge-Lozano, 2012). The discovered knowledge can be used to better understand students' behavior, to access student's learning style (Buldu & Üçgün, 2010), to adapt a course content according to student's knowledge and abilities (Er et al., 2009), to assist instructors (Reis et al., 2015), to improve learning and teaching process (Escobar-Rodriguez & Monge-Lozano, 2012; Harris et al., 2009).

Literature describes a number of scientific research works which use data mining methods on e-learning data (Nate et al., 2014). Merceron & Yacef (2005) present a case study that uses data mining methods to identify behavior of failing students to warn students at risk before final exam (Kulvietiene & Sileikiene, 2006). Other researchers compare different classification algorithms and check which algorithm is optimal for classifying students' based on their final grade. Other authors use neural networks for predicting student's marks (Martin-Blas & Serrano-Fernandez, 2009; Halees, 2012).

Different data mining methods are used for e-learning data analyze, the most common ones are: association, classification, clustering and outlier detections (Escobar-Rodriguez & Monge-Lozano, 2012).

## **Future work**

Electronic study system frequently appears in the focus of the scientific research. The success and relevance of Web Mining (technological category subject to Data Mining) application in study organization has been proven on multiple occasions. The technology has been found especially beneficial in addressing the following issues (Kulvietiene & Sileikiene, 2006; Zimmermann et al., 2011; Ayesha et al., 2010): Forecasting student assessment; Setting student behavior; Student modeling / profiling; E-learning Data Visualization; Training Strategy recommendations; Course structure and organization; Other issues.

Various methods and their algorithms are specific to this technology, i.e.. classification – student profiling according to classes that are formed in advance, clustering – student grouping according to their characteristics, association – revealing relationship between various student data, e.g. the courses and marks that have the major influence on student's attainment level, as well as

forecasting – e.g., forecasting assessment based on the grades of previous years. Their choice depends on the issues raised, the data used and their completeness.

An experimental research using students and teachers data gathered in Moodle learning environment is planned to be conducted in the future. For such research Data Mining would play a fundamental role.

Presently, a copy of database with all the data on the student enrollment on various courses has been developed. The coverage of data collections extends not only to the students involvement in the courses, time they have spent in the system, but also covers information on examination results, student attainment, etc. Such information can be of great value and vast importance when researching applicability of distance learning elements to practical skills development.

Database model that is used in Moodle system consists of more than thirty blocks with the tables grouped according to their purpose (administration part, event part, grade part, user part. etc.).

As the intellectual analysis would not require all the tables, only those that are relevant should be chosen. Before application of Data Mining technology data from various sources have to be selected and “cleared”, later transformed into appropriate format and loaded into database, where algorithms of Data Mining technologies will be applied.

### **Conclusions and recommendations**

Applicability of Moodle in distance learning is researched in nonspecific manner with emphasis on satisfaction of participants in the study process where different Moodle activities are employed. Yet, research into what particular activities are most appropriate for developing specific skills, is lacking. While analyzing scientific literature, most attention was devoted to research into distance learning in the development of practical skills (disciplines that are not related to IT). As the means to develop these skills require substantial investment of time, money, intellectual resources, a typical answer is blended learning, face-to-face classroom methods are combined with computer-mediated activities, and which still presents academia with a large field for the research.

The overarching aim of this research was to examine opinion of students and lecturers about the applicability of Moodle elements. The results clearly indicate that the overall experience with Moodle is good, and that e-learning is beneficial from the point of educology, but complicated in technological respect. As the scope of the present study was not broad enough to allow generalization of the results, it calls for further research with more participants involved. An experimental research would benefit from collecting students and lecturers' data from the Moodle system. It would allow to develop database with information

which could prove highly beneficial for researching distance learning in the development of practical skills, such as participation of students in different e-courses, the time they spend in the system, the results of their progress assessments and examinations, etc. Data mining can be a great scientific instrument in identifying factors leading to successful study process and results, improving adaptation and personalization of the learning environment, etc.

### References

- Ayesha, A., Mustafa, T., & Khan, M. I. (2010). Data Mining Model for Higher Education System, *European Journal of Scientific Research*, vol.43, no.1, 24-29.
- Amandu, G.M., Muliira, J.K., & Fronda, D.C. (2013). Using Moodle E-learning Platform to Foster Student Self-directed Learning: Experiences with Utilization of the Software in Undergraduate Nursing Courses in a Middle Eastern University, *Procedia - Social and Behavioral Sciences* 93, 677 – 683.
- Barge, P., & Londhe, B.R. (2014). From Teaching, Learning to Assessment: Moodle Experience at B'School in India. *Procedia Economics and Finance*, 857 – 865.
- Buldu, A., & Üçgün, K. (2010). Data Mining Application on Students' Data. *Procedia Social and Behavioral Sciences* 2, 5251–5259.
- Er, E., Özden, M., & Arifoglu, A. (2009). A Blended E-learning Environment: A Model Proposition for Integration of Asynchronous and Synchronous E-learning, *International Journal of Learning*, 16(2), 449-460.
- Escobar-Rodriguez, T., Monge-Lozano, P. (2012). The Acceptance of Moodle Technology by Business Administration Students. *Computers & Education*, 58, 1085–1093.
- Halees, A. (2012). Mining Students Data to Analyze e-Learning Behavior: A Case Study.
- Harris, J., Mishra, P., & Koehler, M. (2009). Teachers' Technological Pedagogical Content Knowledge and Learning Activity Types: Curriculum-based Technology Integration Reframed, *Journal of Research on Technology in Education*, 41(4), 393-416.
- Kulvietiene, R., & Sileikiene, I. (2006). The Blended Learning Design and Delivery Method, *WSEAS Transactions on Information Science and Applications*, 12(3), 2360-2366.
- Martin-Blas, T., & Serrano-Fernandez, A. (2009). The role of New Technologies in the Learning Process: Moodle as a Teaching Tool in Physics, *Computers & Education*, 52, 35–44.
- Merceron, A., & Yacef, K. (2005). Educational Data Mining: a Case Study, *Proceedings of the 12th International Conference on Artificial Intelligence in Education AIED*, IOS Press, 20-26.
- Nate, S., & Zwillig, M. (2014). Student data mining solution–knowledge management system related to higher education institutions. *An International Journal*, 2013 Elsevier Ltd. *Expert Systems with Applications* 41, 6400–6407.
- Papamitsiou, Z., & Economides, A. (2004). Learning Analytics and Educational Data Mining in Practice: A Systematic Literature Review of Empirical Evidence. *Educational Technology & Society*, 17 (4), 49–64.
- Reis, L.O., Ikari, O., Taha-Neto, K.A., Gugliotta, A., & Denardi, F. (2015). Delivery of a Urology Online Course Using Moodle Versus Didactic Lectures Methods, *International journal of medical informatics*, 84, 149–154.

- Simovic, V., Kozina, G., & Zupan Milkovic, Z. (2014). E-learning Systems – Support to Quality Teaching, *Proceedings of the 5th International Conference on Education and Educational Technologies*, Malasia.
- Tuijnman, A., & Boström, A. K. (2002). Changing Notions of Lifelong Education and Lifelong Learning, *International Review of Education*, 48(1/2), 93–110.
- Volungevičiene, A., Teresevičiene, M. (2008). Quality Assessment Dimensions of Distance Teaching/Learning Curriculum Designing, *The quality of Higher education*, 32-53.
- Zimmermann, J., Brodersen, K. H., Pellet, J. P., August, E., & Buhmann, J. M. (2011). Predicting Graduate-Level Performance from Undergraduate Achievements., *Proceedings of the 4th international conference on educational data mining*, 357–358.