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E-Homework with Feedback on the Topic of Momentum in the E-learning Environment Moodle and its Analysis

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Abstract

Important aspect of learning is a feedback. The feedback is very important part of the teaching process for students and for teachers, too. The feedback offers information about student's knowledge and subsequently about the success of the teaching process. One way how to get the feedback is by testing. In this article we deal with testing as a studying instrument in the form of e-homeworks. These e- cases offer the feedback for students. Thanks to this feedback students can ameliorate their knowledge during studying of the concrete topic at home. Using testing as a studying instrument reveals the question how to properly set up feedback for students so the testing will be effective. We use two types of e-homeworks. First type is with basic feedback and second type is with comprehensive feedback. We tested students in the first class of two highs schools. The tested topic was mechanics (momentum). On the base of the results we analysed e- cases, specifically we analysed all steps and the time needed for the correct solving of e- cases.

Keywords: *feedback, e-Homework, testing, e-test;*

1. Introduction

Feedback is an important part of teaching process in all the schools. It is important the feedback was followed by a process itself. Homeworks and preparation at home is also an important part of teaching process. In this article we deal with the analysis of e-homework by using the Moodle on amos.ukf.sk that offers a tool for testing and feedback. This portal offers e-tests on the topic of *Momentum.* Tests are available in two modes. First one is with basic feedback (BFB) and second one is with a comprehensive feedback (CFB). E-tests with BFB give only basic information to the pupil after solution of each e-homework. It means correct result and an assessment whether the answer is correct or incorrect. E-tests with CFB give the answer as BFB but additionally they provide detailed information, instructions for e-homework solution. We used mentioned e-tests stored on portal as a source for testing on two high schools in Nitra. Pupils were divided according to the classes in two groups. One group (B) was dealing with BFB e-tests and the second group (C) with CFB e-tests. In our previous study [1-2] we have shown that, when dealing with series of very similar tasks was the development of students' success with BFB tests and with CFB tests very different. The first tasks brought significant success in CFB group. The success of the BFB group was strongly behind. After solution of 4th and 5th task the success of BFB improved significantly and after 6th task it was in a leading position. This result was in accordance with the ENKI model (see [1-7]). The aim of this article is an analysis of the feedback impact on the students' success in solution of physical tasks in case where tasks are not similar. Students were faced with tasks of different difficulty (in number of necessary physical steps and in number of mathematical steps). Average success rate in dealing with particular tasks of e-test are shown in Chart 1 that compares success rate of group BFB and CFB [8]. The data is given in Table 1. The average time needed to solve both types of e-tests - see Table 3.

2. Testing Methodology of e-homework

There has been created 8 simple e-tasks on the topic *Momentum* and published on the portal amos.ukf.sk. Tasks 1 and 8 were the same. They varied only in a value of physical quantities.The only difference between the BFB and CFB tests were in the above mentioned feedback. Students were forced to create an account on the portal and after log in they had to solve e-test. E-test on the topic *Momentum* was intended for homework. Test was set up in a way that students have not been able to return to the previous e-task. Tasks were not randomly mixed (students solved tasks in determined order). Students had unlimited period of time so they could solve e-homework at any time for one week. Before the test was given to students, the topic was thought on the respective lesson. E-test

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with BFB was addressed to 36 students and e-test with CFB was addressed to 25 students. Students who have responded to all the e-tasks incorrectly (20 and 4) or have replied to all e-tasks properly (3 and 2) were excluded from further analysis. Thus, we included 13 results in the BFB group and 19 results in the group CFB in our analysis. Example of comprehensive feedback can be found in [1,2,9].

3. Results

Chart 1 shows the average success rate students reached when solving particular e-tasks (*blue bars*– results achieved in the e-test BFB and *white bars* – results achieved in the e-test CFB).

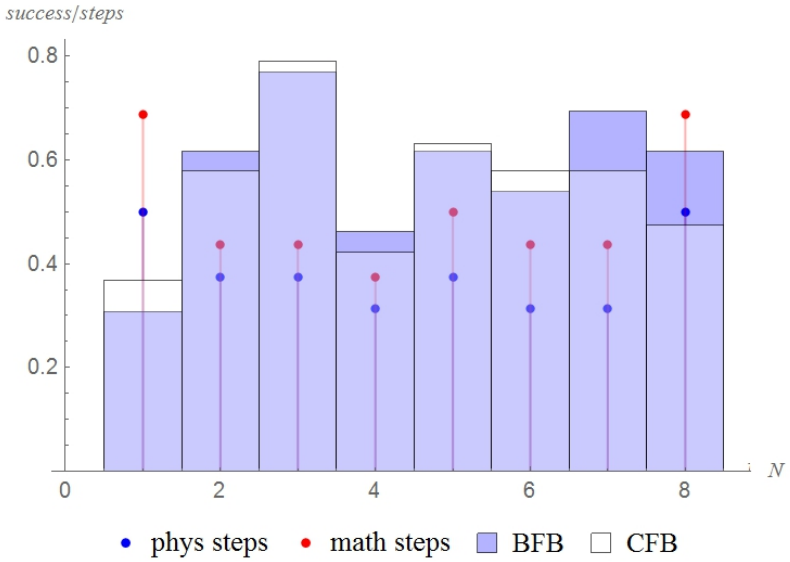

Chart 1: The success rate of e-homework (*blue bars* – BFB, *white bars* – CFB) and the number of steps (blue dots - number of physical steps, red dots - number of mathematical steps).

Table 1: Values of students' success in particular e-tasks

task	1	2	3	4	5	6	7	8
Success rate of BFB	0.44	0.69	0.81	0.56	0.69	0.63	0.75	0.69
Success rate of CFB	0.43	0.62	0.81	0.48	0.67	0.62	0.62	0.52
physical steps	8	6	6	5	6	5	5	8
math. steps	11	7	7	6	8	7	7	11

Established hypotheses:

Hypothesis H_{A0}: Success rate of students in the tests with BFB and CFB is the same (the feedback has no impact on their results).
Hypothesis H_{A1}: Success rate of students in the tests with BFB and CFB is not the same. Difference is significant.
We used Hotelling's two-sample test for hypotheses verification [10] p.198. The Hotelling's test gives an easy rule for comparing two mean vectors. At first, we test the hypothesis of equal mean vectors in the two groups under the assumption of equality of the two covariance matrix. The probability that the hypothesis H_{A0} is valid is $p_{A1} = 67\,\%$. We also tested the case where equality of covariance matrix was not expected [11]. In this case the probability that hypothesis H_{A0} is valid is $p_{A2} = 54\,\%$.
Differences between groups BFB and CFB are not statistically significant. Practically, it did not matter if students dealt with e-homework with or without the feedback. Feedback did not affect the obtained results significantly.

Further we investigated to what extent the number of required physical steps or mathematical steps affected the students' success rate.

Hypothesis H_{B0}: Success rate of students in the tests with BFB and CFB is not affected by the number of required physical or mathematical steps.
Hypothesis H_{B1}: Success rate of students in the tests with BFB and CFB is significantly affected by the number of required physical or mathematical steps.
We investigated the correlation between students' success rate in e-tasks resolving and the number of physical steps or mathematical steps. In e-test was 8 examples (less than 10), therefore we used the recommended method mentioned in [10] p. 88.
Hypothesis H_{B0} for physical steps is rejected on the significance level $\alpha_{\text{phys,BFB}} = 3{,}0\ \%$ and $\alpha_{\text{phys,CFB}} = 1{,}1\ \%$. Hypothesis HB0 for mathematical steps is rejected on the significance level $\alpha_{\text{math,BFB}} = 0{,}09\ \%$ and $\alpha_{\text{math,CFB}} = 0{,}14\ \%$. In all cases the correlation is negative (Table 2). A greater number of physical steps or mathematical steps mean less students' success rate in particular e-task. It is surprising that the number of mathematical steps had greater impact on students' success rate than the number of physical steps - irrespective of whether they dealt with tests BFB or CFB.

Table 2: Correlation coefficient - statistical link between the number of steps and success rate

Mutual agreement	Success rate of BFB	Success rate of CFB
Physical steps	- 0,340	- 0,389
Mathematical steps	- 0,400	- 0,473

We have verified if there was a significant change of successful solving of e-tasks 1 and 8 (whereas tasks were the same and they varied only in values of physical quantities). We denote n_{12} the number of students who solved correctly the task 1 and incorrectly the task 8. And vice versa we denote n_{21} the number of students who solved incorrectly the task 1 and correctly the task 8.
For the group BFB $n_{12}^{(\text{BFB})} = 1, n_{21}^{(\text{BFB})} = 5$ and for the group CFB $n_{12}^{(\text{CFB})} = 1, n_{21}^{(\text{CFB})} = 3$

Hypothesis H_{C0}: Success rate in task 8 has been not higher in BFB and CFB tests than in the task 1. Students' knowledge was not improved by the feedback from either BFB or CFB.
Hypothesis H_{C1}: Success rate in task 8 has been higher in BFB and CFB tests than in the task 1.
We used McNemar's test to verify the hypothesis. Since in BFB and CFB tests was $n_{12} + n_{21} \leq 8$, we used a two-sided test described in [12]. Hypothesis $H_{C0}$is rejected on the significance level 11% in the case of BFB test. Hypothesis H_{C0} is rejected on the significance level 31% in the case of CFB test. Results showed only a small difference but they indicate certain advantages of BFB compared to CFB as we have shown in [1], and also mentioned in the introduction. The improvement can be seen only in case of BFB, and only on the significance level 11 %.

For further study of context the usage of parameter test will be required, e.g. by using the ENKI model. The average time (Table 2) is also interesting in e-homework solving. Students required 20 minutes for solving the e-homework by using e-tests with basic feedback. On the other side, solving the e-homework by using e-tests with a comprehensive feedback took five minutes more. Based on that, we can say that students gave attention to a comprehensive feedback.

Table 3: Average time in e-homework solving without the feedback and with a comprehensive feedback.

without the feedback	20 minutes
with a comprehensive feedback	25 minutes

4. Conclusion

In this article we dealt with the impact of basic or comprehensive feedback on the students' success in solution of e-test consisting of 8 tasks. What was surprising is the result that Hotelling's two-sample test hasn't showed efficiency of CFB against BFB. McNemar's test even indicates that the BFB has better results than CFB as far as we consider tasks 2 - 6 as a learning process for solving tasks 1 and 8. This result is in accordance with the results of our previous work [1], as we mentioned in the introduction. Furthermore, we have shown that the number of necessary physical steps and number of necessary mathematical steps has a significant impact on the success rate in tasks solving (negative correlation). We have pointed out that the number of mathematical steps has a greater impact on the success rate than the number of physical steps. Verification of previous sentence required further methods of analysis (e.g. ENKI model).

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