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TYPOLOGY OF SPATIAL ABILITY TESTS AND ITS IMPLEMENTATION IN ARCHITECTURAL STUDY ENTRANCE EXAMS

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Abstract. *Specialized spatial skills are necessary for success in various fields of STEM (science, technology, engineering, and mathematics) education. Technical disciplines are an academic field where the largest correlation with spatial skills has been noticed, and therefore spatial skills have been included in the entrance exams of study of architecture at the University of Banja Luka.*
Given that the scientific community has not reached consensus on what the spatial abilities are, there are various tests and tools used for its assessment, listed by factors that they measure. The paper will present typology of these factors and the variety of tests used for their assessment. This typology of tasks will be compared to the entrance exams held at the University of Banja Luka in the period 2005-2013.
Also, the results of entrance exams will be compared with the student's success in specific groups of subjects during the study period to see if there would be any correlation among them.
Results indicate at the emergence of a new factor in assessing the ability of candidates to study architecture - ability of divergent thinking. This correlation of divergent thinking and spatial ability has also been a topic of the latest research in cognitive psychology.

Key words: *spatial ability, entrance test, spatial tests, divergent thinking, architectural competencies*

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THE IMPORTANCE OF SPATIAL ABILITY IN ARCHITECTURAL STUDIES

Specialized spatial skills are necessary for success in various fields of STEM (science, technology, engineering, and mathematics) education. Technical disciplines are an academic field where the largest correlation with spatial abilities has been noticed (Stückrath 1968, according to [1]). Smith (1964, according to [1]) in his research finds a correlation between the spatial skills and subjects in primary education such as mathematics and art, as well as technically oriented subjects related to wood or metal modelling or mechanical sciences. He states that test of spatial ability is the only predictor of success in technical subjects, while other tests have little or no impact.

Numerous studies have shown the importance of spatial ability in professional practice also. US Employment Service in 1957 published a list of competence in the field of industry, where the ability of spatial manipulations has been listed as desirable in 85% of those professions (Stumpf and Fau in 1983, according to [1]) Further, 84 professions that require a high level of spatial ability has been identified (Smith 1964, according to [1]). These professions have been organized into the following groups:

- Technology (27 types of engineers, architects...)
- Natural sciences (biologists, chemists, geophysicists, mathematicians, physicists...)
- Technical drawing (14 types of technical draftsman)
- Medicine and dentistry (14 different medical professions) and
- Design (7 different professions).

Spatial education in childhood significantly influenced the work of architect Frank Lloyd Wright. Frobel cubes with which he played often as a child were credited for his success and choice of profession. In his letter to Grant Mason, author of the article about Wright published in the Architectural Review, Wright said: "... you got the essence of my mother's contact with Frobel... and you are perfectly right regarding the formative power and direction the 'kindergarten' gave my instincts and could beyond all else give children if properly applied." (Pfeiffer 1984, according to [2])

However, the development of spatial ability is not adequately implemented in education. In fact, the school is one of the institutions most responsible for the degradation of spatial thinking. Most teachers are not only indifferent to the subject of visualization, but also reject it, finding it childish and primitive. Mechanics and drawing classes, workshops and art classes, where visual thinking plays a dominant role, are considered second-rate intellectual abilities (Sommer 1978 to [3]).

In his book "A Plea for Visual Thinking" Arnheim [4] argues that most educational psychologists mistakenly believe that there is a dichotomy between perception (visual thinking) and reasoning (cognitive thinking). He states that since Descartes, it was considered that the ability of thinking is superior to the ability of perception. Arnheim states that the perception and thinking are both necessary in the process of judgement and that elevating the reasoning skills over the visual ones is ignoring the modus in which the mind actually works. In fact, he believes that "thinking, therefore, in most cases, is visual thinking."

WHAT ARE THE SPATIAL ABILITIES?

In psychological research in the field of education, a distinction is often made between "spatial ability" and "spatial skills”. Spatial ability is defined as an innate ability to visualize space a person have had before he/she underwent any formal training, that is, a person is born with that ability. However, spatial skills are learned or acquired through training. For students at the university level it is almost impossible to distinguish between spatial ability and spatial skills, as until then they had no formal training in spatial skills. Therefore, in this paper we will not make the difference between skills and abilities, and both terms will be used interchangeably.

Spatial skills are important area of research in educational psychology from the 1920s and 30s. However, unlike other types of skills, there is no real consensus on what is meant by the term of "spatial visualization skills". For example, some argue that the "spatial visualization ability is ability of manipulating the object in one’s mind" (Kahle in 1983 according to [3]), while others claim that "spatial visualization involves a complicated, multi-step spatial manipulation of observed data” (Linn and Petersen in 1985, according to [3]). Others argue that the "spatial visualization is mental manipulation of spatial information to determine how the given spatial configuration will look like if part of this configuration is rotated, folded, moved, or otherwise transformed" (Salthouse et. Al. 1990, according to [3]).

In an attempt to address these issues, some authors have defined the categories of spatial ability, assuming that there is no single, all-encompassing definition of spatial visualization ability. Maier [1] and Maresch [5] have proposed the following five components that form spatial ability of a person:

- spatial visualization – ability to see the shape in whole, presented by its rotated parts. Guilford describes this factor as "an ability to think of changes in objects - changes in position, orientation, or internal relationship". This component often includes subcomponent of spatial relations and spatial perception
  - spatial relations – ability to make a relation of pieces in order to form a given shape
  - spatial perception – includes the ability for identifying the horizontal and vertical directions, wherein the orientation of one's body plays an important role in relation to other
- spatial orientation
- mental rotation

Within these broad categories there is some overlapping. For example, there are certain activities that could be classified in the category of spatial relations and in the category of spatial orientation. Tartre (Tartre 1990, according to [3]) studied earlier work of McGehee (McGee 1979, according to [3]), and proposed a classification scheme of spatial skills based on the mental processes that are expected to be used in solving a certain spatial tasks. He believes that there are two different categories of spatial skills - spatial visualization and spatial orientation. Spatial visualization involves mentally moving the object, while the component of spatial orientation involves moving the observer in relation to the object. Spatial visualization is further divided into two categories: mental rotation and mental transformation.

There are also two meta-analytic studies that are often cited in the literature: Lohman's [6] and Carroll's [7] which encourage the appearance of three main factors: spatial relations, spatial orientation and visualization.

Lohman also found the existence of four secondary factors which he defined as closure speed, perceptual speed, visual memory and kinesthetic - speed of alternating use of the left and right hemispheres [6].

Although Lohman's and Carol's meta-analysis is often cited when identifying factors of spatial skills, debate about important and less important factors continues today. It remains unclear what factors in general are, whether they can be observed separately, and if they can be measured. Understandably, the authors have expressed dissatisfaction with the lack of a coherent taxonomy (conversation of Harle and Newcombe, according to [8]).

Table 1 Overview of factors of spatial ability according to different authors [5]

		Spatial ability factors					
Year	Authors	Visualization	Spatial relations	Spatial orientation	Spatial perception	Mental rotation	Later factors
1950	Thurstone, L.L.	•	•	•			
1951	French, J.W.	•		•			
1956	Guilford, J.P.	•		•			
1977	Rost, D.H.	•		•			
1979	Lohman, D.F.	•	•	•			
1979	McGee, M. G.	•		•			
1985	Linn, M.C. Peterson, A.C.	•			•	•	
1988	Lohmann, D.F.	•		•		•	Flexibility of Closure Spatial Scanning Perceptual Speed Serial Integration Visual Memory Kinaesthetic
1993	Carroll, J. B.	•	•				Closure Speed Closure Flexibility Perceptual Speed Serial Pictorial Integration Spatial Scanning Imagery Length Estimation
1994	Maier, H. P.	•	•	•	•	•	

TYPES OF SPATIAL TASKS ACCORDING TO SPATIAL FACTORS

For assessment of spatial skills and its development, standardized instruments in the form of tests of spatial ability were used. There are numerous tasks used in these tests and they differ from author to author, as we said that there is no real consensus on what is meant by the term of "spatial ability".

Classification of spatial tests was established by Eliot in 1983 [9], but he did not focus on the factors these tests measure. His classification was organized in 13 types of tests, characterized first by single-task or multiple-task category, and later by recognition division (two-dimensional) and manipulative division (three-dimensional) of task category.

In this paper we will present a typology of spatial tasks according to the factors they measure. We could make a rough classification of these tasks according to dimensionality of space:

- group of two dimensional tasks
- group of three dimensional tasks

The first group measures 4 of 5 factors of spatial abilities, but they will not be of importance for further measurement and application in this paper, as we will be focused on three-dimensional tasks more relevant to the field of architecture.

The second group, according to their complexity, factors that measure and their implication in architectural studies, could be further classified in three types:

- TYPE A: Tasks of orientation where the subject is moved, transformed or rotated in relation to object
- TYPE B: Tasks of spatial manipulation with objects. This type requires an ability of mental rotation and spatial relations.
- TYPE C: Tasks that require visualization of objects given with its projection.
- TYPE D: Tasks that require visualization of intersecting elements.

Detailed overview of these types is presented in table 2.

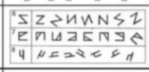
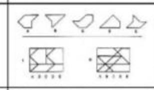
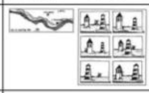
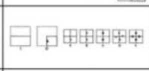
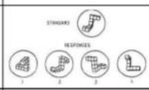
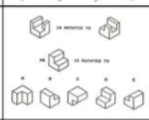
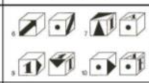
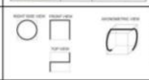
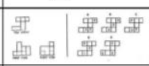
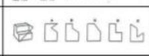
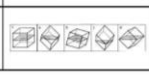
Further studies of spatial abilities reveal new factors and create new tests of spatial ability in relation to these factors. One that may be of interest to architects is a dynamic spatial ability. The dynamic ability is necessary for cognition of change of the object’s position in time. With the evolution of computers, interest in the ability to think about the movement and the ability to integrate spatial information with time was renewed. [10]

In recent years research about spatial imagination [11] [12], and the plan interpretation [19] has been discussed, but these tests have not yet been implemented broadly.

THE USE OF SPATIAL ABILITY TASKS IN THE ENTRANCE EXAMS FOR STUDIES OF ARCHITECTURE

Spatial skills are not properly valued in the educational system in global. They are often neglected in favor of analytical and verbal skills, so the curriculums of primary and secondary schools do not include educational material that could help develop spatial skills. However, as indicated above, these skills are very important for technical professions, and are required when enrolling in technical studies, especially in the studies of architecture.

Table 2 Overview of the tasks types

GROUP	Type	Number	Task			Factors measured				
						Visualization	Spatial perception	Spatial relation	Spatial orientation	Mental rotation
2D		1	Form Board (Ekstrom 1976, according to (Hegarty / Waller 2005))		Which of the given shapes could be rotated to fit into a given rectangle?	•		•		
		2	Card Rotations (Werdelin 1961, similar to Thurstone 193, according to (Maier 1999))		Which shape on the right match to the shape on the left that has been rotated?					•
		3	Hidden Figures (Ekstrom 1976, according to (Hegarty / Waller 2005))		Which of the shapes given in the picture above are contained in complex figures given in the bottom of the drawing?	•	•			
3D	ORIENTATION	1	Arial Orientation (De Lange 1984, according to (Maier 1999))		Determine the position of the observer on the left for each view shown on the right.				•	
		2	Guilford– Zimmerman Spatial Orientation (Guilford 1956, according to (Maier 1999))		Which of the five offered top views show the change in orientation of the bow drawn in the pictures?				•	
	MENTAL MANIPULATION	1	Differential Aptitude Test: SR (DAT:SR) (Bennet 1983, according to (Sorby 1999))		Which of the solids given right match the unfolded net on the left?					•
		2	3D Surface Development (Thurstone 1938, according to (Maier 1999))		Data is a three-dimensional image of the object and its developed network. Match the letters and numbers to correspond to a given shape and it's developed surface.					•
		3	Paper Folding (Guilford and Lacey 1947, according to (Maier 1999))		Sheet of paper is folded and then drilled as shown in the left picture. Which of the given solutions to the right match to the developed form of paper on the left?					•
		4	Shepard-Metzler Mental Rotation Test (Shepard and Metzler 1971, modified by Vanderberg and Kuse 1978, according to (Maier 1999))		Respondents should determine which of the offered rotated solutions below match the given object above.					•
		5	Purdue Spatial Visualisation Test: Rotations (PSVT:R) (Guay, 1977, according to (Sorby 1999))		Which of the offered rotated solutions below match the given object in the middle, if the rule of rotation is given in the example on top.					•
		6	Complement Cube Test (Juščáková 2004, according to (Gorska and Sorby 2008))		Which of the solution given on the right fit to the object on the left to make a cube?			•		•
		7	Cube Comparisons Test (Werdelin 1961 similar to Thurstone 193, according to (Maier 1999))		Which of the given pairs of views present the same cube? All the sides of the cube are different.			•		•
	VISUALISATION	1	Spatial Relation (Maier 1994, according to (Maresch 2013))		To which shape on the right does the shape on the left fits to match a cube?	•		•		
		2	Tube figures (Stump and Fay 1983, according to (Maier 1999))		Left picture presents a figure viewed from the front. Where should observer stand in order to see this figure as it is shown on the right picture?	•	•			
		3	Snake in a cube* (Juščáková 2004, according to (Gorska and Sorby 2008))		Three projection of the figure is shown on the left. Respondent should draw an isometric view on the right.	•	•			
		4	Lappan Test (Lapan 1981, according to (Gorska and Sorby 2008))		Three projection of the figure is shown on the left. Which of the top views shown on the right is correct?	•	•			
	MENTAL CUTTING	1	Mental Cutting Test MCT (CEEB 1939, according to (Sorby 1999))		Which of the sections given on the right matches the figure on the left cut with the given plane?	•				
		2	Surface of water in a vessel (Maier 1994, according to (Maresch 2013))		Which of the four drawings of the dice is possible if the cube is half-filled with water?		•			•

On Faculty of Architecture, Civil Engineering and Geodesy in Banja Luka tests of spatial ability, in addition to the tests in mathematics and free-hand drawing, are used in the last 15 years in assessing the success of candidates. The content of these tests varied from year to year. In future paragraphs we will present a review of the established typology of spatial tasks in the entrance exams for architectural studies in the past 8 years (table 3). Data were collected from student office and archives at the Faculty of Architecture, Civil Engineering and Geodesy in Banja Luka.

Table 3 Implementation of classified spatial tasks in architectural studies entrance exams

Group	Type	Number	Task	Year								
				2005	2006	2007	2008	2009	2010	2011	2012	2013
2D		1	Form Board									
		2	Card Rotations									
		3	Hidden Figures				•					
3D	A	1	Arial Orientation	•								
		2	Guilford– Zimmerman Spatial Orientation			•						
	B	1	Differential Aptitude Test: SR (DAT:SR)		•							
		2	3D Surface Development						•			
		3	Paper folding test									
		4	Shepard-Metzler Mental Rotation Test	••	•	•	•	•	•			•
		5	Purdue Spatial Visualisation Test: Rotations (PSVT:R)	••		•					•	
		6	Complement Cube Test		•							
		7	Cube Comparisons Test							••	•	
	C	1	Spatial relation									
		2	Tube figures		•				•			
		3	Snake in a cube*		•	••	••	•	•	••	•	•
		4	Lappan Test									
	D	1	Mental Cutting Test MCT					•	•			
		2	Surface of water in a vessel									
			Total number of tasks in the test	5	5	5	5	6	5	5	4	4
			Number of tasks with multiple choice	0	3	2	0	1	2	2	0	1
			Number of tasks that require candidate's solution	5	2	3	5	5	3	3	4	3
			Number of unclassified tasks				1	3		1	2	2

Tasks that are applied to the entrance exams were of higher level than the standardized tests of spatial ability. This is evident in tasks that measure the three-dimensional relations, complexity of objects and the type of given answers. In relation to that, the criterion of types of answers is added to table. High percentage of tasks where the candidate is asked to sketch or draw his/her own answer is determined (70%), as opposed to tasks with multiple choice answers (30%). The most frequent types of tasks are the tasks B and C, where the ability of mental rotation and spatial visualization have been measured.

However, more important is the fact that 20% of tasks does not belong to any of given types. This tendency to introduce new types of tasks has been noticed in the last 5 years. These tasks can be divided into two groups:

- Tasks that require specific knowledge in the field of perspective and intersection of solids, even though most of them can be solved intuitively (Figure 1)
- Tasks that require creative ("out of the box") thinking and the ability of spatial imagination (Figure 2)

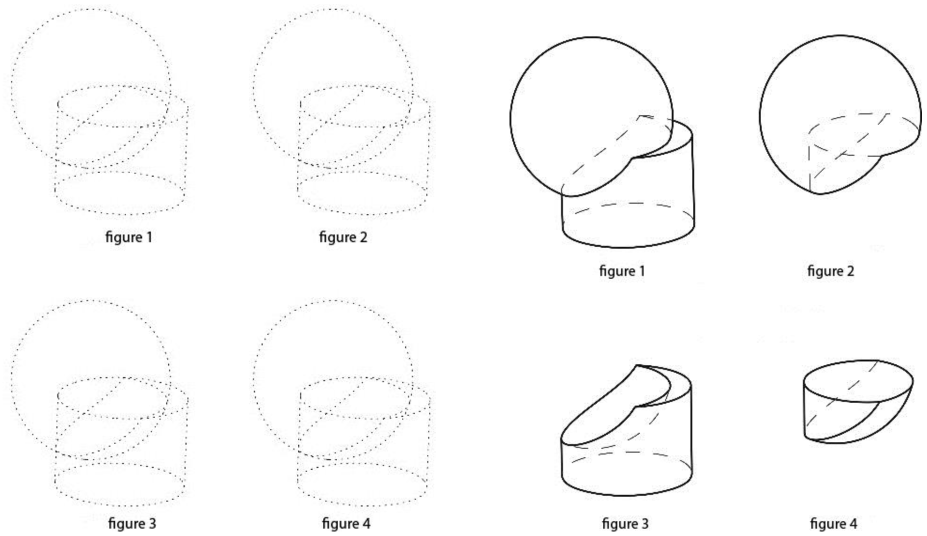


Fig 1 The text of the task is following: Sphere and cylinder are intersected. On the left respondent should draw what these solids would look like if: 1) these solids would be conjoined, 2) the sphere would be subtracted from the cylinder, 3) the cylinder would be subtracted from the sphere and 4) we would observe only the part that belongs to both of the solids. Take into account that the upper cylinder basis is visible. Draw the invisible edges of the object with dashed lines. The answer is given on the right. Source: Informer for prospective students of FACEG in Banja Luka

Fig. 2 The text of the task is following: On the left you see top view and front view of certain solid. If there are some hidden lines, they would be presented as dotted lines. Can you imagine and draw what would this solid look like in isometric view? Sketch at least one possible solution. The answer is given on the right. Source: Informer for prospective students of FACEG in Banja Luka

The emergence of such tasks requiring creative thinking and intuitive spatial reasoning in solving spatial tasks, shows a tendency of correlation between creativity and spatial abilities. This kind of thinking is especially characteristic for the architectural profession.

The modern labor market, in addition to specific professional competence of engineers also requires an innovative approach to problem solving. Defining the *Designer Profile*, Shah states that convergent thinking on which is based the current education system is insufficient for the successful design: "... The science based regimen promotes convergent thinking and deductive reasoning through closed-ended problem solving. While these skills are extremely valuable to any engineer, they are insufficient for design. Design requires abductive reasoning, not only deductive; It requires divergent thinking, not only convergent thinking; It requires creative thinking, not only critical thinking ... "[20]

Recent psychological research on the effects of spatial abilities has also shown that spatial ability is very important for creativity. In the late 1970s, 563 intellectually talented 13-year-old students in the U.S. (according to SAT results) were tested for spatial ability. Thirty years later, they conducted a study on the importance of the influence of spatial ability compared with mathematical and verbal abilities. The aim of this study was to test the hypothesis that spatial abilities play a unique role in the development of creative products [13] [14]. Criterion of creativity was defined by the number of patents of respondents.

Correlation of Entrance Exams Success with Success of Students in Study of Architecture

Considering the structure of entrance exam and assumption that spatial skills are connected to creative thinking, it was necessary to examine if such entrance exams have a correlation to success students achieve during the study period.

It was noticed that convergent thinking dominated in all entrance tests, where there is one correct answer. The aim was to determine the correlation of each of these tests individually with students' academic success of the first two years of study at the Faculty of Architecture and Civil Engineering in Banja Luka. Special attention will be paid to the spatial ability tests in order to determine its correlation with success in specific areas of the curriculum.

It is important to note that preparatory classes for the entrance exam were organized at the Faculty. It was basically a fifteen-day long intensive course held before the exam and during that time, students were prepared by going through and analyzing entrance tests held in previous years.

The research was conducted on a sample of 181 students of architecture through three generations of registered candidates. After two years of study the evaluation of the students was analyzed and the results were compared with the results achieved in the entrance exam. To determine the correlation of entrance exam with success during the study, subjects on which the analysis was performed were divided into three groups:

- Subjects in which mathematical and logical thinking dominates
- Subjects in which the spatial-visual thinking dominates
- Subjects in which an integrated approach to thinking is required (architectural design)

Due to the fact that success of candidates in individual cases depends on a number of factors (the subjectivity of teachers, teaching methods, program objectives, the structure and method of evaluation...) data were taken through three successive generations of students (2009-2011). Possibility to express creativity depends on the teachers and curriculum, but it is possible to group the subject in terms of a dominating way of thinking. The subjects in which mathematical and logical thinking dominates include mathematics, physics, statics and mechanics where the problem is pre-defined and students are required to focus on the most common one possible solution to the problem. In the group of subjects in which dominates the visual-spatial thinking are architectural graphics, architectural drawing, visualization and modeling. Subjects in which an integrated approach is required are topics of architectural design, where the task is not strictly defined, and it requires the production of a large number of possible solutions.

Method of regression was used in statistical data analysis using SPSS software.

RESULTS

Taking into account the results of all three segments of entrance exam (Psc, Pmm, Png), entrance exam has significant predictive value for a group of mathematical and logical subjects (AvML = .46). Entrance exam from mathematics (Pmm) provides a significant level of 0.01, while the entrance exam in freehand drawing (Psc) at the level of 0.05.

Taking into account the results of all three segments of entrance exam (Psc, Pmm, Png), entrance exam has significant predictive value for a group of visual spatial subjects (AvPV = .52). Entrance exams in mathematics and freehand drawing (Pmm, Psc) provide a significant level of 0.01, while the entrance exam in spatial ability (Png) at the level of 0.05.

Taking into account the results of all three segments of entrance exam (Psc, Pmm, Png), entrance exam has significant predictive value for the group of architectural design subjects (AVP = .45). Entrance exams in mathematics and freehand drawing (Pmm, Psc) provide a significant level of 0.01, while the entrance examination in spatial ability has no significance.

Taking into account the results of all three segments of entrance exam (Psc, Pmm, Png), entrance exam has significant predictive value for overall academic achievement of students (AvTotal = .51). Entrance exams in mathematics and freehand drawing (Pmm, Psc) provides a significant level of 0.01, while the entrance examination in spatial ability has no significance.

All variables correlate with entrance exams and they do not interfere with each other, which means that they measure different abilities.

DISCUSSION

Spatial ability is an inevitable source of individual differences that have been neglected in the educational environment; it has also been ignored in the development of expertise and creative achievements. However, more than 50 years long research documents the important role that spatial ability plays in education and professional fields that require skillful manipulation of images and objects. The inclusion of spatial ability factor in identifying gifted students, offering them the possibility of advanced learning, is yet unexplored resource for the field of technical sciences [14].

More recent research on the effect of spatial abilities has shown that spatial ability is very important for creativity [15]. Universities are increasingly encouraged to provide more opportunities for the development of creativity in the engineering profession [16]. The engineering profession requires recognition, verification and problem solving through teamwork. More importantly, it requires a demonstration of originality and critical thinking, creativity and innovation in the development of new methodologies. [16] [17].

Creativity, then, plays a significant role for success in the professions that are closely related to the technology. Creativity is often equated with the concept of divergent thinking, which requires different ways of defining and interpreting the problem, as opposed to convergent thinking which suggests that there is only one acceptable answer. Creative processes depend on both, but we can say that if divergent thinking is more developed, the person is more creative.

Research conducted at the Faculty of Architecture and Civil Engineering in Banja Luka on the influence of preparatory course and the results of the entrance examination showed a high correlation when it comes to math and freehand drawing, while in spatial ability there was no significant influences. Also, non-existence of correlation between entrance exam in spatial ability with overall student’s success in study of architecture brings a new question of integrating new types of tasks in those exams that are related to creative thinking.

The inclusion of creative thinking in the process of solving spatial tasks would contribute to the development of strategies for solving spatial problems. The main contribution to this development would be to ask the examinees to generate a number of possible solutions to a tasks which would than contribute to their developing of divergent thinking. An example of such tasks is shown in Figures 3 and 4. The first task includes the mechanical process of thinking (mechanical reasoning) that belongs to the type of tasks which implementation is still under investigation, while the other measures the factor of mental rotation and spatial relations.

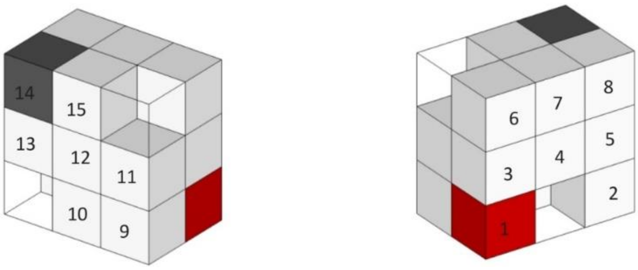


Fig. 3 Text of the task is following: Write the order of moving the red cube (1) in a position of grey cube (14) in fewest number of steps. Cubes are moving within the wire cuboid. Solution: There are several possible solutions. The smallest number of moves is 13 (1-3-4-5-2-1-1-2-13-1-15-14-1). Source: author.

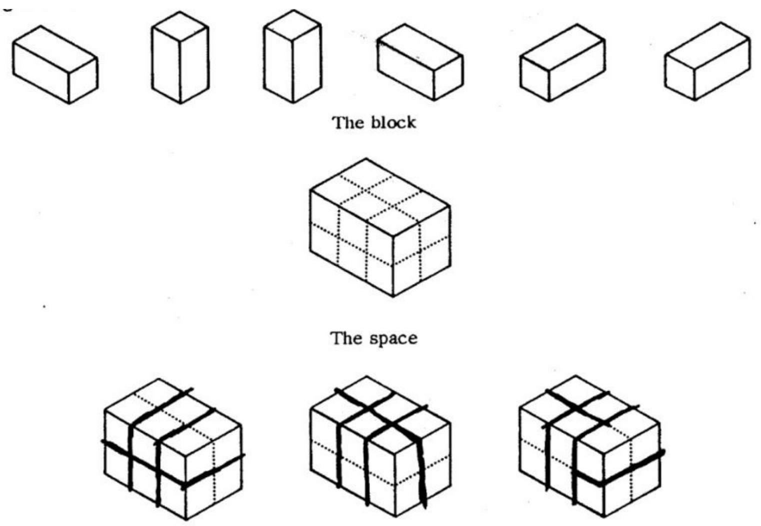


Fig. 4 Text of the task is following: There are 6 identical blocks given in the picture above. Draw as many possible solutions on how these blocks could be arranged to form a cuboid. Draw a visible and invisible lines. Source: [2]

CONCLUSION

Spatial skills are a key component in the evaluation of success in technical fields. The tests of spatial abilities have been an important part of the entrance exams for architectural studies at the Faculty of Architecture, Civil Engineering and Geodesy in Banja Luka in the past 15 years. The analysis of these tests and their comparison with standardized tests of spatial ability, confirmed the application of defined typologies tasks, but also a higher complexity of the test has been noticed. More important, new types of tasks that do not belong to any of the standardized tasks have been detected, requiring creative thinking and a high level of spatial intuition and imagination.

Recent psychological research also points out the key role of creative thinking in professions that are related to technology. Accordingly, it advisable to stimulate creative thinking at students in a way to bring in the type of tasks into an entrance exam whose solution would involve generating multiple answers, and whose examples are presented in this paper.

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TIPOLOGIJA ZADATAKA ZA PROCJENU PROSTORNIH SPOSOBNOSTI I NJIHOVA PRIMJENA U PRIJEMNIM TESTOVIMA ZA STUDIJE ARHITEKTURE

Specijalizovane prostorne sposobnosti su neophodne za uspjeh u različitim oblastima STEM (science, technology, engineering, and mathematics) obrazovanja. Tehničke discipline su akademsko polje gdje je utvrđena najveća korelacija sa prostornim sposobnostima (Stuckrath 1968, prema (Maier 1999, 127)), te su kao takve uključene u prijemne ispite za studije arhitekture na Univerzitetu u Banjoj Luci.

S obzirom da u naučnim krugovima još uvijek nije postignut konsenzus o tome šta predstavljaju prostorne sposobnosti, postoje razni testovi i alati koji se koriste za njeno mjerenje, svrstani prema faktorima koje mjere. U radu će biti prikazana tipologija ovih faktora i zadataka kojima se oni mjere, te će ova tiplogija biti provjerena na prijemnim ispitima održanim na Univerzitetu u Banjoj Luci u periodu 2005-2013.

Takođe, u radu će biti prikazani rezultati poređenja uspjeha studenata na prijemnom ispitu sa uspjehom u toku daljeg školovanja sa ciljem da se ustanovi da li postoji korelaicja između ovih parametara.

Rezultati upućuju na pojavu novog faktora pri procjeni sposobnosti kandidata za studije arhitekture, a to je sposobnost divergentnog mišljenja, na čiju korelaciju sa prostornim sposobnostima upućuju i najnovija svjetska istraživanja.

Ključne reči: *prostorne sposobnosti, prostone veštine, prijemni test, test prostornih sposobnosti, divergentno mišljenje, arhitektonske kompetencije*