

ASSESSING WITH WEB-BASED TECHNOLOGIES THE SPACE SIGHT CAPABILITY OF THE STUDENTS

Abstract: *Mental Cutting Test (MCT) is a multiple-choice test consisting in mentally cutting 26 solids. For every problem, five answers were provided and learners had to identify the only one correct answer and to mark it. This paper presents the implementation of this test in the educational activity, while using Google Forms. The Google form service is a component of the Office suite provided by Google as free of charge web applications, that are easy to use and whose operation is permanently improved.*

Keywords: *Mental Cutting Test, Web-Based Technologies, assessment of space sight capability.*

1. INTRODUCTION

During the past years, our studies have been focused on the development and consolidation of the students' ability to perceive objects in three-dimensional space [1], [2].

First of all, one has to specify that the first year students of the technical universities come to academic level education with a quasi-inexistent graphical education. Consequently, within the graphical subjects in the curriculum (descriptive geometry, technical drawing), serious efforts are made to develop the space sight capability together with learning basic concepts related to graphical representations.

Tests are administered in this respect at the beginning of each academic year in order to find the starting point or initial situation regarding students' space sight capability. Dependent on test results, the difficulty degree of applications made during works classes can be adapted and graded.

This paper presents the results of a MCT test applied to first year undergraduates of the Faculty of Civil Engineering before the beginning of the course on Descriptive Geometry. Dissimilar to last year test, when the test was written on paper, in this case, we made use of Google Forms and solutions were presented on the computer.

Graphical subjects (Descriptive Geometry, Technical Drawing, Computer-Aided Graphics) have a fundamental role to play in the formation of engineering students for their would-be profession.

The space sight capability developed in the study of these subjects is practically indispensable for a technical field specialist.

In the Faculty of Civil Engineering from Cluj-Napoca, Specialisation of Civil Engineering, the instruction goes along three semesters. Descriptive Geometry is studied in the second semester of the first academic year. In this subject, undergraduates learn about object systems of representation in three systems of representation: the orthogonal projection on two planes of projection, axonometry, and the projection with elevations. The undergraduates also become familiar with geometrical reasoning and

abstraction, which are basic elements for a technical representation.

Based on the knowledge acquired in the study of Descriptive Geometry, in the second academic year, semesters one and two, in Technical Drawing and Computer-Aided Graphics, students learn how to arrange projections and sections of solids and dimensioning rules, as well as rules regarding the representation of construction structural members and subunits. During the second semester, the works classes are kept in a percentage of 100% in the computer, using AutoCAD software.

The curriculum is so organised that at the end of the three semesters students are able to write or "read" independently engineering drawings. Space sight will be gradually strengthened as time goes on, in the following years of study, in the works and projects of the rest of engineering subjects.

2. EXPERIMENT DEVELOPMENT. METHODS

Testing was performed during the first academic week, in the class of Descriptive Geometry, in a time interval of about 20 minutes. The test was totally administered to 262 subjects, 87 girls and 175 boys. The test was administered in half-groups of about 15 students. As the majority of the undergraduates had no knowledge of Descriptive Geometry, they could only make use of their innate space sight capability.

The exception of the rule comes from students graduating technical highschools which have some instruction in Technical Drawing. An exception is also regarding students who first matriculate for admission in Architecture, which have a preparation of about two years in graphical subjects, before the admission in Architecture. The two exception allow for 5-8% of the overall number of undergraduates.

The test consists in mentally cutting 26 solids. The solids to be cut and the secant planes were represented axonometrically, and the answers suggested (the sections themselves) were given as projections. For every problem, 5 suggested answers were given, one being correct. The students had to find the correct answer, to encircle it. In order to make students familiar with such problems, at the beginning of the test, two solved problems were presented (Figure 1).

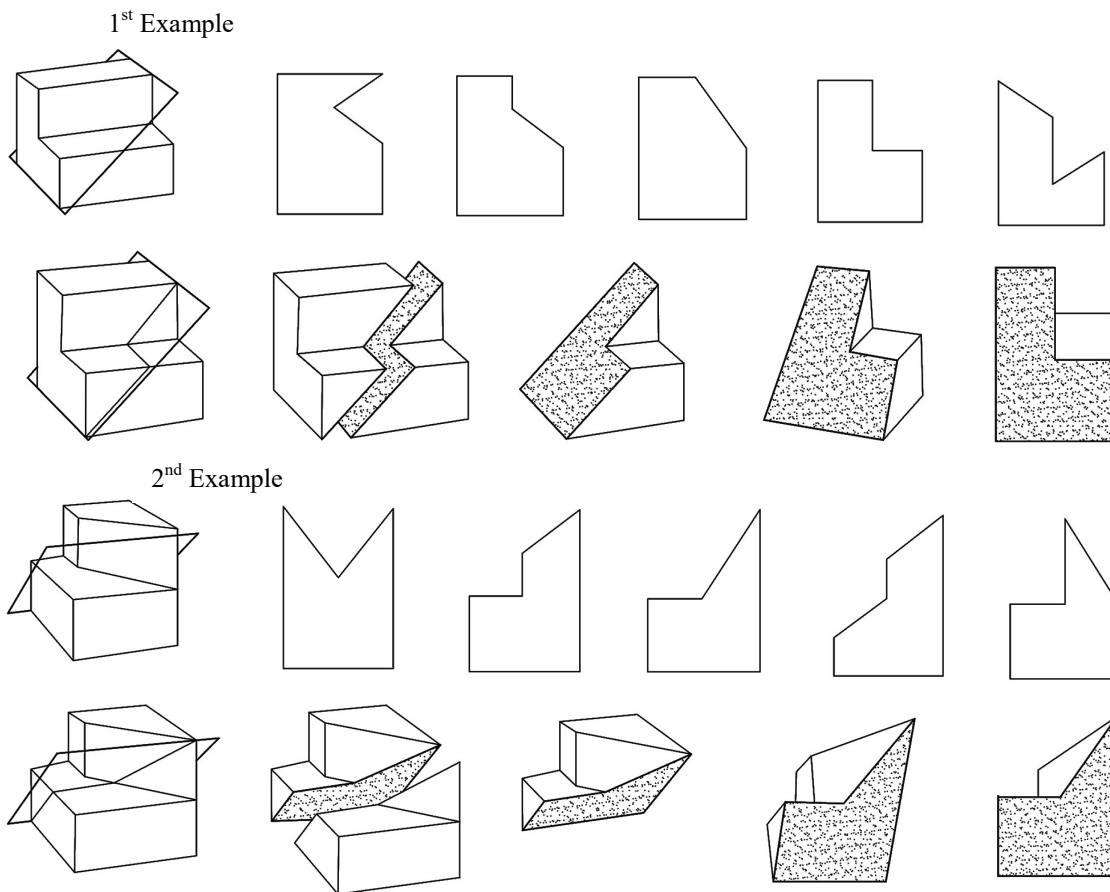


Fig. 1 Test presentation.

The solved examples, the 26 solids and the suggested solutions were included in a table (see Table 1). As mentioned, different from the previous academic year, the test was implemented using Google

Forms, a component of the Office suite, offered by Google as a web-based free application, easy to use and continuously improved in functioning.

Table 1

Examples for some solids contained in the test					
Solids and sectional planes	Answers				
	1	2	3	4	5

Google Forms allows an easy solution of questionnaires, as web pages, easy to access, with an intuitive interface, and useful facilities, such as data validation options with regular expressions (RegEx), an essential component to results quality.

After questionnaire fill in, Google Forms provides the option of table form results presentation. By means of API (Application Programming Interface), results can be queried similar to a database, with a SQL (Structured Query Language) like syntax, leading to fast responses for complex queries regarding the resulting data set.

Using Google Forms brings about a series of benefits, compared to the implementation of an own web based application for tests, among which: it is no longer necessary to rent a domain, so costs related to web hosting or costs for the maintenance of an own web server are no more present. The need to implement of a web application is eliminated, as well as that for a related database and of the issues with respect to their proper implementation. Using this platform also is beneficial from the viewpoint of the Google servers reliability, having the guaranty of a non-stop service, without disfunctions, and where the limiting factor could be only the Internet connection.

There are also several drawbacks in this service use. First the limitations related to application customisation, as only the templates provided by the application can be used. With a little effort, there are partial solutions for this issue as changes in rubric visualisation are possible, though no modifications of the structural parts of the application can be made.

Technical limitations also affect the table with results, such as:

- maximum 400000 cells, in maximum 256 rows,
- maximum 40000 cells with formulae,
- maximum 200 worksheets,
- maximum 1000 GoogleLookup formulae (data search),
- maximum 50 external data import functions.

For our purpose, the limits mentioned above were not touched. But they are permanently improved by Google along with the service development.

3. RESULTS AND CONCLUSIONS

After students filled in the results, with the help of Google Forms services, results were found in table form (see Figure 2). The results could not be queried and relatively easily responses for complex queries regarding the resulting data set were obtained. The query and interpretation range is very varied. For instance, function of the percentage of wrong responses for a certain problem, the teacher can better adapt the explanations and exercises during the classes to make the problem clearer.

In order to be more suggestive, the various test results can also be presented as diagrams (Figures 3 – 5). The test results of each individual student are kept for the teacher to grade the degree of difficulty of the applications during the teaching of graphical subjects, to improve students' results.

In this way, an attempt to optimise teaching activity is made, both by rejecting a uniform teaching and by making students familiar with modern assessment techniques used in the educational process.

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Fig. 2 Table form results. Example.

We think results and testing can be improved by repeated administration of tests, as the students' situation and way of making learning go in-depth develops rapidly by different from case to case. In this context, after 4-5 weeks, the results of the initial test may no more represent reality. Of course, the test needs changing and adapting for every stage so that the subjects are not

conditioned by solution memorising or boredom due to solving of the same problems. Test repetition is possible (without affecting the time allotted to applications) because by solving problems with the computer, by appealing to the Google Forms service, the speed in finding out results and their interpretation has increased considerably.

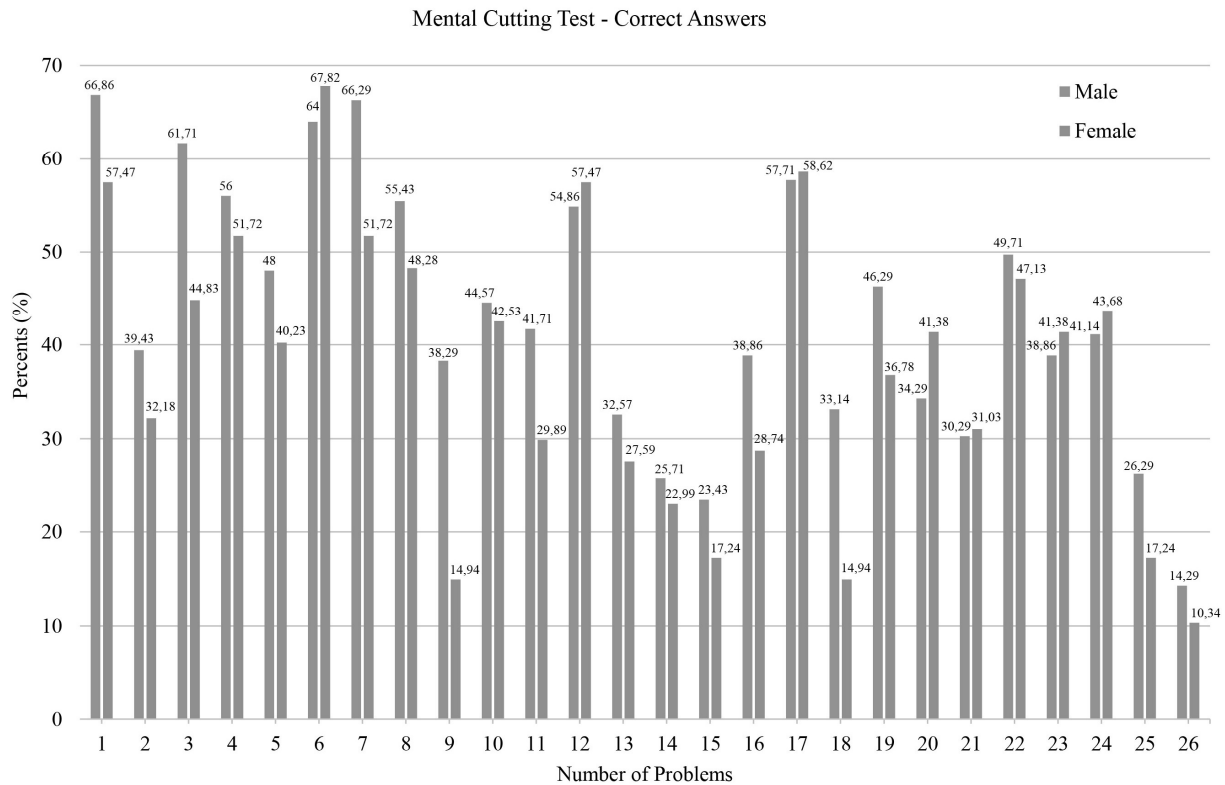


Fig. 3 Comparison of girls-boys results for every problem.

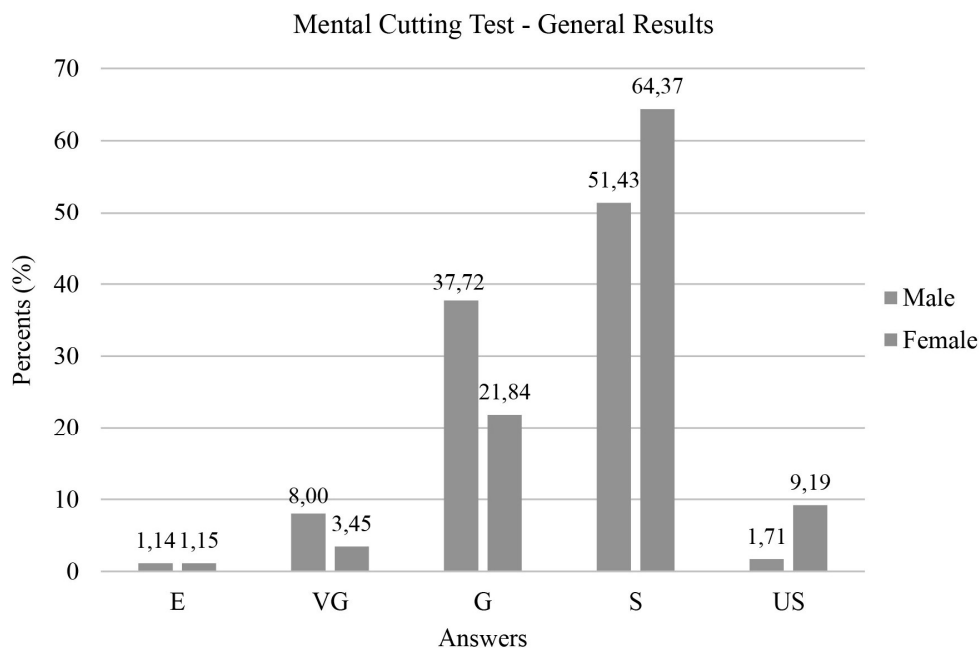


Fig. 4 Comparison of girls – boys general results.

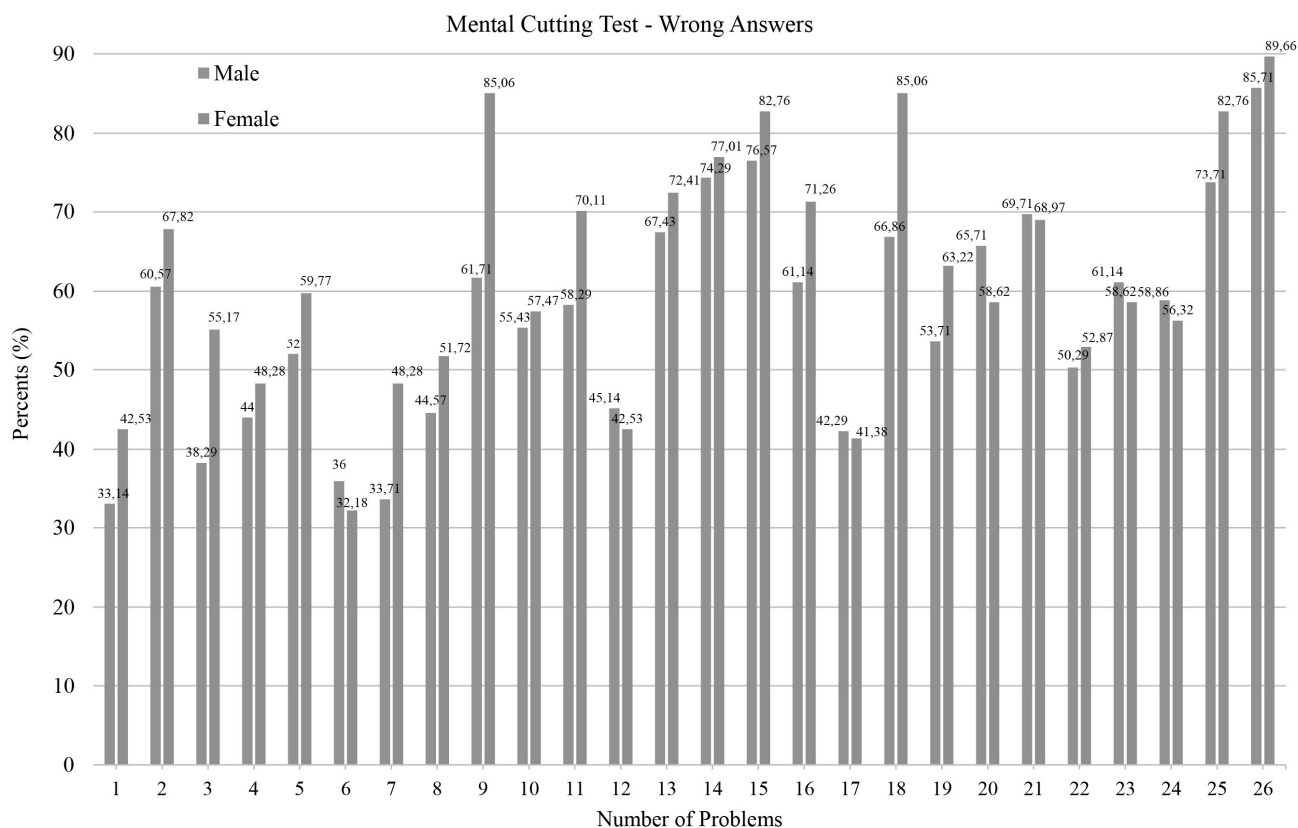


Fig. 5 Wrong answers highlight.

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