



## **Subject Tests vs. General Study Skills Admission Tests – Which Perform Better in Selecting Prospective Successful Bachelor Students in Biology?**

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### **Abstract**

*The effectiveness of various types of admission test in selecting prospective successful university students is being intensively discussed. Until 2015/2016, Faculty of Science, Charles University (Prague, Czech Republic) used a combination of a knowledge-based biology test and a general study skills test for selecting students into biological bachelor study programs. Since 2016/2017, the use of the general study skills test was abandoned and only the biology test has been used. The aim of our study is to evaluate the relation between students' scores in both types of admission tests and their academic performance in the bachelor degree. We analysed data from six subsequent academic years (2009/2010-2014/2015; n = 1662). There was a rather weak correlation between the students' scores in the general study skills test and their grade average in the 1<sup>st</sup> study year. Scores of the biology test and the study average correlated moderately and this correlation was stronger than if the scores from both tests were pooled. The results of the admission test in biology quite well reflected the later student outcome of the final bachelor's exam, while in the case of the general study skills this relation was not significant. We therefore consider knowledge tests in biology being a more reliable criterion in selecting prospective students than the general study skills.*

**Keywords:** *effectiveness of admission tests, academic performance, bachelor study, biology, general study skills test.*

### **1. Introduction**

Predicting success and failure of graduate students is difficult when using the easily obtained quantitative data [1]. Yet there is a big demand for such a prediction as all universities and colleges face the challenge of finding the right criteria to choose the best future students from the applicants. In general, there are two main domains tested in entrance exams: the subject(s) important for the study field (Subject test) and/or general study skills (GSS). Some universities also rely on the applicants' study results at secondary schools.

A meta-analysis of US studies concluded that Subject tests were better predictors of student academic performance (SAP) in the first grade than graduate record examination (GRE, standardized test used to measure applicants' aptitude for abstract thinking in the areas of analytical writing, mathematics, and vocabulary), although GRE was a valid predictor as well [2, 3]. To predict future research success, a letter from mentor was the most valid tool [4].

In the Czech Republic, Rubešová on the example of Faculty of Science bachelor students showed that high school assessment and success in faculty entrance exams did partially predict SAP. Gender and length of the gap between high school leaving exam and faculty entrance exams did not have any influence [5], which is in concordance with analysis of medical school students' data [6]. The Subject tests used at Faculty of Science [5] were better predictors of SAP than the GSS test used to predict SAP of future chemists at other faculties [7]. Tábořská also explained that one of Czech medical faculties stopped using the GSS test as a part of their faculty entrance exams because an analysis showed it was much worse predictor of SAP than the Subject tests [8]. This is in contrast with the overall situation in the Czech Republic, where an increasing number of universities and colleges are switching from Subject tests to commercial GSS tests.

All these findings made us to wonder, what is the best predictor of SAP of future biologists and biology teachers. Local validation of graduate admissions measures seems to be necessary as the general tests might not be best suited for the profession. Until the academic year 2015/2016, Faculty of Science, Charles University (Prague, Czech Republic) used a combination of a knowledge-based biology test (Biology) and a GSS test for selecting students into biological bachelor study programs and then switched to using only the biology test. This gives us a good opportunity to use archive data



from both types of admission tests and compare their value in predicting the students' academic performance in bachelor degree at this faculty.

## 2. Methodology

We studied the relation between the students' results in admission tests and their academic performance in the biological bachelor study programs (including the teacher training programs) at Faculty of Science, Charles University. We analysed data from six subsequent academic years (2009/2010-2014/2015). Only the students, who successfully passed the admission exams and finished at least the 1<sup>st</sup> year of bachelor study were included ( $n = 1662$ ; 1204 females and 457 males; number of students per year ranged from 229 to 302).

The admission exam consisted of a knowledge test in biology (prepared by the academic staff of the faculty) and a GSS test (prepared by of Dept. of Psychology, Faculty of Philosophy, Charles University). A new set of tests was prepared for every year of admission. The biology test consisted of 50 close-ended multiple-choice questions, each with one correct answer (2 points per correct answer; maximum 100 points in total). The GSS test consisted of several parts with multiple test items, focusing on different aspects of general study skills (see above; maximum 100 points in total). The applicants were accepted according to the pooled scores from both tests.

We used the students' grade average of all exams in the first year of bachelor study and the students' grades in final bachelor's exam as measures of their academic performance. Particular exams were either oral, close-ended written tests or open-ended tests in different forms. In the calculation of the grade average, failed exams attempts were also included. The bachelor's final exam consisted of an oral part and of a bachelor thesis defence. Individual exams, as well as the final bachelor's exam are evaluated from 1 - excellent to 4 - not passed.

We analysed the data in Statistica 13.0. We checked the distribution of the data by a visual inspection of histograms. Because they looked close to normal distribution and because of the high numbers of students, we decided to use parametric variants of statistical tests.

## 3. Results

### 3.1. Results of the Biology and GSS admission tests

The students' results in both admission tests showed a weak, but significant negative mutual correlation (Pearson's  $r = -0.1069$ ;  $p < 0.0005$ ), see Fig. 1 for details. In general, students had significantly better results in the GSS test than in the Biology test (repeated measures ANOVA,  $p < 0.001$ ; observed power 1.0; mean GSS = 71.52 points, SD = 10.44; mean Biology = 62.92 points, SD = 9.54 points). In the Biology test, male students did slightly better than females (one-way ANOVA,  $p < 0.05$ ; observed power 0.70; mean males = 63.96 points, SD = 9.63; mean females = 62.51 points, SD = 9.48 points). In contrast, there was not a significant difference in the GSS test between the genders (one-way ANOVA,  $p = 0.43$ ; observed power 0.12).

### 3.2. Biology and GSS admission tests as predictors of the students' grade average

We found a moderate negative correlation between the results of the Biology admission test and the grade average in the 1<sup>st</sup> year of study (Pearson  $r = -0.426$ ;  $p < 0.01$ ), see Fig. 2. This means, that the students with higher test scores had in general better grades and the test results explained about 18 % of variance in the grade average. In contrast, the results of GSS test and the grade average correlated very weakly (Pearson  $r = -0.095$ ;  $p < 0.0001$ ), explaining less than 1 % of variance, see Fig. 3. Surprisingly, the students' score in the Biology test was an even better predictor, than the pooled score from both tests (Pearson  $r = -0.357$ ;  $p < 0.01$ ), which was used by the faculty as the criterion for the acceptance of students.

We came to very similar results, when the data was evaluated separately for males and females, as well as for each individual academic year.

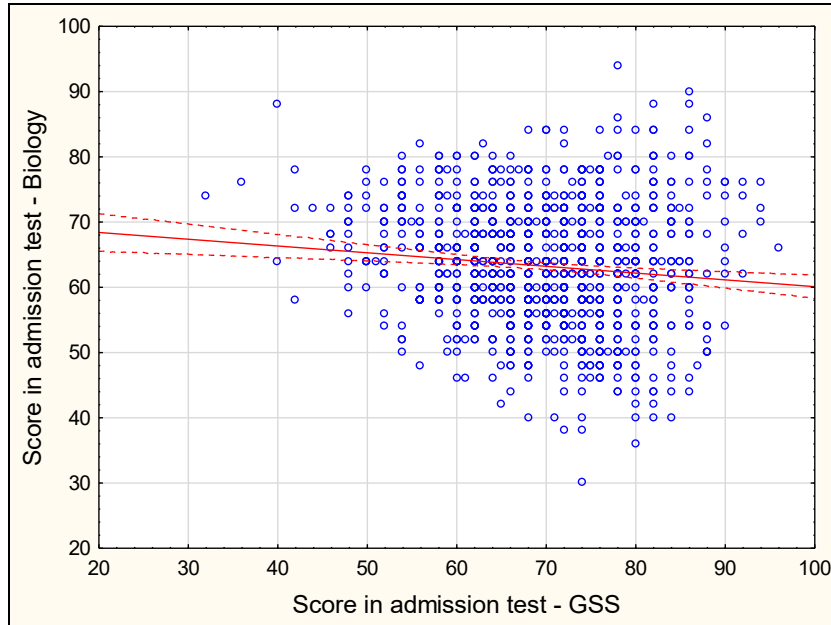


Fig. 1: Correlation between the results of the GSS and Biology admission test. Red solid line = linear regression fit ( $y = 70.4802 - 0.1038 \cdot x$ ; Pearson's  $r = -0.1069$ ;  $p < 0,0005$ ); dashed red line =  $\pm 95\%$  confidence interval.

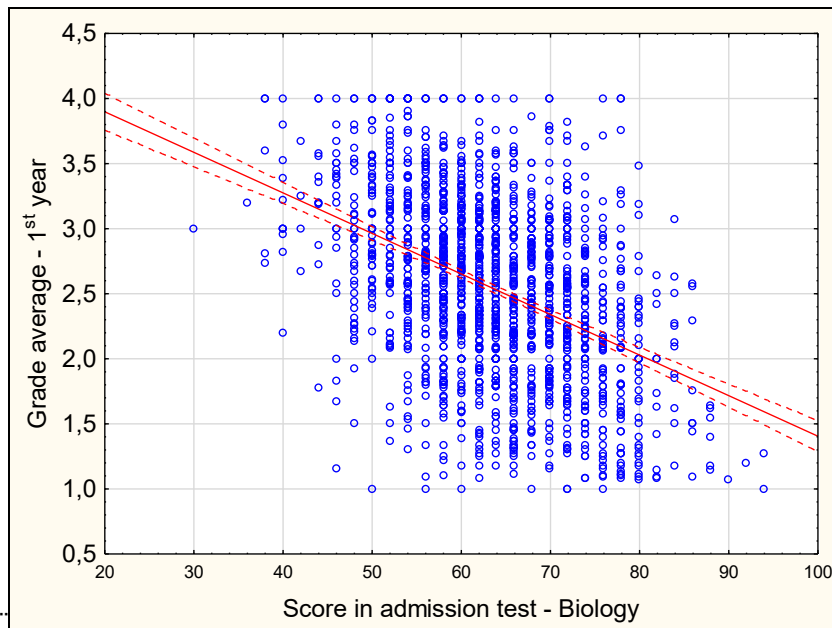


Fig. 2: Correlation between the results of the Biology admission test and the grade average in the 1<sup>st</sup> year of study. Grades: 1 - excellent to 4 – not passed. For explanation of symbols see legend of Fig. 1.

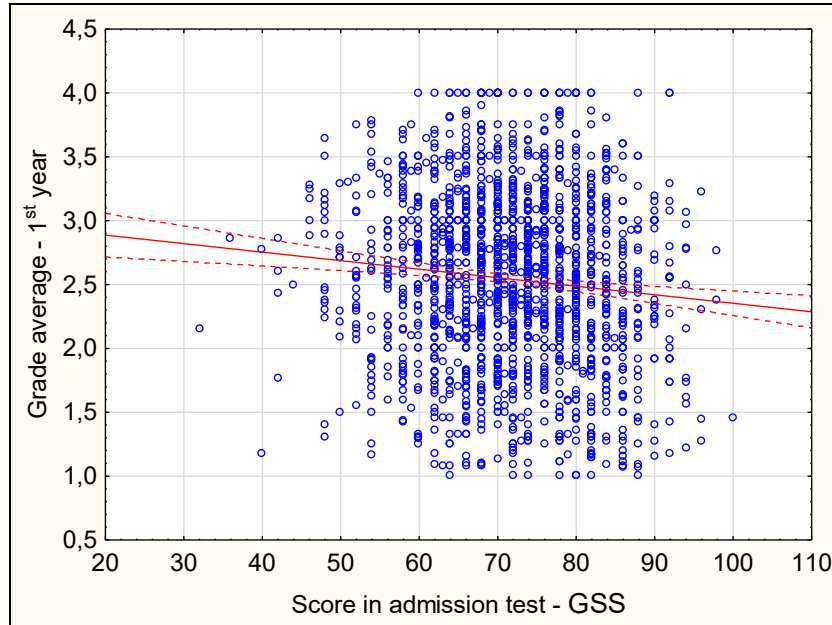


Fig. 3: Correlation between the GSS test and the grade average in the 1<sup>st</sup> year of study ( $y = 3.0203 - 0.0067 * x$ ; Pearson's  $r = 0.0985$ ;  $p < 0.0001$ ). Symbols explained in the legend of Fig. 1.

### 3.2. Biology and GSS admission tests as predictors of the students' grades in final bachelor's exam

The results of the Biology admission test quite well reflected the later student outcome of the state bachelor's examination (one-way ANOVA;  $p < 0.01$ ), see Fig. 4 for details. Students with the final grade 1 (excellent) had significantly higher test scores in the Biology test than the rest of students (Tukeys HSD post-hoc test,  $p < 0.001$ ). In contrast, there was no difference in the results of the GSS tests (one-way ANOVA;  $p > 0.1$ ).

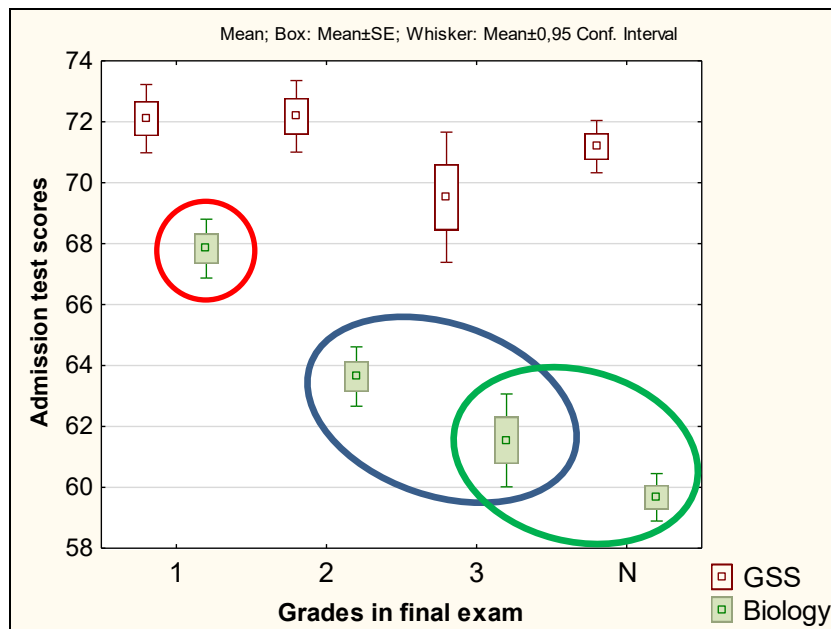


Fig 4: Students' results in admission tests (Biology, GSS), grouped according to their grades in final bachelors' exams (grades 1, 2, 3 = successfully passed; N = not passed or abandoned the study before graduating). The ovals in different colours indicate homogenous groups ( $p > 0.05$ .)



#### 4. Discussion and Conclusions

Although GSS tests seem to be widely used [2], several studies indicate that Subject tests are better predictors of academic performance, or SAP [2, 5]. These findings are in concordance with our results which showed only a weak correlation between bachelor students' academic performance and their GSS tests scores, compared to a moderate correlation between bachelor students' academic performance and their Biology Subject tests. The Biology test seems to be an even better predictor of SAP than the combination of both types of tests. Consequently, this had led, like in case of one Czech faculties of medicine [8], to abandoning the GSS test as part of admission tests for future biologists and biology teachers at Faculty of Science, Charles University. We conclude that although the GSS tests may reflect important study skills, they lack other important features, such as the students' subject-specific knowledge background, diligence and motivation for the study. These aspects are probably better covered by the Subject tests.

We are well aware of the limitations of our study. First, we included only the students, who passed the process of admission and finished at least first year of study. We therefore could not access data on possible SAP of unsuccessful applicants or of successful applicants, who had decided not to study at Faculty of Science. Second, the grade average in the 1<sup>st</sup> study year and the grades in the bachelors' final exam, used as measures of SAP in our study, describe only a part of the whole complex picture. We propose a more detailed future study, including measures of the students' performance in subsequent degrees as well as their research activities.

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#### References

- [1] Hardgrave, B. C., Wilson, R. L., & Walstrom, K. A. "Predicting graduate student success: A comparison of neural networks and traditional techniques", *Computers & Operations Research*, vol. 21, no. 3, pp. 249–263, 1994.
- [2] Kuncel, N. R., Hezlett, S. A., & Ones, D. S. "A comprehensive meta-analysis of the predictive validity of the Graduate Record Examinations: Implications for graduate student selection and performance". *Psychological Bulletin*, vol. 127, no. 1, pp. 162–181, 2001.
- [3] Kuncel, N. R., & Hezlett, S. A. "Standardized Tests Predict Graduate Students' Success", *Science*, vol. 315, no. 5815, pp. 1080–1081, 2007,
- [4] Hall, J. D., O'Connell, A. B. & J. G. Cook, „Predictors of Student Productivity in Biomedical Graduate School Applications", *PLOS ONE*, vol. 12, no. 1, pp. e0169121, 2017.
- [5] Rubešová, J. "Souvisí úspěšnost studia na vysoké škole se středoškolským prospěchem? *Pedagogická orientace*", 19(3), 89–103, 2009.
- [6] Höschl, C., & Kožený, J. "Predicting academic performance of medical students: The first three years", *American Journal of Psychiatry*, 154(6), 87, 1997.
- [7] Synek, J., & Otrřisal, V. "Predikční validita testu OSP – výsledky analýzy", *Scio*. 2008. <https://docplayer.cz/15157738-Www-scio-cz-s-r-o-zpracovali-jan-synek-vaclav-otrisal-15-zari-2008.html>
- [8] Táborská, E. "Proč Lékařská fakulta nepoužívá TSP?", @muni.cz – Online verze měsíčníku Masarykovy univerzity. 2005. <https://www.em.muni.cz/tema/83-proc-lekarska-fakulta-nepouziva-tsp>