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Relation between Moodle Activity and Student Performance in the Context of EFL Training in Higher Education

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Abstract

The paper aims to explore the relation between students' Moodle activity during different semester phases, measured through the total number of logs and quiz logs, and their final test score. The study takes a quantitative approach to the analysis: Spearman's rank test is used to identify the presence and direction of correlation between variables in a sample of 53 observations, and linear regression is performed to probe the strength of this relation. The results show that there is a similar significant moderate correlation for the first and the second month of the formal instruction period and no significant correlation for the examination period. The outcomes of linear regression are statistically significant and suggest that Moodle activity can account for about 25% of the variation in the final score. Both students' quiz activity during the formal instruction period and during the examination period are significantly moderately correlated with the final test score, which results in the suggestion that diverse interactive content that allows practicing and revising the material is of great importance in an effective e-learning course. A relatively robust moderate correlation between Moodle activity in the first month and the final test score suggests that educators can use Moodle statistics from as early as the first four weeks of instruction to identify procrastinating students and low achievers.

Keywords: e-learning, LMS Moodle, educational data mining, EFL, course performance

1 Introduction

Learning management systems (LMS) as a type of centralised virtual environment for creating and managing e-learning courses has been steadily into educational sphere, complementing and substituting traditional learning settings. With the onset of the COVID-19 pandemic, the use of LMS software such as Moodle turned from optional to necessary or even mandatory, as observed by Guncaga et al. (2022) in a cross-cultural study involving the Slovak, Czech and Kazakh national contexts. This change also fuelled pedagogical and scholarly interest in the opportunities and limitations associated with the transposition of the teaching and learning process into the virtual space.

The scope of the use of e-learning tools in English as a Foreign Language (EFL) studies in a higher education context is quite broad. Results of recent research suggest that Moodle in particular can be used effectively to train individual communicative language skills such as reading comprehension (Bataineh & Mayyas, 2017; Ismail, Rahmat & Emzir, 2020), written (Mujiono & Fatimah, 2022) and oral production (Manan, Emzir & Rahmat, 2019), to expand the mastery of grammar (Bataineh & Mayyas, 2017; Pumjarean, Muangnakin & Tuntinakhongul, 2017) and vocabulary (Malmir & Aghazamani, 2019) or to train partial linguistic competences such as phonetic and phonology competence (Vančová, 2020). Successful use of Moodle can also be witnessed in the adjacent area of English for Specific Purposes (ESP) within non-philological studies (Shalatska, Zotova-Sadylo & Muzyka, 2020). Modern ICT tools such as Kahoot! quizzes and escape rooms can

be used to increase the attractiveness of Literary Studies courses within EFL study programmes (Hrinak, 2021).

Two broad uses of Moodle for educational purposes can be outlined. First, it can work as a repository of information contained in resources such as Book, File, Folder, Label, Page or URL. Apart from that, Moodle courses can be enhanced by more dynamic activities, including assignments, quizzes, forums, surveys, and other units. One of the issues of interest that arises in this regard is the relation between students' Moodle work and their final performance. This can be explored more easily compared to the data from face-to-face educational settings thanks to the log tracking statistics that accompanies every course and can be processed using educational data mining techniques. Another issues worth exploring is the extent to which Moodle data can be used to predict students' final performance, which particularly important in a situation where a substantial share of face-to-face teaching and learning is substituted by e-learning activity. The present paper aims to address these issues in the context of EFL studies at the tertiary level in the national context of the Slovak Republic.

2 Literature review on the impact of Moodle on university students' academic performance

The introduction of Moodle-based blended learning into study routine within academic courses has consistently demonstrated a positive effect on student performance across multiple national contexts. Among the research efforts in this direction, both a longitudinal (e.g., Quinn & Gray, 2020; Umek et al., 2015) and a cross-sectional (e.g., Novo-Corti, Varela-Candamio & Ramil-Díaz, 2013; Núñez et al., 2011; Yüksel, 2022) approach to study design can be noticed, which can be said to enhance the validity of the conclusion on the effectiveness of Moodle in higher education settings. A longitudinal study by Umek et al. (2015) was based on a sample collected over a consecutive six-year period at the same faculty, involving the same lecturer and the same generation of students for each compulsory course that was first taught without the use of Moodle and then was modified to incorporate it. The analysis detected a significant improvement in the academic performance, reflected in a higher average final grade and a lower average number of attempts to successfully complete final evaluation. A meta-study by Kim and Kim (2013) also provides an insight into the matter in a time-related perspective, namely by analysing the results of research efforts on e-learning in the South Korean context over a ten-year period starting from 2002. Overall effectiveness of e-learning in this research effort was identified as positive but associated with a relatively small effect size.

The design and results of cross-sectional studies indicate that the effectiveness of e-learning tools tends to be explored predominantly against students' mastery of declarative knowledge in the given academic field (e.g., Novo-Corti, Varela-Candamio & Ramil-Díaz, 2013; Yüksel, 2022). For instance, Novo-Corti, Varela-Candamio and Ramil-Díaz (2013) observed that students' e-learning activity in the form of on-line tests completion is associated with an increase in their scores. The final evaluation in this research effort was focused on retrieving what the authors refer to as "conceptual relating knowledge" and on probing the depth of understanding of the given specialised subject (Microeconomics). Both above-mentioned components appear to be related more closely to the knowledge dimension rather than the skill dimension of proficiency.

Even if a research effort takes into consideration both the declarative knowledge dimension and the practical application dimension, the latter appears to demonstrate weaker responsiveness to the positive impact of e-learning. This can be seen quite clearly from a quasi-experimental study by Núñez et al. (2011) that was focused on enhancing

the mastery of self-regulated learning strategies by students of Education and Psychology study programmes through a Moodle course. The analysis detected a significant improvement in the declarative knowledge of students taking the Moodle programme and a less marked but still statistically significant improvement in their approaches to learning and academic performance. Both approaches to learning and academic performance were treated as areas where the acquired declarative knowledge should be naturally applied in practice once it has been effectively mastered, even though the application competence of students was not specifically targeted in the course itself.

Another important issue regarding the use of LMS Moodle in higher education is the relation between the intensity of the use of the given e-learning platform and its components on the one hand and final course performance on the other hand. Correlation studies that use total Moodle logs as empirical data were able to detect a significant weak to medium correlation in this respect, spanning from the minimum of r=0.14 in Alves et al. (2013) to the maximum of r=0.45 in Viegas et al. (2012) depending on the type of course being monitored, the share of e-learning activities and the structure of the final evaluation.

When the sum of Moodle logs is broken down into individual variables, research reveals that some of them are more closely associated with final academic performance than the others. Quinn and Gray (2020) found out that the variables that demonstrate highest correlations (>0.4) are login regularity, assignment views, assignment submissions, total activity, and weekday activity. These individual factors demonstrate some variation as far as their nature. Login regularity has to do with the mode of students' semester-long activity, while total activity and weekday activity are related to its intensity, and assignment views and submission are productive actions, as opposed to accessing resources, which work as passive repositories of learning material. Similar findings are provided in Jokhan, Sharma and Singh (2018), where average logins per week and average completion rates of activities can be used to predict students' performance at the early stages of the course with an accuracy of 60.8%.

If we take a closer look at individual Moodle activities, their relation to the final performance appears to be more readily explainable by the features of the learning content rather than the technical form. More specifically, student actions on those modules the content of which appears to be the most important in view of the requirement of the final evaluation tend to correlate more strongly with final scores. For instance, Filippidi, Tselios and Komis (2010) identified three factors that appear to correlate significantly with the final performance, namely moderate use (as opposed to low use), questionnaire view and glossary view. Questionnaires and glossaries are identified by the authors as the two types of modules that allow gaining deeper understanding of the learning materials contained in resource modules. Resource modules in turn provide the basic input that was taken for the minimum threshold that every student should have mastered and thus was not the most prominent part of the final evaluation. On the contrary, resource views have been found to be significantly related to students' performance by Rakic et al. (2020), which can probably be associated with their higher value for final evaluation. Another example of a possible dependency of the correlation strength of modules and their contribution to final evaluation can be found in Alves et al. (2013). The authors admit that the Moodle course was primarily designed to enhance the effectiveness of laboratory classes, which explains why students' continuous assessment (including lab work) was more strongly correlated with Moodle activity than their exam grade.

Alongside assignments, another form of Moodle activities explored in relation to students' performance is the quiz activity. Quizzes are different from assignments in two ways: (1) they can be designed as self-correcting activities and (2) they allow repeated access. With two features combined, a specific quiz activity can represent an interesting interactive tool that allows students to monitor their correct mastery of the target material and to revise it multiple times when needed. Bognár, Fauszt and Váraljai (2021) demonstrated that the intensity of access to quiz activities have a decisively higher positive effect on the final performance than static resources such as pdf-files or videos. Similar conclusions were made by Cerezo et al. (2016) who found out that the time spent on completing quiz activities has a significant moderate correlation (0.45) with the final mark, while the time spent on theoretical content shows no significant correlation.

In contemporary research paradigm, the relation between quiz activity and final performance is explored taking into consideration the number of quizzes taken by students (e.g., Bognár, Fauszt & Váraljai, 2021; Hussain et al., 2018;), students' score on individual quizzes (e.g., Merello-Giménez & Zorio-Grima, 2017) or both (e.g., Aravinthan, Lokuge & Manalo, 2011; Keržič et al., 2018). In general, it has been found that a higher number of quizzes taken by students is associated with a higher final grade, but that the score achieved in individual quizzes does not necessarily correlate with the final performance.

Some interesting take-aways can be found in the papers dedicated to the exploration of the impact of the number of completed quizzes on final performance. Hussain et al. (2018) found out that high numbers of quiz completion have the strongest significant positive correlation (0.55) with the final scores of high achievers, while for moderate achievers the correlation coefficient is only half as large (0.28). Low achievers, on the contrary, seem to demonstrate the negative tendency suggesting that those students who performed poorly in the course might have been those who had made the most quiz attempts with no restrictions being set on their number. Similar findings are provided by Młynarska, Green and Cunningham (2016), who detected a relatively large share of negative correlations between high log numbers and grades. The findings of Bognár, Fauszt and Váraljai (2021) suggest that the impact of the intensity of quiz taking on the final score is limited by the point where higher quiz activity is not associated with any score improvement. In their study this limit appeared at 300 quiz attempts, which makes up a third of all attempts recorded.

Even if the number of quiz attempts is limited, evidence found in Keržič et al. (2018) suggests that there still is significant difference in the performance between students completing more quizzes and those completing fewer quizzes. The completion of quizzes in this case was measured not through their number count but by summing up their partial scores. The researchers also found out that the chances of earning a higher examination grade are increased for students who successfully complete quizzes that integrate multiple course themes and who do not postpone the completion of quiz activity, dealing with it continuously on a week-by-week basis. The last point resonates with Cerezo el al.'s (2016) observation that shorter spans between the time when a quiz was assigned and the time when it was submitted are associated with higher final marks, as suggested by the significant moderate correlation of -0.35. The detrimental impact of procrastination on final performance has also been verified by Yang et al. (2020).

3 Research outline

Taking in consideration the sustained scholarly interest in the impact of students' e-learning activity on their performance, the author of the present paper set out to explore

this issue in the settings of philological EFL training at the tertiary level of studies. To date international research efforts have relied on empirical evidence from the sphere of applied science (e.g., Alves et al., 2013; Viegas et al., 2012;) and social sciences, such as economics (e.g. Merello-Gimenez & Zorio-Grima, 2017; Novo-Corti, Varela-Candamio & Ramil-Díaz, 2013), public administration (e.g., Keržič et al., 2018; Umek et al., 2015;), psychology (Cerezo et al., 2016; Núñez et al., 2011) and education (e.g., Filippidi, Tselios & Komis, 2010; Yang et al., 2022; Yüksel, 2022). However, a certain gap can be spotted in EFL training for the courses that combine theoretical linguistic knowledge with its application in practice. This study, therefore, aims to provide some insights that can help fill this gap.

3.1 Methodology and data collection

For the purposes of the present study, a quantitative non-experimental research design was chosen employing methods of cross-sectional correlation. If a significant moderate correlation is detected, the research effort proceeds with linear regression analysis to find out how the change in the given independent variable or variables affects the change in the dependable variable. Before a linear regression can be performed, the assumptions of regressions (linear relationship, multivariate normality, negligible or absent multicollinearity, lack of autocorrelation and homoscedasticity) are checked.

The data for the analysis were taken from an elective applied linguistic course, which is offered within the Education study programme and the English Language and Anglophone Cultures study programme at the higher educational institution specified earlier as the author's affiliation. The course combines theoretical knowledge about the contrastive features of the British and the American varieties of English with their practical application through independent retrieval from memory or recognition in context. The course also intends to expand learners' orientation in the pragmatics of American English, its regional dialects, ethnolects and slang, as well as broaden their knowledge of the social and cultural background of the U. S. American nation that has influenced the development and the current state of American English. The course was taught by the author of the present paper in the blended form and comprised one face-to-face academic hour and one Moodle module per week. Submissions for the activities with the material that was important for the final evaluation and was not covered during the presence meeting were set as obligatory. Quizzes that allowed practicing the retrieval of the target linguistic items were set as voluntary and accessible without any restrictions. The last quiz in the course provided an opportunity to practice one item from each task of the final test. Even thought the course was offered to the students of all years of the bachelor's degree programme, the majority of the participants were sophomores; students of other years were not included into the study.

The data on students' Moodle activity were approached using the techniques of educational data mining. First, the information about course logs for all participants was acquired from Moodle Reports section. Then the data were cleaned by removing logs that fell beyond the observation period and logs of users who did not take the final test at all or had to take it before the end of the formal instruction period. The set of logs for each participant was refined by excluding event names that belong to a single succession of steps taken to perform the given action in Moodle. For example, submitting of an assignment in Moodle is recorded as three independent events: "A file has been uploaded", "Submission created" and "A submission has been submitted"; only the first one of them was taken into consideration. Event names that were not related to accessing the course content or reacting to it were also deleted.

The data on students' performance was take from their first attempt to pass the final test. It should be noted here that the final evaluation for the course consists of an on-site test and an analysis paper prepared at home. Of these two indicators, only an on-site test could guarantee independence of observation, which is a prerequisite for both correlation and linear regression analysis.

3.2 Research procedure

The refined data on Moodle logs were clustered into four groups: Month 1, Month 2, Month 3, each comprising four weeks, and Exam Period, the logs for which were counted from the end of formal instruction till the examination date that students had the freedom to choose and that was available for every week of the entire examination period. Based on the theoretical premises covered in the Literature Review section, each cluster was broken down into two samples to be studied independently: (1) total number of logs per participant and (2) actions on quizzes per participant. Due to a small number of quizzes and irregularity of their appearance in the course, the cluster for actions on them was subsequently reduced to two samples: quizzes taken during the formal instruction period and quizzes taken during the examination period, referred to as Quiz Semester and Quiz Exam respectively. The descriptive statistics about each of the samples is presented in Table 1.

	Mean	Median	SD
Month 1	29.7	25	23.8
Month 2	46.9	42	40.6
Month 3	59.2	40	57.4
Exam Period	65.1	54	49.5
Quiz Semester	18.9	15	18.9
Quiz Exam Period	15.2	10	15.9
Final Test	32.1	34.8	10.1

Table 1: Descriptive statistics for research samples, n=53

The samples of total activity, quiz activity and final test scores were checked for normal distribution using the Lilliefors test. As multiple samples exhibited a significant difference from normal distribution, the Spearman's rank correlation test was used for analysis. The remaining assumptions of the Spearman's test were fulfilled as scatterplots for the variables showed a monotonic association and the data contained only paired samples of log numbers and test scores.

4 Results

To determine how students' activity in Moodle is related to their results in the final test, the research was divided into stages for each of which a separate research question was formulated.

Q1: Is there a correlation between students' activity in Moodle and their results in the final test?

Correlation analysis using the two-tailed Spearman's rank correlation test (see Table 2) detected a significant positive moderate correlation between Moodle activity during the first (rs=0.5) and the second (rs=0.52) month of the semester and the test results, with correlation coefficient values being very close to each other. There also appears to be a significant weak correlation between the test score and the third month of the semester

(rs=0.37), given a lowered confidence level. On the other hand, there is no statistically significant correlation between students' Moodle activity during the examination period and their final test score.

	Month1		Month 2		Month 3		Exam Period	
	rs	p	rs	p	rs	p	rs	p
Month 2	0.74*	2.00804E-10						
Month 3	0.64*	2,03012E-07	0.67*	5.09293E-08				
Exam Period	0.25	0.08	0.15	0.28	0.2	0.15		
Final Test	0.5*	0.00015	0.52*	5.97192E-05	0.37**	0.0072	0.15	0.28

Table 2: The results of the Spearman's rank correlation test, n=53
*Statistically significant at α=0.001
**Statistically significant at α=0.005

Based on the results obtained in Q1, the next question of interest was formulated as follows:

Q2: Does an increase in Moodle activity result in an increase in the final test score for the samples that showed a significant moderate correlation in Q1?

Simple linear regression was used to test if Moodle activity in Month 1 and Moodle activity in Month 2 significantly predicted the score in the final test. The results of regression analysis for both independent variables in presented Table 3 below.

	Fitted regression model	R^2	R^2 conf. interval, α=.05	St. error	F (1; 51)	β	p
Month 1	y = 0.2088x + 25.878	0.24	[0.10; 0.31]	0.05	16.22	0.21	0.00019
Month 2	y = 0,1239x + 26.272	0.25	[0.06; 0.18]	0.03	16.69	0.12	0.00016

Table 3: The results of simple linear regression
x = Moodle logs, y = final test score, n=53

The regression model was statistically significant for both variables and displayed almost the same predictive power, accounting for about one forth of the variation in test scores. The F value for both regressions was checked against the critical F value for α=.05 from the f-table. With Fcrit= 4.0012 for F (1; 51), both regressions are characterised by F > Fcrit. This allows us to reject the null hypothesis and to accept the H1 hypothesis stating that values of the final test score can be predicted by the values of Moodle activity in Month 1 and Month 2.

The comparison scatter plots for both models (see Fig. 1) reveals that the regression model for Month 1 shows a more homogeneous linear relation as opposed to Month 2, which is monotonic but not quite linear from center to the right.

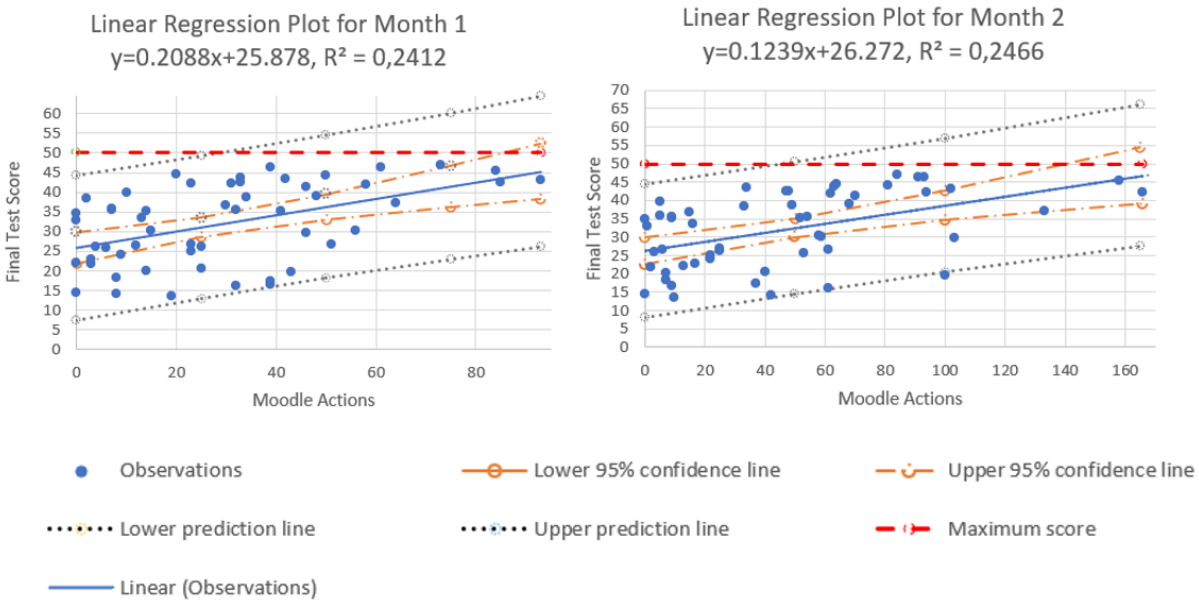


Figure1: Linear regression plots for Month 1 and Month 2

Despite a slightly lower coefficient of determination, the regression model for Month 1 seems to be slightly more robust as a larger share of observations there lies within the 95% confidence interval: 18 observations (34%) for Month 1 and 11 observations (21%) for Month 2.

Q3: What is the correlation between students' quiz activity on Moodle and their final test score?

The results of the two-tailed Spearman's rank correlation test provided in Table 4 detected a significant moderate correlation between both quiz access samples and test scores.

	Quiz Semester		Quiz Exam Period	
	rs	p	rs	p
Final Test	0.48*	0.00024	0.44*	0.00092

Table 4: The results of the Spearman's rank correlation test, n=53
*Statistically significant at α=0.001

Due to the proximity of the correlation coefficients for quiz activity during the formal instruction period and examination period, the next step in the analysis was to explore the relation between Final Test Scores as a dependent value and both quiz samples as two independent valuables and to examine their potential to predict the dependent value. For this purpose, multiple regression analysis was carried out.

The assumptions of multiple linear regression were checked to validate the adequacy of its subsequent interpretation. More specifically, the model contained no outlier as the nominal values of only two standardized residuals exceeded 2, but only slightly (2.04 and

2.31). The time series plot of residuals showed a barely identifiable downward shift of the trendline, while none of the residual plots contained any curvature. This was taken for the verification of the independence assumption. Variance Inflation Factor (VIF) for each independent value (1.3 and 1.16) did not substantially exceed the no-correlation limit of 1, which was accepted as a sign of lack of multicollinearity. The constant variance assumption was verified from the random distribution of residuals with no polynomial curvature on the Residuals vs. Fitted Values plot. The results of the Lilliefors test indicate that there is a non-significant difference from the normal distribution ($D(53) = 0.093$, $p = 0.304$), which allowed verifying the normality assumption.

The results of the multiple regression analysis are presented in Table 5 below.

Independent variables		Coefficients	Standard error	t Stat.	p
Semester Quiz Activity		0.219	0.07	3.24	0.002
Exam Quiz Activity		0.15	0.08	1.88	0.066
Constant		25.669	1.87	13.7	1.46E-18
R2	= 0.29				
F	= 10.15	p<0.05			
n	= 53				

Table 5: The effect of quiz access on final test scores

The results of multiple regression indicate that students' quiz activity during semester significantly predicted their final test score. Quiz activity measured during the examination period, however, did not demonstrate significant predictive power in this respect.

5 Discussion

The presence of a significant moderate correlation between the total number of Moodle logs for the first two months of an academic semester and the final test score, which was detected by the present research effort, can be used to highlight the importance of sustainable and coherent activity from the side of the students during the entire length of formal instruction. This seemingly obvious conclusion is further backed by a lack of significant correlation between the final score and Moodle activity during the examination period. In practice, this means that intensified activity during the weeks immediately proceeding an exam date is not likely to compensate for procrastinating with one's studies during the first two months of a three-month long formal instruction period. The presence of a lower correlation for the third month of the semester can be explained by an external factor that had to do with an obligatory course requirement for some of the assignments to be submitted by the end of the formal instruction period. Thus, Moodle activity of some procrastinating students intensified close to the end of the semester as they had to submit a larger share of assignments than continuous performers.

While total Moodle activity during the examination period was not significantly related to the final score, quiz activity during the same period demonstrated a significant moderate correlation that was only slightly lower than the correlation for the formal instruction period. These findings can be translated into a conclusion that successful course performance rests on the continuous mastery of material during formal

instruction time coupled with a purposeful use of interactive e-learning activities for revision while preparing for the final test.

The confidence interval for the coefficient of determination appears to be sounder for Month 1 than for Month 2, reaching the mark of 31% in the upper confidence limit as opposed to 18%. This allows us to suggest that students' performance as early as the first four week of the semester can help identify them either as failing students and prospective low achievers or as prospective moderate and high achievers. The data from the next four weeks of the semester, can confirm such a prediction, especially if they correlate strongly with the values for the first month of formal instruction.

It is curious to note that the expected mean test score value with zero Moodle activity in either Month 1 or Month 2 is almost the same in both cases and rounds up to 26, which is roughly half of the maximum score. According to the results of the multiple regression, the same mean score appears to be achievable without quiz activity at all. In practice, this means that students can achieve a passing score with low e-learning activity, but consistent Moodle work and specifically quiz taking can increase their chances of reaching the pass mark. The β-values suggest with 95% of confidence that for one-point increase in the final score a student might need to use Moodle about five times during Month 1 or about eight times in Month 2. A significant strong correlation between Month 1 and Month 2 leads us to an assumption that both these criteria should rather be met for the final score increase. A one-point increase in the final test score also requires taking five quiz attempts during the formal instruction period and seven quiz attempts while preparing for the exam.

One of the limitations of the present study is the inability of the author to secure random sampling. The randomization of the available convenience sample consisting of the course participants (n=53) would produce a random sample of fewer than 30 observations and would thus have a diminished confidence interval. At the same time the research sample can be said to approach randomness as it includes students from all EFL study programmes offered by the University, who come from all parts of the country (Western, Central and Eastern) and were not pre-selected by an entrance examination. The research results can thus be applicable on a population of second year students of EFL in the Slovak national context.

Relatively low coefficients of determination emerging from the regressions account for about one fourth of the variation in the final test score. This means that the models' usability is not for predicting the final score as precisely as possible, but rather for identifying Moodle activity patterns that are associated with low test scores and can then be remedied by an educator through purposeful intervention.

Apart from e-learning activity and quiz taking intensity, other variables might have impacted students' final test score. None of the quizzes and assignments from the formal instruction period were counted towards the final score and only some of them very labelled as mandatory for submission, which means that the decision on how to approach Moodle work largely relied on the study habbits of students and reflected their overall attitude to their academic performance and self-expectations. As correlation works in both ways, two complimentary conclusions can be drawn from the results. We can conclude that active users of Moodle during the first two month of the semester are likely to get higher score results. Alternatively, high achievers are likely to use Moodle more often as their keep track of the course progress and their duties. Students' overall academic excellence can also constitute a factor worth considering. Some of the quizzes were specifically highlighted by the tutor as those that could help prepare for the final

test. Low achievers' increased access to them, however, did not result in the improvement of their final score.

Conclusion

The findings of the present study suggest that Moodle active as early as the first four weeks of the semester can be indicative of the dynamics of students' progress through the rest of the formal instruction period and their performance in final evaluation. Therefore, it would be advisable that educators pay particular attention to Moodle course participation statistics during the early stages of the course to identify procrastinating students and take purposeful action to engage them more effectively into Moodle activity during the middle part of the course. It turns out that Moodle activity can account for about 25% of the variation of the final score, which means that students are potentially able to reach the pass mark taking very few actions on Moodle. However, increased Moodle use can help safeguard the passing score for low achievers and increase the final score for moderate achievers. An important implication for educators in this regard is the need to go beyond the merely repository function of Moodle and to create diversified interactive content including quizzes. Availability of a sufficient number of quizzes that allow practicing the target material over the formal instruction period and revise it during the examination period is also important as students' quiz activity appears to significantly correlate with their final performance during both periods.

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