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"AT 100 PERCENT" ASSESSMENT

Leszek Rudak

Abstract. The article presents the proposal for rules for granting a pass out of mathematics for business studies. The proposed schema guarantees that each student demonstrates a mastery of all the required skills, not only 60 or 70 percent as at the traditional exams. The proposed organization also eliminates the need for time-consuming repeated checking solutions of similar tasks written by the same student. The idea of the assessment procedure is based on two rules: (1) students must demonstrate that they have mastered all the required knowledge and all the skills, having three attempts; (2) each subsequent attempt includes only the previously failed topics. The proposed system was introduced on a trial basis at the Faculty of Management at the University of Warsaw, where it was subject to the assessment of circa 150 students. The conclusions and examples of students' comments have been provided in the article.

Keywords: teaching of quantitative subjects, assessment system, evaluation of students' progress.

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1. Introduction

This article presents a proposal for a solution to the problem of gaps in the knowledge of students finishing math education in business studies with a positive mark. Math is a tool for future managers: it will be helpful in making decisions, preparing a business plan, analysis of investments, solving logistical problems and many other moments of their professional lives. Therefore, as a matter of practicality, a course of math should provide a complete set of useful formulae, procedures and methods and the final test should verify that students have mastered all the methods and procedures at the appropriate level. However, a problem arises here, because traditional examination or testing has a specified level to pass: 60%, 75%... However, this means that students can complete the exam with a good rating without knowing some of the issues, as Salman Khan wrote: "…a mark of 75 percent means you are missing fully one-quarter of what you need to know…" [Khan 2012, p. 84].

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In the next section, “Incomplete knowledge problem”, we use example issues from linear algebra to show the (possible) consequences for student knowledge, if the level of requirements is set at 75% and the (possible) effects for teachers work, as well. In the part, “New evaluation procedure”, we present a proposal for the organization of the assessment which gives the student a positive mark only if he/she shows the knowledge of all the required topics, and which neither generates additional work for the teacher, nor seems too painful for students. In the section, “Students’ evaluation of the procedure”, we quote the opinions of the students assessed using this system at the final exam of Mathematics II at the Faculty of Management at the University of Warsaw in 2015. The summary contains an analysis of the advantages and disadvantages of the proposed procedure.

2. Incomplete knowledge problem

Let us look at the problem of the gaps in the knowledge and skills of students, finishing Mathematics with a positive mark, using an artificial example. We assume (not exactly in accordance with actual curriculum), that the curriculum of linear algebra contains only four areas: matrix multiplication, calculation of determinants, finding an inverse matrix and solving systems of linear equations. Moreover, we assume that each subject has the same weight in a final exam.

If the level of requirements is set at 75 percent, a student who has mastered only three of these skills and solved the relevant tasks faultlessly will reach the required level and obtain a positive mark. So, he/she goes for further stages of education without full knowledge. In our example, most disturbing would be the lack of skill of solving systems of linear equations, because this is a very important tool for economic considerations. Such deficiencies can lead to major difficulties in further education and in practical applications of the acquired knowledge.

We use the example constructed above to indicate certain adverse phenomena that can be observed in common situations. Let us just say that, as above, a student who has not mastered solving systems of linear equations attempts to take the final exam. The student commits a few, not very significant errors (for example, in accounting), in the remaining tasks. Of course, he/she does not reach the required level, does not pass and must apply once again, within the correction test (but the teacher just learned that the student knows how to solve those tasks in which there were minor errors). The correction test is established so that students who do not possess sufficient knowledge to pass the exam will be able to make up the missing knowledge.

However, the student in question is doing nothing – he/she does not fill the gaps in his/her knowledge. Counting on luck, he/she solves the tasks with the same topics as before and if he/she is sufficiently focused and does not commit simple mistakes... gets a positive mark and finishes his/her mathematical education without one of the most important skills.

One needs to mention here that the teacher discovers for the second time that the student knows three themes (seen it already at work in the first term), and so performs unnecessary work.

The example concerned the requirements level equal to 75 percent, but the consideration can always be the same when this level is less than 100 percent. Whenever a student is finishing classes with a good result, he/she may not know some of the topics, but all are important and useful (otherwise they would not be placed in the curriculum). Therefore, raising the level of requirements does not solve the problem of the gaps in the knowledge and skills of students completing mathematics education with a positive mark, unless you raise the level to 100 percent.

3. New evaluation procedure

Setting the assessment level for positive evaluation to 100 percent with the traditional exam seems impossible. Practice shows that most students who deserve a good assessment commit, often minor, errors throughout the work. Tasks usually have small imperfections resulting from clerical or accounting errors, unfinished transformations, understatements, etc. However, if there are no significant errors and the used methods are correct, then the task is evaluating a large number of points which meet the reduced requirements. But this results in the ability to make a transition for students who mastered only a part of the whole material.

To create the possibility of setting the requirements level to 100 percent, one needs to change the organisation of the final exam. The preparation of the new assessment begins with the designation of all the essential elements of the curriculum and the creation of a sample set of tasks for checking the mastery of these topics – the basis of the final test. Students should have access to this from the beginning: they should be familiar with the requirements and should know how they will be checked. During the final test, each student must demonstrate all the required knowledge (as specified in the basis) and all the skills (listed there), i.e. he/she must solve all the tasks correctly.

The final test is made up of a maximum of three steps (three terms or three attempts). In the first, the student solves all the required tasks. The

result is either a course credit – when the student has solved all the tasks perfectly, or a list of the topics whose mastery was shown in this test.

A student who has not obtained credits in the first stage goes to the second stage. This time, he/she solves only the tasks that relate to the failed subjects in the first stage. He/she does not solve the second time tasks that have already been solved correctly. The result of the second phase is the same as in the first stage: either a course credit or a (complete) list of "passed" topics. A credit occurs when a student in both the first and second tests showed all the required knowledge. A student who did not receive credits of the course in the first and second term proceed to the third stage.

This time again he/she must solve tasks on topics that are not scored in the first or second attempt only. The result is to pass the course if the student will complete all the deficiencies or a lack of credit otherwise.

Referring to the example from the section, The Gap, let us examine the path for a positive assessment of a hypothetical student. In the first stage he/she solves problems for all four subjects. If he/she correctly solves all the tasks, then he/she will receive credit for the course. If he/she properly multiplies matrices and calculates the determinant only, and for the other tasks he/she did nothing (either did not start or did not finish or did it wrong), then his/her result will be the information that he/she "passed" the matrix multiplication and calculate determinants and will have to proceed to a second term.

In the second term the student will only solve tasks related to the inverse matrix and systems of linear equations (because the others scored in the first attempt). If he/she now solves everything correctly, he/she will receive a credit for the course, but if he/she properly designates the inverse matrix only, it is left to him/her to demonstrate the ability to solve systems of linear equations. He/she will be able to do this in the third approach. In the third stage, the hypothetical student receives only the tasks associated with solving systems of linear equations. If he/she faultlessly solves them, then he/she will receive a credit for the course.

The final mark may be based on the number of attempts in order to obtain a credit for the course. One can even count the number of tasks "transferred" to the next term and use this number to state the appropriate mark. So this system can be used not only for the binary decision: pass or not pass, but for grading as well.

Such a system of examination has two major advantages from the point of view of universities and teachers. Obtaining a positive assessment requires the student to demonstrate all the knowledge and all the skills. Students cannot omit any topic. The second advantage is that every time – at any stage –

a check is performed on just what the student did not know at the previous stages, so there is no situation in which the teacher checks for the second time tasks, which he/she knows in advance that the student can solve (as demonstrated in the previous attempts).

From the viewpoint of the student, the advantage is that after any stage (if he/she does not get a course credit) the student gets an indication of what he/she has yet to learn. Students can also, if not trying for a maximal score for the test, divide the preparation in stages – deliberately not trying to solve all the tasks, leaving some topics for the next term.

4. Students' evaluation of the procedure

The examination system presented above has been used at the Faculty of Management at University of Warsaw to determine the final assessment of Mathematics II, whose contents include integral calculus and linear algebra. The examination system "at 100 percent" was applied to approximately 150 students. Unfortunately, only 23 people took part in the (optional) survey after the completion of the examination, so the results and statements given below should not be regarded as authoritative, but still they are worth quoting.

The most important information about the examination system was to identify the preferred method of assigning "at 100 percent" or traditional. The results show that none of the systems have an advantage: 35% students chose the system "at 100 percent" as favourite, 30% chose the traditional system and 35% did not favour any of these systems. However, one can assume that this system has not yet gained the recognition of students. This is confirmed by a comparison of the surveys evaluating activities (such questionnaires are filled in by the students after each class at UW) in Mathematics II in 2014 (traditional assessment) and in 2015 ("at 100 percent" assessment) taught by the same teacher. Two important differences are registered here. The questionnaire was filled in by three times more students in 2015 than in 2014, suggesting that the students wanted to communicate something. The second difference concerns the valuation of the method of assessing students. In the survey of 2014 the average score was 4.93 (on a five-point scale), but in 2015 the result was lower by almost 0.8 and was 4.15 (at the scale of this questionnaire this is a fairly large difference). Differences of evaluations of the other elements were negligible (not exceeding 0.2).

In the survey, prepared especially after the new crediting, the marks of students as a response to a request for an indication of the good and bad features of this system and a general commentary on credit are of importance – these were open questions. The opinion that dominates among them is that the system is

more motivating but also more dangerous, because even small mistakes can prevent one from obtaining a high score or even a pass for the whole course.

Here we quote three selected students' comments.

The bad features of the new system: a minor error does not necessarily result from ignorance. In the traditional evaluation one "pays" for dissociation by obtaining a lower grade, but in the "at 100 percent" assignment this means failing the year or at least successive terms.

The good features of the new system: consolidate all the knowledge acquired in the classroom; clear and transparent rules; effective verification of real knowledge – and not the level of happiness at the moment.

Overall comment: credit "at 100 percent" gives me, as a student, a lot of satisfaction and at the same time is motivating. On the other hand, traditional credit in exchange for half or 60% of the points – although it allows to avoid issues that make it difficult – causes a feeling of dissatisfaction, that after all you could do better.

5. Summary

The proposed scheme of crediting a course based on the principle of "at 100 percent" can be characterized by two rules:

1. students must demonstrate that they have mastered all the required knowledge and all the skills, having three attempts;
2. each subsequent attempt will include only the previously failed topics.

This method of examining solves the problem of possible gaps in students' knowledge, when they can get a positive score for the correct answer only for 60 or 70 percent of tasks in the traditional system but it is not free of defects. The biggest (as also indicated in a survey by students) is (practically) a binary assessment of tasks, which does not take into account partial, incomplete solutions. In the traditional system, incomplete solutions or those with only minor errors add points, which together can decide on the credit of the course. In assessing "at 100 percent", such trials do not affect the final evaluation as only the full solution are counted.

It seems that the grading system "at 100 percent" can raise the level of the knowledge and skills of graduates and the motivation of students (as was indicated in the survey), perhaps after removing defects in binary assessment tasks (for example, by categorizing errors and other treatment of calculation errors or simple, accidental omissions or informal language rather than significant errors in the method of solution).

References

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