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PREDICTION OF SUCCESS IN THE SCHOOL BY USING THE PRIMARY MENTAL ABILITIES TESTS*

Summary

This work deals with the predictive value research for one group of primary mental abilities' tests of the pupils' success in general and especially of their success in learning native language and mathematics. It also shows the differences between the predictive values of individual tests and samples of pupils from villages and from cities.

There are two criteria applied in the tests' selection: a) the subject matter of tests and b) the psychological operations that tests register.

We look for some correlation between achievements in the tests and the pupils' success that have been evaluated by the grades for native language, mathematics and general success.

The research is conducted on samples of the third and the fourth grade elementary school pupils from urban and rural environments ($N = 138$). The pupils are from schools in Kacer, Ravna, Mackap, Zlatibor and Uzice.

The results are the following: 1. Primary mental abilities' tests (perceptive, spacious and verbal) stand for the significant predictors of general success in the school and of success in native language and mathematics. 2. There are some differences between predictive values of the tests. Those differences appear in relation to psychological operations registered by the tests rather than to their contents. 3. The differences between predictive values of the tests appear also when children from urban and rural environments are compared. That is to say that, evidently, tests that register more complex psychological operations are better success predictors of the children who attend schools in the cities, and the ones that register simpler psychological operations are better success predictors of the children from the rural environments. 4. Most of the tests with figural subject matter are more efficient predictors of success in learning the native language than mathematics, which shows that for the prediction of success in the case of individual subjects psychological operations are also more important than the subject matter of the tests.

*Key words: primary mental abilities, success in the school,
prediction of success in the school.*

Prediction (foreknowledge) of success in any kind of activity stands for a very significant problem in psychology. Some of the recent researches have proved that the success in the school as a specific and important activity of a pupil can be almost pre-

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cisely predicted. Especially important results can be found in the works of our psychologists A. Bukvic and P. Kovacevic.

Bukvic (1980) gave some important conclusions about predicting success in the school by using different types of the tests. First, he clearly emphasized that the tests of intelligence had originated and developed in this area of psychological research and that in some stage of their development they had become the principal methods for prediction of success in the school. Later, it appeared that the predictive value of general intelligence tests depended on the type of tests. That way, the *Raven's Progressive Matrix* test and the *Domino-48* test had a smaller predictive value than the *Verbal Series* test, which meant that the intelligence tests with verbal contents were better success predictors compared to the ones with the figural contents. What could be distinguished from Bukvic's observations was a hypothesis, which referred to the conclusion that the ability tests' predictive value depended on the age of pupils. Therefore Bine-Simone's scale tests still stood for very efficient predictors of pupils' success in the schools' class teaching. But, the tests of this type lost their predictive validity in the subject teaching. The initial forms of the two kinds of intellectual abilities appeared around the age of 11. These were the verbal and spacious-perceptive intellectual abilities. During the pupil's further growth the number of these abilities rose. Thurstone, Guilford and other scientists confirmed this fact. According to this, prediction of success in the higher grades of elementary school as well as in the high school became more complex because of the different predictive values of general success in the school and of success in individual subjects.

In 1979. P. Kovačević and A. Bukvić conducted the predictive value research of one group of the tests, with figural, verbal and numerical contents, for success of the elementary (subject teaching) and high school pupils. It was noticed that the conclusion about the important differences between these tests' predictive values could not be precisely brought out on the basis of received approximate correlation. Therefore the authors suggested that the intellectual operations which had manifested during the solving of tests had to be accurately registered in these comparisons. They concluded that *The Verbal Analogies* and *The Information* showed the highest predictive value in the group of verbal tests (46. and 45.); *Figural Analogies* and *The Disassamblance of Squares* deviated from the group of figural tests as well as *The Fractions*, *Calculations* and *The Equations* from the group of numerical tests. According to this data authors claimed that the contents were not crucial elements we could rely on in prediction of success in the school. Eventually, authors distinguished two groups of operations, generally different, but both necessarily present in the tests as well as in the school activities. The first group was more general because those operations demanded some of the common ways of deducing and recognizing regularity and relations (analogies), while the other group was more concrete because it included operations that demanded the same or similar material.

Basic Problems and Hypothesis of the Research

The interesting thing in this essay is finding out whether the tests which evaluate primary mental abilities (perceptive factor, spacious factor, verbal factor...) can be efficient at predicting success in the schools' class teaching. The Bine-Simone's scale tests and tests that show child's readiness for school, have already proved to be very

efficient predictors of success in the school.

Considering the variety of contents that pupils adopt when they study particular subjects, their age and their socio-cultural status, it is interesting to presume that the primary mental abilities are important factors of pupils' success in the school and especially in learning particular subjects. Beside this we have to find out what determines the degree of individual abilities' predictive value. We assume that the type of test is the most important factor because of the differences between tests' predictive value for the general success and the success in native language and mathematics. In the scope of this problem we are interested in paying attention to whether the tests' subject matter or the psychological operations that they register are more crucial. We are also especially interested in finding out if there are any differences between the tests' predictive values of pupils from villages and pupils from the city schools.

In connection to the problems included in this research we bring out the following hypothesis:

1. We expect the significant predictive value of one group of perceptive, spacious and verbal abilities' tests for the pupils' general success and especially for the success in native language and math.
2. We expect important differences between the predictive values of this group of tests when comparing pupils from the villages and from cities.
3. We expect that for the prediction of success psychological operations registered by the tests are more important than their subject matter.
4. We expect that the predictive values of applied tests depend on the type of teaching subject and on the sample of pupil.

Plan of the Research, the Selection of Tests and the Sample

This research is correlative. We look for the correlation between achievements in the perceptive, spacious and verbal abilities' tests and the approximate grade for pupil's general success, as well as the marks for the native language and math. First we test pupils using the ability tests and then we take the grades from the pupils' grade book.

There are two criteria applied in the selection of tests: a) the tests' subject matter and b) psychological operations, that is, mechanisms registered by the tests. Considering their subject matter we include figural and verbal tests.

The tests with **figural subject matter** are the following:

- T1-Surface Developing
- T2-Rotation of the Figure
- T3-Visualizing the Space (popular 'little bricks')
- T4-Figural Analogies
- T5-Hidden Figures
- T6-Filling the Squares
- T7-Perception of Faces
- T8-Identical Elements
- T9-Figural Classifications

The representatives of factor theories claim that the first three tests evaluate spacious abilities, the fourth evaluates deducing ability, the fifth and the sixth evaluate shaping flexibility and the last three tests evaluate perceptive skills.

In relation to psychological operations, these tests register the following: identification of elements, classification of elements, recognizing similarities and differences, deducing by analogy, transformation of figures and shaping flexibility of the perceptive totality.

The tests with **verbal subject matter** include:

T1- Completing the Story

T2- Verbal Analogies

T3- Missing Vocals

T4- Word Formation

T5- Rhyming

T6- Letter Changing

T7- Verbal Classifications

In relation to psychological operations tests T1, T2 and T7 register psychological operations with the words given in a context and therefore are noted as verbal understanding and deducing tests, while the T3-T6 tests register operations with isolated words and are noted as verbal formation tests. Some of the following psychological operations-mechanisms are also registered by this group of tests: word identification, understanding of notions given in the context or isolated, noticing relations between words-notions, different mechanisms of finding new words- notions and finding and the selection of important characteristics of words-notions given in pairs.

Therefore, in this research we include two types of tests with different subject matter, but to some extent, with similar psychological operations-mechanisms that they reach. Besides, the selection of tests is made to examine more than just a few primary mental abilities (for example, some tests are usually used for evaluating intelligence in general, and some, beside the specific abilities, also evaluate the style of perception). We need to mention that all these tests are involved in many researches and they include all metric characteristics. In our country these tests were used in the projects of A. Bukvic, B. Nestic and others, at the Institute of Psychology in Belgrade.

This research is conducted on the samples of the third and the fourth grade elementary school pupils from the rural and urban environments. The pupils are from the schools in Kacer, Ravna, Mackat, Zlatibor and Uzice. There are 138 pupils of which 74 come from cities and 64 from villages.

The Results of Research

Statistical analysis of the data consist of determining the coefficient of correlation between achievements in the primary mental abilities tests and pupils' success in the school defined by the grades for native language, math and general success. We will present the results dividing them into two parts, because of the large number of tests. First we will present the coefficients of correlation between spacious and perceptive abilities' tests and the success in the school and then we will analyze the relations between verbal abilities and success in the school.

Spacious and Perceptive Abilities

Coefficients of correlation between spacious and perceptive ability tests are presented in the tables 1. and 2. Table 1 shows the correlation coefficients of the sam-

ples of pupils from the cities and table 2 shows the correlation coefficient of the samples of pupils from the villages. According to the tables we can make few notes:

1. All of the determined correlation coefficients are positive, most of them are statistically important and with medium intensity, which shows a linear relation between the spacious and perceptive abilities' tests and the pupils' success. So, we can say that this group of primary mental abilities' tests is a significant predictor of general success in the school and success in native language and math.

2. There are some differences between the predictive values of applied tests depending on the pupils' environment and on the teaching subjects. That means that careful analysis show the following:

2.1. Tests that register spacious or the "S" factor (*Surface Developing, Figure Rotation, and Discovering Space*) are the significant predictors of success in the school for the city but not for the village pupils. This can be explained by the fact that these abilities' development level is different for these two groups of children, which is proved in the assays of B. Stevanovic about the different speed of intelligence development for the city and for the village children. In one of the important researches B. Stevanovic reaches a conclusion that the mental development of children from poor socio-cultural environment is at least one year back comparing to the children from more advanced socio-cultural environment. In relation to the general success and math the highest correlation is found in native language, which means that these tests have higher predictive values for this subject.

Table 1. Coefficients of correlation (r), and their significance (p), between the spacious (T1-T3) and perceptive ability tests (T4-T9) and the success in the school for the third and the fourth grade elementary school pupils (city school N=74)

Test	Parameter	General success	Success in mathematic	Success in native lang.
T 1 - Surface Developing	r	0.443	0.433	0.483
	p	0.01	0.01	0.01
T 2 - Rotation of the Figure	r	0.321	0.272	0.365
	p	0.01	0.05	0.01
T 3 - Visualizing the Space	r	0.525	0.468	0.538
	p	0.01	0.01	0.01
T 4- Figural Analogies	r	0.523	0.449	0.535
	p	0.01	0.01	0.01
T 5 - Hidden Figures	r	0.386	0.361	0.374
	p	0.01	0.01	0.01
T 6 - Filling the Squares	r	0.325	0.356	0.302
	p	0.01	0.01	0.01
T 7 - Perception of Faces	r	0.232	0.221	0.277
	p	0.05	–	0.01
T 8 - Identical Elements	r	0.297	0.316	0.218
	p	0.05	0.01	–
T 9 - Figural Classifications	r	0.332	0.351	0.305
	p	0.01	0.01	0.01

2.2. Deducing by analogy tests are more efficient predictors of success for the city pupils. Considering subject teaching, correlation tells that these tests are better predictors of the native language and general success than of the success in math. We come to the same conclusion for verbal analogy test. So, according to the results of this research, deducing by analogy, which is a logical as well as a psychological mechanism, can be considered as a significant positive factor of success in the school.

2.3. Tests that register the so-called shaping flexibility (*Hidden figures and Filling the squares*) are better predictors of the village children's success in the school. These tests are equally important for both native language and math. Since the dependence-independence on the field cognitive style is also measured by these tests, it can be used as an important method in learning math, native language and for achieving success in general.

Tabela 2. Coefficients of the correlation (r), and their significance (p), between the spacious (T1-T3) and perceptive (T4-T10) ability tests and the success in the school of the third and fourth grade elementary school pupils (village school N=64)

Test	Parameter	General success	Success in mathematic	Success in native lang.
T 1 - Surface Developing	r p	0.246 –	0.232 –	0.234 –
T 2 - Rotation of the Figure	r p	0,166 –	0.114 –	0.126 –
T 3 - Visualizing the Space	r p	0.305 0.05	0.375 0.01	0.281 0.05
T 4 - Figural Analogies	r p	0.397 0.01	0.367 0.01	0.391 0.01
T 5 - Hidden Figures	r p	0.454 0.01	0.382 0.01	0.431 0.01
T 6 - Filling the Squares	r p	0.432 0.01	0.430 0.01	0.371 0.01
T 7 - Perception of Faces	r p	0.447 0.01	0.593 0.01	0.647 0.01
T 8 - Identical Elements	r p	0.554 0.01	0.545 0.01	0.576 0.01
T 9 - Figural Classifications	r p	0.529 0.01	0.572 0.01	0.599 0.01

2.4. The tests that register perceptive abilities or 'P' factor (*Perception of Faces, Identical Elements and The Figural Classifications*) are more efficient predictors of success for the village children. This also appears in observing the general success in the school and especially the success in native language and math. These tests are of the same importance for the prediction of success in native language and math for both populations of pupils.

Therefore, not all of applied tests show the same predictive values. The degree of their predictive values depends on children's environment much more than on the kind of subject that they learn. We notice that tests that register more complex psy-

chological operations (identification of rotating figures, spacious visualizing, transformation of figures) are better success predictors for the city children. On the other hand, tests that register simpler psychological operations (recognizing similarities and differences, identification of simple shapes, classification) are better predictors of success for the village children.

The Verbal Abilities

Coefficients of correlation between the verbal ability tests are showed in tables 3. and 4. Table 3. shows the correlation coefficients of city pupils' samples and the table 4. of village pupils' samples. According to this tables we can note the following:

1. If we take an approximate look at the tables we can see that all coefficients are positive and significant to the statistics, which means that there is a linear relation between the verbal ability tests and the pupils' success. So, it is clear that this group of primary mental abilities' tests is an important predictor of general success in the school and success in native language and math.

Tabela 3. Coefficients of correlation (r), and their significance (p), between the verbal abilities tests and success in the school for the third and the fourth grade elementary school pupils (city school N=74)

Test	Parameter	General success	Success in mathematic	Success in native lang.
T 1 - Completing the Story	r	0.567	0.481	0.622
	p	0.01	0.01	0.01
T 2 - Verbal Analogies	r	0.491	0.417	0.503
	p	0.01	0.01	0.01
T 3 - Missing Vocals	r	0.232	0.216	0.287
	p	0.05	–	0.05
T 4 - Word Formation	r	0.321	0.353	0.393
	p	0.01	0.01	0.01
T 5 - Rhyming	r	0.386	0.384	0.481
	p	0.01	0.01	0.01
T 6 - Letter Changing	r	0.504	0.501	0.509
	p	0.01	0.01	0.01
T 7 - Verbal Classifications	r	0.492	0.455	0.573
	p	0.01	0.01	0.01

2. There are some differences in the predictive value of applied tests, referring to pupils' environment and their teaching subjects. Careful analysis show the following:

2.1. Verbal understanding and deducing tests (tests that register operations with the words in a given context) show some important correlation for both populations of pupils, but they are higher for the city pupils. This is evident for general success, native language and math.

2.2. Verbal formation tests (tests that register operations with the isolated words) are the significant predictors of success for both populations, but the heights of

correlation tell that they are higher for village pupils. This is evident for general success, native language and math.

2.3. Verbal classification test is an efficient predictor of success in the school for both populations.

2.4. In relation to native language and math, the results of this research show that the verbal abilities' tests are equally significant predictors of success, because the differences between the correlation are small.

Tabela 4. Coefficients of correlation (r), and their significance (p), between the verbal ability tests and the success in the school for the third and the fourth grade elementary school pupils (village school N=64)

Test	Parameter	General success	Success in mathematic	Success in native lang.
T 1 - Completing the Story	r	0.361	0.319	0.411
	p	0.01	0.05	0.01
T 2 - Verbal Analogies	r	0.302	0.367	0.379
	p	0.05	0.01	0.01
T 3 - Missing Vocals	r	0.524	0.568	0.509
	p	0.01	0.01	0.01
T 4 - Word Formation	r	0.481	0.495	0.511
	p	0.01	0.01	0.01
T 5 - Rhyming	r	0.480	0.451	0.416
	p	0.01	0.01	0.01
T 6 - Letter Changing	r	0.554	0.557	0.532
	p	0.01	0.01	0.01
T 7 - Verbal Classifications	r	0.538	0.504	0.508
	p	0.01	0.01	0.01

Therefore, not all of the applied verbal tests have the same predictive value. The degree of their predictive value depends on children's environment rather than on the kind of subject. We have noticed that the verbal understanding and deducing tests are better predictors of success for the city pupils. On the other hand, verbal formation tests are better success predictors for the village pupils. In another word, tests that register more complex psychological operations are more efficient predictors of success for the city pupils, while the ones that register simpler psychological operations are better predictors of success for the village pupils.

We shall remind that the figural tests presented the same results and that the age of tested pupils was 10 and 11 years- the age of important development changes in the area of mental abilities. Therefore we can say without doubt that this is result of the different mental development speed between the city and the village children, different level of their mental maturity, as well as the different structure and organization of their socio-cultural environment. That means that the city children develop their mental abilities at a faster pace in comparison to the children from villages; the maturity of some of their mental abilities comes earlier; eventually, the experience and some earlier researches tell that the urban environments prompts the development of certain abilities much more than rural does, and vice versa.

The Conclusions

1. Primary mental abilities' tests (perceptive, spacious and verbal) stand for the significant predictors of general success in the school and of success in native language and math.

2. There are some differences between the predictive values of tests. Those differences appear in relation to the psychological operations registered by the tests rather than to tests' subject matter.

3. The differences between predictive values of the tests appear also when children from urban and rural environment are compared. That is to say that, evidently, the tests that register more complex psychological operations are more efficient predictors of success for the children who attend schools in cities, and the ones that register simpler psychological operations are better predictors of success for the children from the rural environments.

4. Most of the tests with figural contents are more efficient predictors of success in learning the native language than mathematics, which shows that, for the prediction of success in the case of individual subjects, psychological operations are also more important than the tests' subject matter.

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PREDIKCIJA ŠKOLSKOG USPEHA POMOĆU TESTOVA PRIMARNIH MENTALNIH SPOSOBNOSTI

Rezime

U radu se saopštavaju rezultati provere prediktivne vrednosti jedne grupe testova primarnih mentalnih sposobnosti za školski uspeh učenika uopšte i posebno u maternjem jeziku i matematici, potom utvrđuju se razlike u prediktivnoj vrednosti između pojedinih testova i na uzorcima učenika iz sela i grada.

Prilikom izbora testova pošlo se od dva kriterijuma: a) sadržaja zadataka u testovima i b) psiholoških operacija koje testovi registruju.

Između postignuća na testovima i uspeha učenika koji je definisan preko ocena iz maternjeg jezika, matematike i opšteg uspeha tražene su korelacije.

Istraživanje je sprovedeno na uzorku učenika trećeg i četvrtog razreda osnovne škole iz gradske i seoske sredine (N = 138). Učenici su iz škola u Kačeru, Ravni, Mačkatu, Zlatiboru i Užicu.

Rezultati su bili sledeći: 1. Testovi primarnih mentalnih sposobnosti (perceptivnih, prostornih i verbalnih) se mogu smatrati značajnim prediktorima školskog uspeha uopšte i uspeha u maternjem jeziku i matematici. 2. Postoje razlike između testova u pogledu prediktivne vrednosti. Te razlike se više iskazuju u odnosu na psihološke operacije koje testovi registruju a manje u odnosu na njihov sadržaj. 3. Razlike u prediktivnoj vrednosti testova se iskazuju i kada se uporede deca iz seoske i gradske sredine. Naime, vidljiva je tendencija da su testovi koji registruju složenije psihološke operacije bolji prediktori uspeha dece iz gradskih škola, dok testovi koji registruju jednostavnije psihološke operacije su, pokazalo se, bolji prediktori školskog uspeha dece iz seoske sredine. 4. Većina testova figuralnog sadržaja ima nešto bolju predikciju uspeha u maternjem jeziku nego matematici što pokazuje da su i u slučaju pojedinih predmeta za predviđanje uspeha bitnije od sadržaja psihološke operacije koje registruju testovi.

Ključne reči: perceptivne sposobnosti, prostorne sposobnosti, verbalne sposobnosti, predikcija, školski uspeh.