

Using Communication and Collaboration Tools in Virtual Learning Environments Moodle for Mathematics in Primary School

Renata Kondratavičienė

Vytautas Magnus University,
Lithuania

r.kondrataviciene@pdf.viko.lt

Abstract. With the advancement of information and communication technologies, teaching mathematics in a real-life classroom is combined with teaching in a virtual learning environment (VLE). It is important to determine how a primary school teacher can use VLE communication and collaboration tools to teach mathematics primary school students.

Participants – 4th grade students ($n = 51$). Access to quantitative studies has been chosen for the study. **Methods of study:** Analysis of scientific literature, testing, descriptive statistics, and inference statistics. Data from the pilot study and the educational experiment were processed using version 23 of the IBM SPSS Statistical Package for Social Sciences. The normality of the variable distribution was tested using the Shapiro-Wilk test. Throughout the research, decisions are taken at a value $\alpha = 0.05$. Study adhered to the fundamental principles of the European Code of Conduct for Study Ethics. The curator of the education was in contact with the students and their parents by e-mail and using the VLE communication and collaboration tools (messages, forums, feedback). The aim was to find out whether the number of emails and messages sent by the curator affected the students' learning time in the VLE. The hypothesis of zero Pearson coefficient equality in the population is checked.

There was a statistically significant weak relationship between the number of emails sent by the curator of the curriculum, the number of messages for students and the time spent by the student for the lessons of the curriculum. There was a mean relationship in the boy's group, but there was no statistically significant relationship in girls' group.

There was also a statistically significant weak relationship between e-mails sent by the curriculum curator, the number of messages sent to students and the evaluation of the lessons of the curriculum. There was an average relationship in the boy's group, but in the girl's group there was no statistically significant relationship between the emails sent by the tutor, the number of messages to students and the evaluation of the lessons of the curriculum. This confirms the theory of

constructivism that VLE is suitable for education because teachers can act as learning facilitators to communicate with each other during learning.

Keywords: mathematics, primary school students, virtual learning environments Moodle.

INTRODUCTION

The further, the more teaching(s) in a real-life classroom is combined with teaching and learning in a virtual learning environment (VLE). Research shows that the use of a VLE in education encourages students to take responsibility for their learning achievements, to learn collaboratively [1], and for the teacher to communicate with students' parents [2].

Looking at the use of VLE in teaching mathematics, it was found that virtual learning engages the student into the learning process, allows for collaboration with remote students [3]. Integration of virtual reality game elements by learning to apply fractional operations in real life, promotes better mathematical achievements of primary school students [4]. The use of problem-solving methodologies integrated with advanced computer environments, automated assessment, and web conferencing systems in a VLE promotes student interaction and helps teachers train students to design, speculate, explore, test, and verify [5]. In modern VLE, the use of integrated communication and collaboration allows to advise and evaluate the student's knowledge and abilities, to offer him the most suitable individual learning path [6], to develop responsibility and integrity by performing interactive tasks [7].

From the research carried out, we can see that attention was paid to the development of mathematic abilities of primary school pupils in the VLE. However, there is still a lack of a holistic approach to the use of VLE's Moodle

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communication and collaboration tools to develop the mathematic abilities of primary school students. In view of the situation discussed, the scientific problem of the research is formulated – how a primary school teacher can use the VLE Moodle communication and cooperation tools to promote the development of mathematics abilities of primary school students. The problem issue highlights the object of the study – the use of communication and collaboration tools in the VLE Moodle for learning mathematics in primary school. The aim of the research is to reveal the use of VLE Moodle communication and collaboration tools to develop the math skills of primary school students. Methods of research: analysis of scientific literature, testing, descriptive statistics, and inference statistics.

LITERATURE REVIEW

VLE is a learning management system with learning content, communication and evaluation tools, links to additional sources of information [6]. When learning in a virtual learning environment, the teacher helps the student using the tools of the virtual learning environment [8]: content management; preparing tasks and organizing surveys; student learning, tracking and evaluation of progress; administration-management tools; communication and collaboration tools. Communication and collaboration tools (conversations, videoconferences, messages, discussion boards, calendars, feedback) are designed to support remote communication between participants in the learning process [9].

Learning in Lithuania, as in the world, is used both commercially and open source VLE. However, the commercial VLE is paid and not accessible to all students and teachers. Therefore, as an alternative to commercial VLE, open-source environments are created and distributed free of charge, which can be customised to their own needs without prejudice to the license agreement. Open-source VLE Moodle developed by Australian scientists is widely used in Lithuania. In this environment, teachers can publish educational materials, present homework, develop knowledge and competence tests, communicate with students and their parents. VLE Moodle offers a student-centred toolkit and a friendly learning environment (see Table 1).

Table 1 VLE Moodle TOOLS

VLE Moodle Tools	VLE Moodle Function
Educational Content Management Tools	Ability to create educational content using internal content creation tools, insert content from external sources [9].
Tools for drafting tasks and organizing surveys	Ability to create tasks, tests, compile and submit surveys using a wide range of tools, activities, and resources.
Students' learning, progress monitoring and evaluation tools	Possibility to apply automated, manual evaluation, self-assessment, peer, individual or group assessment, including interactive content [9]
Communication and cooperation tools	Ability to communicate synchronously and asynchronously, to use co-creation activities.

Administration-Management Tools	Convenient user registration, user interface.
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It is noted that students who communicate in a virtual environment often engage in tasks and problem solving, therefore virtual environments are increasingly included in math learning so that students can learn to solve problems [10]. By integrating elements of virtual reality game by learning to apply fractional operations in real life found better mathematical achievements for primary school students.

RESEARCH METHODOLOGY

To determine the experience of VLE tools using in math lessons, a group of subjects was formed using availability sampling, where the general sample units are included in the sample that are most accessible to the researcher. The sample size was determined using the Paniotto single-level randomisation formula. Participants of the research (n = 51) are 4th grade students.

The systematic analysis of literature helped to understand the benefits of applying the VLE in learning mathematics. However, an instrument suitable to determine the impact of the use of VLE communication and cooperation tools on the development of mathematical abilities of primary school students was not found. Therefore, first, a mathematical competence development program was developed and validated and placed in a virtual learning environment Moodle. In the selection of the tasks, the topics of educational content that were studied by class 4th grade students during the study were considered. The topic of content was analysed not only in the documents regulating the content of education in Lithuania but also in the International Mathematics and Sciences TIMSS program.

The study used open source VLE Moodle to support modelling and pedagogical interaction of educational learning content. This environment was chosen with the support of researchers [11] insights, researcher's experience to administer and organize education(s) VLE Moodle, free access to the VLE environment.

Before creating the lesson tasks, the tasks were piloted. The process of testing the tasks allowed to see typical mistakes made by students, to turn part of the tasks into a closed type to suit the lessons electronically in a virtual learning environment. Each task and its assessment instruction were tested in a group of 14 students, and by evaluating and considering the results obtained, modelling the compliance of the task with the level of student learning achievement, cooperated with 3 teachers and 2 scientists.

The lessons of the curriculum were prepared using the activity "Test" of the VLE Moodle. The author of the study gave all lessons to 4th grade students (25 boys and 26 girls) remotely. After each lesson, she provided feedback to students using communication and collaboration tools. Her parents and teachers helped her to organise the pupils' participation in the classes.

Research adhered to the fundamental principles of the European Code of Conduct for Research Ethics [12]: reliability, integrity, respect for colleagues, responsibility for research. Research Ethics Principles provide that students' participation in the study should be voluntary. Participants were informed that they could withdraw from the experiment whenever they wished and not to exert any pressure if this happened. However, regular contacts were maintained with the pupils, their parents and teachers who participated in the study to avoid spill overs. According to [13], the data collection procedure may raise concerns among study participants about its unusualness and novelty. In view of this threat, the investigator reassured the participants in the study before collecting the data, providing them with as much information as possible on the data collection procedure and dispelling concerns about data collection in a preventive manner.

The survey data was processed using version 27 of the IBM SPSS Statistical Package for Social Sciences.

RESEARCH RESULTS

We will discuss the results of the virtual learning environment Moodle communication and collaboration tools for learning mathematics. The general parameters of the activities carried out during the 4th grade education programme were analysed: number of emails, messages, student's time for educational program lessons, estimates of lessons of the curriculum.

The Shapiro-Wilks test was used to verify the normality of the distribution of those activities. It was found that the data for class 4th grade student' educational programme lessons scores, e-mails sent, number of messages, and time spent on the curriculum were distributed according to the normal law (see Table 2).

TABLE 2 RESULTS OF THE SHAPIR-WILK CRITERIA

Activities of the Education Programmer	Shapiro-Wilks Criteria		
	Statistics	Number of degrees of freedom	Meaning of P
Number of emails, messages	0,974	51	0,333
Time spent by the student for the educational program	0,961	51	0,089
Educational Program Lesson Task Estimates	0,962	51	0,100

For digital data, the Pearson criterion was used for the calculation of the correlation coefficient in the case of a normal distribution (see Table 3).

TABLE 3. RESULTS OF THE PEARSON CORRELATION COEFFICIENT

Activities of the Education Programmer		Educational Program Lesson Task grade	Number of emails, messages	Time spent by the student for the educational program
Time spent by the student for the educational program	Pearson's correlation coefficient	0,890**	0.401**	1,000
	Meaning of P	0,000	0,004	
Number of emails, messages	Pearson's correlation coefficient	0,475**	1,000	0.401**
	Meaning of P	0,000		0,004
Educational Program Lesson Task Estimates	Pearson's correlation coefficient	1,000	0,475**	0,890**
	Meaning of P		0,000	0,000

Curator of the curriculum, author of the study, contacted students and their parents by e-mail and using the communication and collaboration tools (messages, forums, feedback) in the virtual learning environment Moodle. As part of the lessons of the curriculum, students in primary classes had the opportunity to receive answers to their questions.

13 letters were sent to all students: the first – sending login data to the Moodle environment, the second – inviting you to participate in the educational program, third-eleventh inviting nine lessons of the educational program remotely, twelfth – inviting you to take a final test, thirteenth – sending gratitude to students for their participation. In addition, more emails and messages were sent to the students by repeatedly inviting them to take one or another test or to perform lesson tasks by answering students' questions. The number of emails and messages sent to students by the curator of the programme can be seen in "Fig. 1".

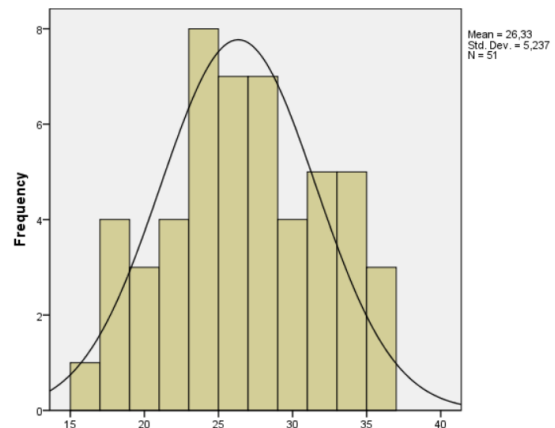


Fig. 1. Number of emails and messages sent to students by the curator of the education programme.

It was wanted to find out whether the number of emails sent by the curator of the education programme to the students had an impact on the time spent on the curriculum. The hypothesis of the population's Pearson coefficient equal to zero: $H_0: \rho = 0$; $H_a: \rho \neq 0$. The results of the linear correlation analysis are presented in Table 2.

The study showed a statistically significant ($p = 0.004$) weak ($r = 0.401$) relationship between emails sent to students by the curator of the curriculum, the number of messages and the time spent by the student for the lessons of the curriculum. In the boys group ($r = 0.599$), there was no statistically significant relationship in the girls group ($p = 0,180$). Thus, our study confirmed the idea expressed by other authors that educational activities organized by the VLE should be based on pedagogical interaction [14].

There was also a statistically significant ($p=0.000$) weak ($r = 0.475$) relationship between emails sent to students by the curator of the curriculum, the number of messages and estimates of school lessons. In the boys group ($r = 0.581$), there was no statistically significant relationship between e-mails sent by the curator of the education programme, the number of messages to pupils and estimates of school assignments in the girls group ($p = 0.015$). That learning in maths in a virtual learning environment can be more effective than conventional learning is also supported by other authors [15], arguing that similar learning outcomes are achieved in less time and effort.

CONCLUSIONS

After evaluating the impact of using the communication and collaboration tools of the VLE Moodle on the development of students' mathematical abilities, it can be concluded that the number of e-mails sent by the curator of the educational program had an impact on the student's time devoted to learning and the estimations of the tasks of the educational program lessons.

There was a statistically significant weak direct link between emails sent to students by the curator of the programme, the number of messages and the time spent by the student in the curriculum.

A strong direct statistically significant link was established between the time spent by the student for the lessons of the curriculum and the estimates of the lessons of the curriculum.

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