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IMAGINATION AND A FUTURE ENGINEER

Introduction of computers into engineering geometry has been a great success in the recent years. Their graphic abilities enable and speed up the work of engineers. Thus classical geometry - as a tool of presentation loses one of its functions. Due to more and more innovated software one can think that geometry loses its importance also in the development of space imagination.

We have come out of the requirement that space imagination is necessary for technical imagination. It is known that stereometry has become a marginal subject at elementary and secondary schools during the last twenty years [Juščáková,Z.-Pavelová,E.1998; Pomykalová,E. 1999]. In our opinion its importance will not be overestimated if some of its aspects are regarded to be irreplaceable.

In terms of methodology the school geometry can be analysed both through the activities carried out by pupils and experience they obtain. We mean the following activities: experiment, solution of construction tasks, formation and verification of hypotheses, evidence; and knowledge: constructions, propositions, formuli...

In terms of psychology geometry can be divided into branches according to psychical functions: imagination, combinatory abilities, memory, creativeness, abilities of argumentation, abstraction abilities. [Vopěnka,P.1989]

We are dealing with these problems due to low level of the space imagination of our students as well as due to the stimuli of our colleagues from the department of architecture. We cannot admit such gaps in the competences of engineers. It is impossible to say that in university students nothing can be done in developing of these abilities. In the entrance exams we would like to accept students with the best space imagination if possible.

That is why we have looked for the tasks which test the space imagination. When analysing this ability and observing its manifestations we came to the conclusion that in the geometrical tasks the positional (especially complanary and non-intersacrory versus concurrent) and metrical (perpendicularity, center, central) relations are often determined by means of knowledge obtained and the ability of "insight into"(vision+concept). The attributes of the space imagination are as follows:

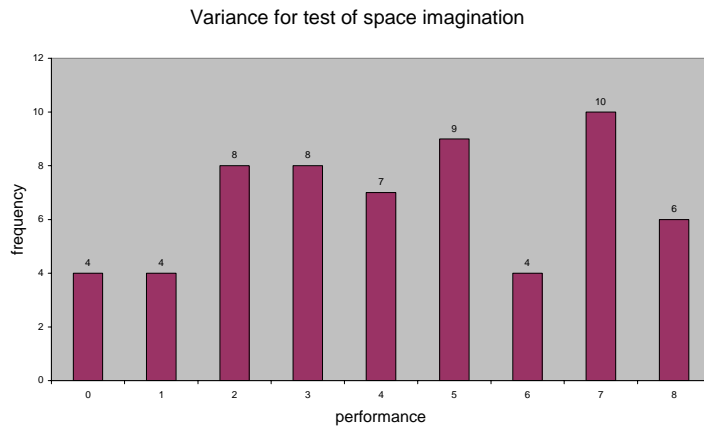
- to understand and create a space in transition from D2 into D3 and vice versa;
- to construct a space by connection of geometrical properties of an object with its functional determination.

Following these principles we have developed a test which could find out the abilities for the further development of the students of technical university. This test was used at the entrance exams for the school year 2000/2001 for applicants for architecture (62) and design (110) at the Faculty of Applied Arts of the Technical University in Košice. Evaluation of this test has shown a strong motivation and maximal effect. Reliability of the test has been high, $\bar{r}_a = 0.996$ in architects and $\bar{r}_d = 0.997$ in designers.

Statistical evaluation of tests

Applicants for architecture: 62 students

Graph 1



For better characteristics of the basic group the histograms of the obtained scores in the test of space imagination are given in Graph 1. It is not a normal (gauss) distribution of frequency. Successfulness in the test of space imagination was 53.43%.

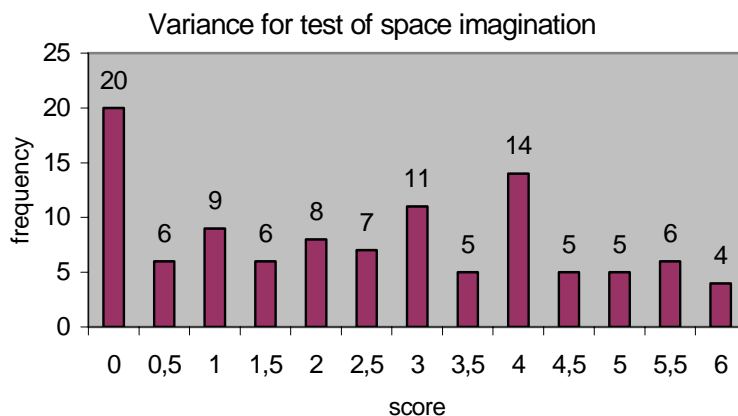
Similar results were obtained in the mathematical test. Normal distribution was presented in the tests of graphic abilities, foreign language tests and general knowledge tests .

Statistic of test for architects:

Mean	test of space imagination maximum 8 points	exam of art abilities maximum 62 points
Arithmetic average	4,27	31,32
Median	4	32,55
Mode	7	34,7
Variance	2,397	8,68

Applicants for design: 110 students

Graph 2

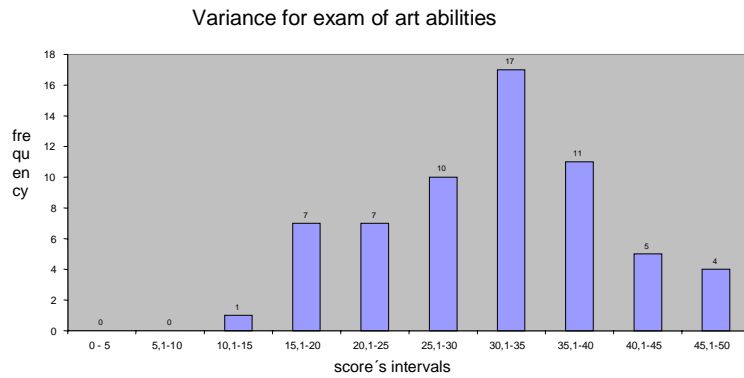


If we don't consider a numerous group of applicants who obtained no points in the test of space imagination the distribution of frequency is almost normal. Successfulness in the space imagination was 40.23%.

Statistic of test for designers:

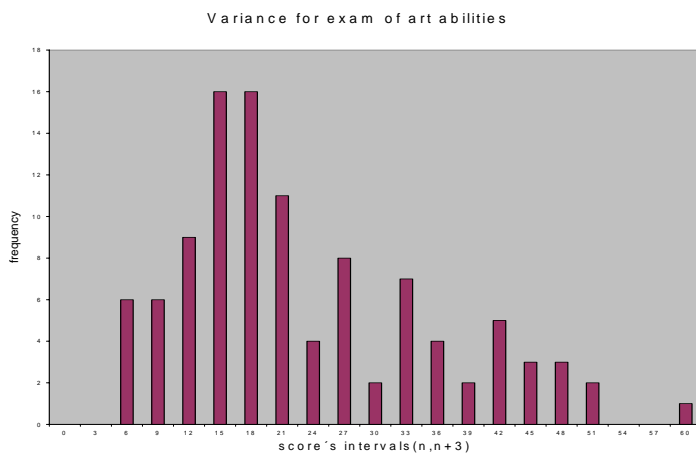
Mean	test of space imagination maximum 6 points	exam of art abilities maximum 70 points
Arithmetic average	2,55	21,49
Median	2,5	17,8
Mode	0	11,1
Variance	1,847	12,05

Graph 3



The exam of art abilities for architecture consisted of four parts: drawing, composition, design and home works. Our statistics has shown the total in all four skills.

Graph 4



The exam for design of art abilities was similar: drawing, modeling, design and home works.

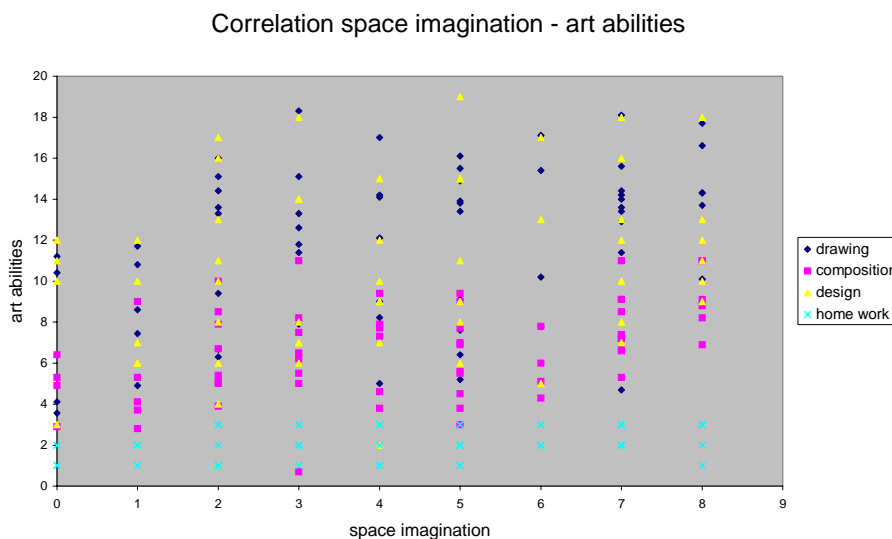
Both exams were evaluated by several members selection board.

Connections and correlations

- for architecture

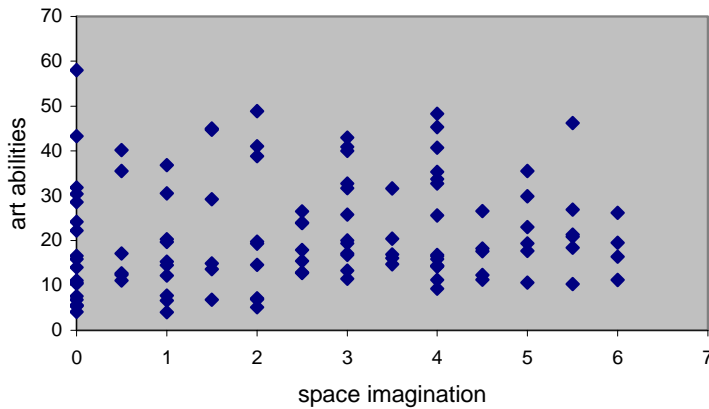
	covariance	f-test	pears.coef
Sp.imagin. – art abil.	8,6635588	2,54025E-19	0,4164052
Sp.imagin. – maths	3,2219043	1,00478E-10	0,2325945
Sp.imagin.-stud. abil.	4,3402706	1,10278E-15	0,2456448

Graph a



Graph a

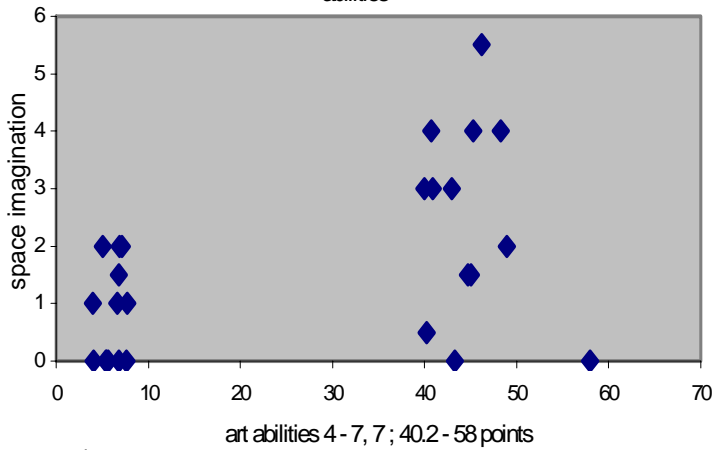
Correlation space imagination - art abilities



The graph a showing the correlation between the space imagination and the art skills indicates that in the basic group there are many applicants both with low space imagination and art skills. The coefficient of correlation ($r_1 = 0.104189$) shows insignificant

Graph b

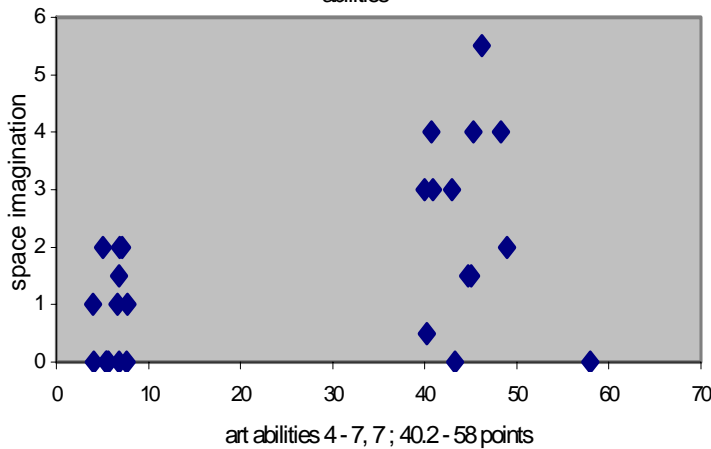
Dependence of the marginal values of the space imagination and abilities



The marginal values of scores in space imagination more markedly indicate that the number of applicants with minimal space imagination with the growing values of scores in art abilities has decreased, but neither other correlations neither graph b or calculation $r_b = 0.07776$ have confirmed it.

Graph c

Dependence of the marginal values of the space imagination and abilities



Vice versa:

Now let us consider the marginal values of art abilities. It can be stated that applicants with low art abilities reached lower than 30% successfulness in the test of space imagination.

Minimal (maximal) scores of art abilities with the appropriate scores in space imagination correlated "slightly" ($r_{\min} = 0.216221$ ($r_{\max} = 0.210959$), but the total correlation $r_c = 0.6199$ begins to be interesting. Similarly in the statistic group of applicants for architecture the verification of the correlation between the space imagination and the art abilities by t criterion ($t = 1.8524755$)

for the level of significance 0.05 ($k = 2.000$) gives a zero hypothesis. If this correlation does not confirm the supposed dependence, these are the random variations of scores.

Obviously this fact is going to be the subject of our further research. We have supposed that it would be necessary to improve the scales of the given exams and improve diagnostics. Art abilities are evaluated by a selection board. And these are highly subjective evaluations out of which the average values are given. The test of space imagination is evaluated according to exactly given scale - more objectively. It can result in a certain "roughness" of evaluation, strictness which classifies the applicants into some performance classes and some specific qualities can be neglected. The results obtained require more detailed analysis.

Considering the opinions of some artists one more question should be answered: space imagination and art abilities do not correlate in a certain sense, there are artists "who think in colours, materials,..." but not in the physical space.

Furthermore there have been many applicants from the secondary schools of applied arts. Their art abilities are so well trained that they are highly evaluated at the entrance exams but their "technical thinking" is at lower level as it can be observed during their study at Technical University. When compared, the graduates from secondary grammar schools are then also better at art abilities.

I visited two secondary schools of applied arts in Košice and Bratislava and their teachers confirmed my presumptions. They have had some problems with space imagination especially at the department of exhibition management where it is mostly required.

Both branches (architecture and design) in a certain sense represent an integration connection of aesthetics and engineering. It is not simple to measure an importance of space imagination in both fields. In conclusion we would like to state that its necessity requires the process of education at technical universities and technical practice as well. As no significant correlations between the test of space imagination and other tests have been recorded, it only confirms its substantiation at the entrance exams.

The presented problematic was solved by the research work VEGA 1/7319/20.

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WYOBRAŹNIA PRZYSZŁEGO INŻYNIERA

W artykule przedstawiona została metoda testowania wyobraźni przestrzennej, którą wykorzystano jako element egzaminów wstępnych na Wydziale Wzornictwa Przemysłowego Uniwersytetu Technicznego w Koszycach (Słowacja). Autorka opisała sposób przeprowadzenia testów, opis statystyczny uzyskanych wyników oraz ich związek z oceną uzdolnień plastycznych kandydatów na w/w studia.

Przeprowadzone badania nie wykazały związku między ocenami z testu na wyobraźnię przestrzenną a oceną z uzdolnień plastycznych. W końcowej części artykułu przeprowadzono analizę, której celem jest ustalenie przyczyn takiego stanu.