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ИЗПОЛЗВАНЕ НА СМЕСЕНОТО ОБУЧЕНИЕ В КАТЕДРАТА ПО БОТАНИКА НА СОФИЙСКИЯ УНИВЕРСИТЕТ: РЕЗУЛТАТИ И ДОБРИ ПРАКТИКИ

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Резюме: Целта на статията е да се сподели опитът ни в обучението по ботаника в БФ на СУ от използването на смесено обучение в реални учебни зали с осигуряване на постоянен електронен достъп до преподавания материал и провеждане на онлайн тестове. За тази цел съпоставихме набор дългосрочни данни (2002-2017) от изпитните оценки на 3888 студенти, обучавани чрез класическо и смесено обучение в задължителни бакалавърски курсове, свързани с Водорасли и Гъби. Получените резултати ясно показват предимствата на смесеното обучение за преподавателите и за студентите. Подчертано е, че електронното тестване е природосъобразно и *зелено* поради нулевата консумация на хартия. Доказаните предимства на електронното тестване и обучение ни дават основание да ги препоръчаме на всички наши колеги за бъдещата им работа.

Ключови думи: студенти-биолози, обучение по ботаника, електронно обучение, електронно тестване.

I. INTRODUCTION

E-learning (eLearning, or "electronic learning") is commonly used as an umbrella term that describes a wide set of different forms of education using electronic devices and digital media in different virtual learning environments (Moodle, Blackboard, *etc.*). It differs from the form of distance education, known as *M-learning* (mobile learning), in which m-learners use mobile device educational technology at their time convenience [1-3]. By contrast, *blended learning* combines online digital media with traditional classroom methods [4-9]. It requires the physical presence of both teacher and student, face-to-face classroom practices but is enhanced by computer-mediated activities regarding content and delivery. It may vary widely in design and execution, aiming at optimal use of modern information and communication technology (ICT) [10]. Therefore, it is not surprising that the terms *blended learning*, *hybrid learning*, *technology-mediated instruction*, *web-enhanced instruction*, and *mixed-mode instruction* are often used interchangeably by researchers [11].

There has been much written about the advantages of e-learning theory and practice, and it is generally agreed that with the advent of eLearning the face of education, as we know it, has completely changed. However, there still exists a widespread opinion that eLearning is easier, less time consuming, etc. in comparison with "traditional" teaching and examination, and that it is applicable mainly in the field of humanities. In reality, the creation of electronic courses and environment is quite complicated and requires much more efforts than most people believe or understand [12-14]. As different contexts and needs pose different requirements, a vast variety of models for establishing eLearning have been devised [14-18]. These are grounded in a set of best practices, which, when followed, may lead to improvement of the eLearning experience and content. Recently eLearning has become much more attractive for scholars of natural and medical sciences, and this is also valid for Bulgaria [19-27]. That is why this paper aim is to share some results from our experience from teaching botany at the Faculty of Biology of Sofia University, when a combination of teaching in physical classrooms and providing permanent access to teaching material with completing tests online was applied. To this end, we compared a set of long-term data (2002-2017) of exam scores of students in courses related to teaching of algae and fungi, which were obtained using both classical and blended education.

The analyses are based on a dataset, which contained a total of 3888 scores: 3403 scores from standard exams (on paper, face-to-face method and tests - **PS**) and 485 scores from online tests (**ES**). They were obtained during exams of students in five compulsory courses at bachelor degree of education related to studying algae and fungi: 1) full-time courses *Systematics of Algae and Fungi*, and *Algae and Fungi as Economic Resources*; 3) parts on *Algae and Fungi* in the courses: *Botany 2*, *Structure and Biodiversity of Plants and Fungi*, *Biodiversity of Plants and Fungi*. These students were educated in both regular (or full-time, n=3413) and extramural way (or part-time, n=475). In the period 2002-2013, the teaching was based on traditional, in the classrooms, face-to-face only approach and the exams were done on paper. These “paper exams” were of two different types. In the academic years from 2002 to 2006 they were carried in the traditional for the faculty way: based on traditional written exam (involving hand-writing of a full text on given questions: generally two questions – one from the field of algology and one form the field of mycology), followed by face-to-face interview with the teacher. In the years 2006-2014, the exams were based on paper tests, which contained closed-type questions covering the entire material studied, with equal proportion of questions on algology and mycology. In the period 2014-2017, we introduced blended learning: it was delivered in physical classrooms, which was supported by providing permanent online access to teaching materials and completing tests online on the Moodle platform. In the academic year 2014-2015, both educational forms were applied in different courses: eLearning – for 65 students in one course tutored by Blagoy Uzunov, and classical teaching - with 138 students in the four other courses tutored by Maya Stoyneva-Gärtner. An exception is the education of students in *Biotechnologie*s (both regular and extramural, n=616) and in *Ecochemistry* (n=218) in the course *Structure and Biodiversity of Plants and Fungi*, which was carried in the traditional way for the whole studied period. The scores of these students comprise 21% of the scores in the analyzed dataset.

The scores compared in this paper were obtained from the exams tutored by the same two lecturers – authors of this paper: 3143 PS and 305 ES tutored by Maya Stoyneva-Gärtner (2002-2017), and 260 PS vs. 180 ES by Blagoy Uzunov (2012-2017). Both teachers applied the same approaches in teaching and examination processes with similar test organization and contents (with application of different closed-type questions; for details see [23-25, 26]).

The scores used were standard for R Bulgaria 6-grade scale: 2 – Fail, 3 – Pass, 4 – Good, 5 – Very Good and 6 – Excellent, while 0 was used for those students who were trained during courses, but did not attend the exams. Due to the significant difference in the number of students tested traditionally and online, we normalized the results by comparing the average scores and the percentage of the scores (instead of their real number). It has to be mentioned also that for the purposes of current analysis we used only the final scores and that some students attended additional exams in order to improve their marks according to the right, ensured by the Sofia University Regulations.

The results obtained during this study are represented in four figures provided below. At the first step of the analysis, we compared the scores from all paper and online exams (Fig. 1). Then, in order to make better grounded comparison, we decided to exclude from the data set all scores, obtained during standard exams with hand-writing of the full-text questions, which were followed by face-to-face interview (2002-2006, 693 tested students). Thus, the second comparison was done between the scores obtained from paper tests, completed by 2710 students in the period 2006-2017, with the scores obtained from online tests of 485 students in the years 2014-2017 (Fig. 2.)

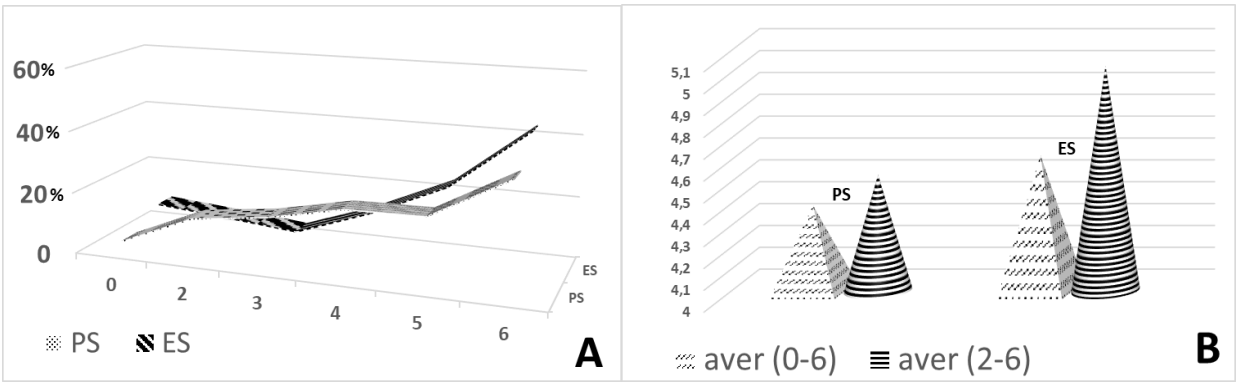

Fig. 1. Comparison of scores from standard exams and paper tests (PS) with the scores from online tests (ES) carried in the period 2002-2017; A - Comparison of percentage of different marks; B – Comparison of average marks calculated as average from all marks (0-6), and from Fail to Excellent marks only (2-6). For details, see the text of the paper.

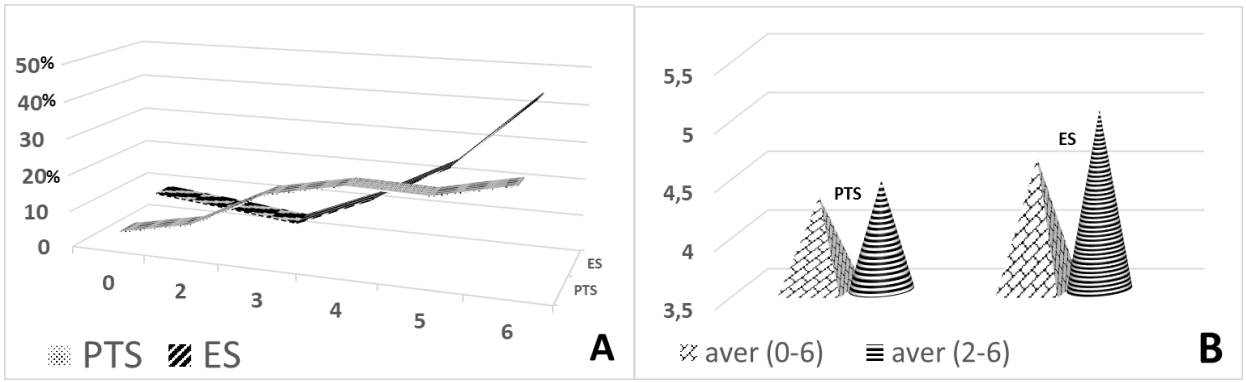

Fig. 2. Comparison of scores from paper test exams (PTS) and from online tests (ES) carried in the period 2006-2017; A - Comparison of percentage of different marks; B – Comparison of average marks calculated as average from all marks (0-6), and from Fail to Excellent marks only (2-6). For details, see the text of the paper.

Further comparison was conducted between the scores of students from the fulltime education, who made paper test exams (2006-2017, n=2361) and online test exams (2014-2017, n=435), as well as between their average values (Fig. 3). The comparisons between the scores of part-time students, who sat for paper test exams (2006-2014, n=350) and online test exams (2014-2017, n=50), and between the respective average values, are presented on Fig. 4.

II. ANALYSIS

The comparison of the scores between all traditional exams and online tests carried in all compulsory courses related with Algae and Fungi (Fig. 1) showed decrease of the percentage of the Pass marks, increase of the Good vs. Pass marks, increase of both Very good and Excellent marks, and increase of the average marks from Good (4) to Very good level (5) in the case of blended education. The comparison of the scores of paper test exams and online tests carried in the compulsory courses (Fig. 2) confirmed the same trends, with better pronounced increase of pass and excellent scores in eLearning courses.

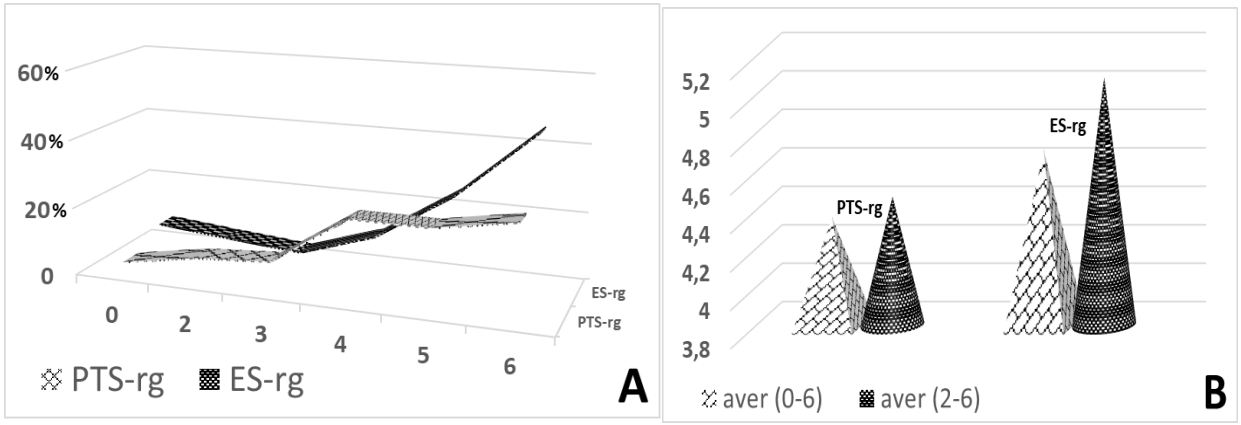

Fig. 3. Comparison of scores of full-time (regular) students from paper test exams (PTS-rg) and from online tests (ES-rg); A - Comparison of percentage of different marks; B – Comparison of average marks calculated as average from all marks (0-6), and from Fail to Excellent marks only (2-6). For details see the text of the paper.

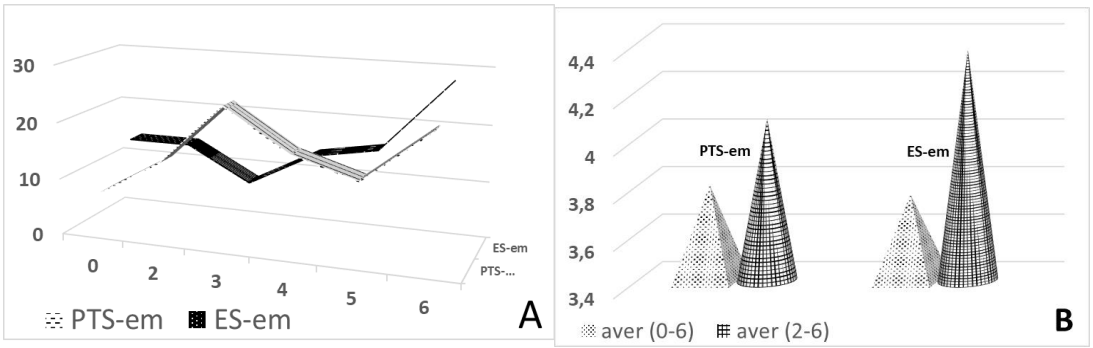

Fig. 4. Comparison of scores of part-time (extramural) students from paper test exams (PTS-em) and from online tests (ES-em); A - Comparison of percentage of different marks; B – Comparison of average marks calculated as average from all marks (0-6), and from Fail to Excellent marks only (2-6). For details see the text of the paper.

The comparison of the full-time student scores (Fig. 3) with the scores of the part-time students (Fig. 4) does not show significant differences from the results from the general comparisons of paper and online exams. Again, we found similar increase of Pass to Good marks, and of the average marks from Good to Very good level, with the same insignificant difference in the values when all marks are calculated and when only marks from 2 to 6 are taken into account.

The detected changes in the percentage representation of Pass and Good marks are in accordance with the results from previous studies [24]. We believe that they are due to the same main reasons, which were outlined in the above cited references: 1) improved confidence of the tested student when the direct contact with the teacher is avoided during the exam; 2) better confidence of young people of the current *digital generation* when they have to use electronic devices instead of paper and pen; 3) permanent access to the teaching material (provided fully or in part) instead of listening to it only once during face-to-face lectures. Doubtlessly, having written this, we should restate the understanding that not all students learn in the same way.

All comparisons with graphic expressions on Figs.1-4 show also an increase in Very good and Excellent marks, which is better pronounced when paper and online test scores are

compared. We believe that, in addition to the above mentioned positive effects of eLearning, there were some extra reasons for this increase. One of them may be that during updating of each course we worked on its shortening and simplification in presentations, lectures and exercises. In this case, *simplification* should be understood more as concise presentation of the core terminology, topics, etc. rather than pure reduction in volume. In parallel with this simplification, much more supplementary material was provided to students as full text of text-books, scientific papers, etc., with added links to scientific movies - in comparison with classroom education, where this material was provided as reference lists only. The second reason could be found in the more easily taken decision for using the opportunity for improve the marks by passing an online test when face-to-face contact with the teacher is avoided. Additional reasons could be found in the higher rate of students attending such extra exams for improving marks, as well as in the fact that the dataset includes the students from the specialty *Molecular Biology*, who traditionally score the highest at the admission exams (17% of all and 23% of full-time students). Detailed discussion on a number of exams taken by one student and the distribution of scores by different specialties in the faculty is beyond the scope of this study and will be published elsewhere. Currently, we can say that the reasons for higher ES do not lie in the easier way of study or examination.

Based on the above, a conclusion can be drawn that providing teaching materials online in the blended type of education is indeed helpful and can be successfully applied for all students in natural and medical studies. The opportunity to have at full disposal complex schemes, figures and photos organized by the teacher can be said to be extremely positive and cannot be compared with self-drawings and re-paintings, made in haste during the lectures. Moreover, this material is permanently available and each trainee can have access to it at will, thus they can make personal choice for studying and analyzation at the most convenient for them moments. Another great advantage of providing online material is related to the possibility to print the lectures before coming to the classroom, which allows students to add notes to these ready texts and thus saves time for more discussions. This helps in providing students with enough, and even more personal attention, guidance, and assistance by the lecturers. Furthermore, the eLearning platform Moodle offers better opportunities for permanent contact with the teacher, which increases trainees' confidence during studying.

Last but not least, we would like to stress on the improved teaching and learning experience related to the immediately getting the exam results, with the possibility each student to see the wrong and correct answers with the proper comments, and the time-saving process of assessment. In the case of eLearning, the teacher spends relatively more initial time for the test preparation, but gains much more time back by the automatic assessment process and by avoiding the obligatory meeting with each student and explaining the tests results. When the time for finding the proper test, for its skimming by the teacher before starting the discussion, conversation with the student, etc. is calculated, the positive result from e-testing and assessment is more than obvious. No teacher is able to produce the same amount of test varieties in a reasonable time, compared to what the electronic device can in order to provide unique test variation for each student. This time-saving aspect has to be particularly emphasized as extremely valuable for university teachers, who have to combine research and teaching activities.

Noteworthy is also the positive psychological effect, which was detected earlier by us [23, 26] and was recorded during this study as well – modern students much more easily accept the score, given by computer than the personal "subjective" score of the teacher.

A special attention has to be paid to the environmental aspect of the traditional examination on paper. The rough calculation of the paper used by students in our previous standard exams comes to ca. 8000 pages, which means that at least one tree was destroyed (http://treehouse.i-hmc.co.uk/calculator/index.php). This has to be taken into account especially

in any Faculty of Biology where students are educated in nature conservation; moreover, such an amount of *wasted* paper is economically unreasonable. Considering the fact that students-bachelors in our faculty (ca. 2000 per year) have a minimum of 8 exams per year during their 8-semester education, and for each of them at least 4 sheets of paper are used, it is possible to estimate that each year these examinations “kill” at least 64 trees! This number increases when the second and third attendance at exams is calculated, and when additional obligatory state exams are taken into account as well.

III. CONCLUSIONS

The results from applying blended learning with online testing in the field of botany in this long-term study clearly show an increase in exam scores, which in our opinion is related generally to improved recall, and not to the easier way of studying and examining, as proved above. In addition to better scores, we recorded many advantages of this way of eLearning for both students and teachers, such as less time spent on assessment, improved access to materials, eco-friendly education, etc. Further detailed analysis of the scores of students from different specialties at the Faculty of Biology would help to provide more suggestions for improving both teaching and exams.

The results from this study confirm our previous statements that the online testing is more appealing to the new generation students, therefore should be recommended as a good practice for teachers. Moreover, due to its time efficiency, it is more attractive for the university teachers, who (by contrast to school teachers and pure scholars) have to combine teaching and research activities. At the same time, it leaves more time for contacts and discussions with the trainees, which is important for their confidence during studying. We strongly argue the correctness of the claim that during blended education the online and in-person learning experiences complement one another (http://edglossary.org/blended-learning). Extremely valuable is also the possibility to generate unique tests for each student, which is among the greatest advantages of online testing. Furthermore, the e-testing is nature-friendly and *green* on account of paper consumption for it is none. This is extremely important when we consider the reputation of a faculty related with studies and practice of nature conservation, and when we look at eLearning in perspective.

The good practices achieved are related with the successful use of blended learning with e-testing of student knowledge in the oldest department of the Biological Faculty of Sofia University “St. Kliment Ohridski” - Department of Botany, which is the first higher education institution of botany and first higher school institution in the field of biology in Bulgaria [28]. The outlined advantages are considered indicative that this way of teaching and testing is applicable to other departments of the same faculty. Therefore, taking into account all benefits and proved traits of e-testing and education, we strongly recommend them to all our colleagues for their future work and particularly for successful future use during the obligatory for our bachelors state exams.

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APPLYING BLENDED LEARNING AT SOFIA UNIVERSITY, DEPARTMENT OF BOTANY: RESULTS AND GOOD PRACTICES

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Abstract: The aim of the present paper is to share our experience gained from teaching botany at the Faculty of Biology of Sofia University, when education in physical classrooms is combined with permanent access to digital teaching materials and online tests. We compared a set of long-term data (2002-2017) of exam scores of 3888 students in compulsory bachelor courses related with teaching of Algae and Fungi which were obtained using both classical and blended learning. The results obtained clearly show the advantages of blended education for both teachers and students. It is proved that e-testing is nature friendly and *green* due to zero paper consumption. Taking into account all benefits and proved traits of e-testing and education, we recommend them to all our colleagues for their future work.

Keywords: biology students, education in botany, e-learning, e-testing.