IJIAET International Journal of Innovative Analyses and Emerging Technology

| e-ISSN: 2792-4025 | http://openaccessjournals.eu | Volume: 3 Issue: 3

Developing Intelligence and Ability Tests

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Abstract: Intelligence (lat. Intellectus - understanding, knowledge) is the ability to carry out the cognitive process and solve problems effectively, especially when mastering a new range of life tasks. There are radically different interpretations of intelligence. This article presents different views on intelligence and abilities and opinions of different scientists in the field of the science of intelligence diagnostics.

Keywords: structural-genetic approach, mental functions, intelligence, experimental psychological theories, socio-cultural intelligence, genetic intelligence, procedural intelligence, educational intelligence, phenomenological intelligence, psychometry, numerical factor

In Piaget's structural-genetic approach, intelligence is interpreted as the highest way of balancing the subject with the environment, which is characterized by universality. In the cognitive approach, intelligence is considered as a set of cognitive operations. With the factor-analytical approach, stable factors are found on the basis of a set of test indicators (C. Spearman, L. Thurston, H. Eysenck, S. Barth, D. Wexler, F. Vernon). Today, general intelligence exists as a universal mental ability, which may be based on the genetically determined property of an unequal system to process information with a certain speed and accuracy (G. Eysenck).

“Intelligence is a relatively stable structure of human mental abilities” or “Intelligence is a combination of mental abilities, perception, mental functions (comparisons, abstractions, concepts, judgments, inferences, etc. to analyze existing knowledge. Also, intelligence is determined by the system of mental operations, the style of decision tasks, individual cognitive style, etc.

An attempt to systematize the collected data in the field of intelligence with the help of experimental psychological theories and research by M.A. Made by Cold.

He proposed eight main approaches, each of which is characterized by a certain conceptual line in the interpretation of the essence of intelligence.

1. Sociocultural intelligence is considered as the result of the process of socialization and the influence of culture as a whole (J. Brunner, L. Levy-Bruhl, A. R. Luria, L. S. Vygotsky, etc.).
2. Genetic intelligence is determined as a result of the increasingly complex adaptation of human interaction with the outside world to the requirements of the environment in natural conditions (W. R. Charlesworth, J. Piaget).
3. Procedural-activity intelligence is considered as a separate form of human activity (S.L. Rubinshtein, A.V. Brushlinsky; L.A. Venger, K.A. Abulkhanova-Slavskaya, etc.).
4. Educational intelligence as a product of purposeful learning (A. Staats, K. Fischer, R. Feuerstein, etc.).

5. Information intelligence is defined as a set of elementary information processing processes (G. Eysenck, E. Hunt, R. Sternberg, etc.).
6. Phenomenological intelligence as a special form of the content of consciousness (W. Koehler, K. Dunker, M. Wertheimer, J. Campion and others).
7. Intelligence at the structural level as a system of cognitive processes of different levels (B.G. Ananiev, E.I. Stepanova, B.M. Velichkovsky and others).
8. Regulatory intelligence as a form of self-regulation of mental activity (LL Thurston and others).

If we study the approximate classification of various approaches to the problem of intelligence, we can distinguish two bases for classification:

1) cultural - neurophysiology (influence of the external environment - heredity);
2) psychometry - general education. Currently, the main approach to the study of intelligence is the psychometric approach in its factorial version.

Factor models of intelligence.

According to the traditional interpretation, all factor models of intelligence can be divided into four main groups according to two bipolar characteristics:

1) depending on what is the source of the model - assumptions or empirical data,
2) based on how the model of intelligence is built - from individual properties to the whole or from the whole to individual properties.

Typical variants of the multifactorial model, which assumes a set of primary intellectual factors, are J. Gilford (a priori), L. Thurston (a posteriori) and Russian authors V. D. Shadrikov (a priori) are the model. These models can be called spatial, one-factor, since each factor is interpreted as one of the independent dimensions of space.

Finally, in hierarchical models (C. Spearman, F. Vernon, P. Humphreys), multifactorial factors are located at different levels of society: at the highest level - the general mental energy factor, at the second level - its derivatives, etc. The factors are interrelated: the level development of the general factor is associated with the level of development of certain factors.

Ch. Spearman dealt with the problems of professional abilities (mathematical, literary, etc.).

When processing test data, he found that the results of many tests aimed at determining the characteristics of thinking, memory, attention and perception are closely related to each other: people who successfully passed tests for thinking also successfully perform other tests of cognitive abilities. In contrast, subjects who performed poorly performed poorly on most tests. According to Spearman, the success of any intellectual work is determined by: 1) some general factor, a general ability, 2) a factor specific to this activity.

Therefore, when performing tests, the success of the solution depends on the level of development of the subject's general ability (general G-factor) and the corresponding special ability (S-factor). In factor tests created on the basis of a hierarchical model, Spearman's G-factor and its 3 groups of factors are distinguished: verbal, spatial and numerical. Several other interpretations can be given, but the hierarchical model is widely used because of the tests on which it is based. In Spearman's study, a group of different indicators are related to each other and define the same ability.

They are called group factors, and they are not present in all tests of ability, but are common to a more or less limited group of tests.

On this basis, the English psychologist Vernon contributed to the theory of intelligence differentiation. At the top is the general factor (discovered by Spearman), followed by the broad group factors of verbal-educational (v:id) and practical-mechanical (k:m) intelligence.

L. Thurstone model. The works of Charles Spearman's opponents deny that there is a common basis for intellectual activity. They believed that a certain intellectual action is the result of the interaction of many individual factors. The main propagandist of this point of view was L. Thurston, who proposed a method of multivariate analysis of correlation matrices. American psychologists did not recognize the theories of British scientists, who considered the main factor in the classification and ranking of human abilities the main factor, they focused on group factors.

It was founded by American psychologist Kelly's The Crossroads of Human Thought (1928), in which he criticized Spearman's theory. Relationships between tests group factors: atrophic relationships, operations with numbers, memory and speed of thinking. One of Kelly's successors was Thurstone, who created the multifactorial theory of intelligence. This method allows you to identify several independent "hidden" factors that determine the correlation between the results of various tests of a certain group of subjects. Thurston originally identified 12 factors, 7 of which were frequently replicated in research:

V. Verbal understanding - understanding of the text, verbal analogies, conceptual thinking, interpretation of proverbs.

H. Fluency of speech is measured by tests for finding rhymes, naming words belonging to a certain category.

N. Numerical coefficient - checked by tasks for the speed and accuracy of arithmetic calculations.

S. Spatial factor - divided into two sub-factors. The first determines the success and speed of understanding spatial relationships (recognition of flat geometric shapes). The second is related to the mental manipulation of visual images in three-dimensional space.

M. associative memory - measured by tests for memorizing verbal associative pairs.

R. The speed of perception is determined by the rapid and accurate perception of details, similarities and differences in images.

I. The inductive factor is tested using rule-based search and sequence completion tasks. On the basis of the multifactorial theory of intelligence and its modifications, many tests for the structure of abilities have been developed.

J. Gilford's model. J. Gilford proposed a model of the "structure of intelligence (SI)", systematizing the results of research in the field of general abilities. However, this model is not the result of factorization of experimentally obtained correlation matrices, but refers to a priori models. The factors in the model are independent.

Thus, the model is three-dimensional, the intelligence scale in the model consists of names. Guilford explains mental operations as a mental process and includes: cognition, memory, divergent thinking, convergent thinking, evaluation. In the theory of the American psychologist Guildford, the factor is a confirmation of the model of intelligence, and not a tool for its construction. This model is based on three dimensions and their relationships and defines various intellectual abilities. The intelligence factor consists of the type of intelligent operations carried out in the field and the set of results obtained from them.

Guilford attempted to justify the basic dimension of the intellectual model with five different types of operations, namely:

- understanding of information – (S);
- remember (memory) - (M);
- divergent thinking - (D);
- convergent thinking (production of logical advantages from available information) - (N);
- based conclusion and evaluation (comparison and evaluation of units of information) - (E).

According to experts, the secondary dimension is determined by the interpretation of the meaning and meaning of these terms. According to him:

- this information is figurative – (F);
- symbolic – (S);
- semantic - (M);
- behavioral – (B) can be

D. Wexler model. Unlike the Vernon model, the Wexler model includes only three levels: 1) the level of general intelligence; 2) the level of "group" factors, i.e., non-verbal and verbal intelligence, and 3) the level of specific factors corresponding to individual subtests. D. Wexler defined intelligence as purposeful human behavior, rational thinking and the ability to communicate effectively with the outside world. He showed that the success of intelligence tests depends on intellectual parameters, as well as cultural participation, interest, physical activity, etc.

According to Wexler, verbal intelligence reflects a person's abilities, and non-verbal intelligence reflects his natural psychophysiological abilities. The results of psychogenetic studies show the opposite: mainly due to heredity according to the verbal score on the Wechsler scale, and social factors determine the successful completion of non-verbal tests, as well as the "Understandable" subtest.

Model S. Barth. C. Barth's functional model of the structure of intelligence includes 5 levels. The criterion for selecting a level is determined by the complexity of the cognitive process:

1) the level of general intelligence, 2) the level of conceptual relations, 3) the level of associations, 4) the level of perception, 5) the level of intuition.

The hierarchical model, according to many authors, is not a theory, but a method of working with specific factors arising from factor-analytical studies.

Monometric approach. The most striking and consistent representative of the one-dimensional approach to intelligence was the famous psychologist G. Yu. Eysenck. From the point of view of Eysenck, one can speak of different types of the concept of intelligence: biological, psychometric and social, corresponding to different structural levels of intelligence. Some elements of the drawing are used, introduced by Eysenck, Guildford, one of the famous representatives of the English school. The drawing of his model is also in the form of a cube, each side is indicated by different names, and it looks like this:

- intellectual processes (thinking, memory, perception);
- test materials (verbal, peripheral);
- "quality" (speed and strength of intellectual processes).

Intelligence has been found to be built on the ability to complete tasks with extreme frustration and to check for errors. Eysenck himself confirms that Guildford's operations are similar to his own "intellectual operations".

The categories "test materials" and "entity" are also similar. Only instead of the category "the result of thinking" the author introduces the category "quality". Without denying the existence of a common factor, Eysenck bases his models on the Q-factor (Spearman) and primary factors (Thurston), and IQ - on speed, extreme frustration and a tendency to investigate errors. According to Eysenck, "to date, this model is the most effective and gives the best results."

Cognitive models of intelligence. The authors of cognitive models of intelligence mean by the term "intelligence" not a property of the psyche, but a certain system of cognitive processes that provide problem solving. Cognitive researchers rarely address issues of individual differences and refer to psychological measurements.

R. Sternberg Model. The most popular in the late 80s and early 90s was the concept of intelligence by Robert Sternberg. The so-called "hierarchical model of intelligence" was supposed to explain the relationship of mental processes that regulate intelligence and behavior, intelligence and personal experience, intelligence and adaptive behavior. Intelligence provides information processing. Sternberg identifies three different components of intelligence responsible for information processing:

I. Metacomponents are control processes that regulate specific information processing processes. This includes: 1) recognizing the existence of a problem; 2) awareness of the problem and the choice of appropriate processes for its solution; 3) choice of strategy; 4) choice of mental representativeness; 5) distribution of "mental resources"; 6) control the process of solving problems; 7) evaluation of the effectiveness of the solution.

II. Executing components are low-level processes in the hierarchy. In particular, the process called "inductive reasoning" includes coding, identifying relationships, matching, applying comparisons, reasoning, and answering. W. Neisser criticizes Sternberg's position, arguing that the number of executive components can be infinite, and their properties are determined by the specific characteristics of the tasks.

II. The learning components are necessary for the subject to learn how to perform the meta-components and the execution components. Sternberg called them: 1) selective coding; 2) selective combination; 3) introduces selective comparison.

During problem solving, the components work in concert: the metacomponents regulate the functioning of the executive and cognitive components, which, in turn, provide feedback to the metacomponents.

Level of metacomponents R. Sternberg's concept is described in the most detailed and justified way. According to him, the main difficulty in solving problems lies not in the solution itself, but in the correct understanding of the essence of the problem.

One of the most frequently cited variants of the "everyday approach" to intelligence is R. Sternberg's old opponent H. is the Gardner model. Gardner criticizes the "hard way" and tries to explain intelligence on a very broad scale.

According to him, we can talk about many types of human intelligence. According to him, the main method of studying human intelligence is not experiment, measurement, or even survey to identify "simple patterns", but observation of the natural behavior of people in the course of indirect research. Tests, interviews and other instrumental methods are only suitable for measuring a person's cognitive abilities, motivation and general activity. Gardner identifies, in addition to the traditional (according to Thurston), as the main components of intelligence: musical abilities, motivation, initiative, sensorimotor abilities, etc. In one of his latest works, he describes 7 types of intelligence:

1. Language intelligence. Characterized by the ability to use natural language to convey information, as well as motivation and excitement (poet, writer, editor, journalist).
2. Musical intelligence. Defines the ability to perform, compose and/or enjoy music (performer, composer, music critic).
3. Logical and mathematical intelligence. Defines the ability to determine relationships between symbols and concepts by exploring, classifying, manipulating categories and objects (mathematician, scientist).
4. Cosmic intelligence - the ability to see, perceive and manage things in the mind, perceive and create visual-spatial compositions (architect, engineer, surgeon).
5. Kinesthetic intelligence of the body is the ability to use motor skills in sports, performing arts, manually (dancer, athlete, mechanic).
6. Interpersonal intelligence. Gives the ability to understand other people and build relationships with them (teacher, psychologist, salesperson).
7. Intrapersonal intelligence. Expresses the ability to understand oneself, feelings, aspirations (psychologist, poet).

Having studied the literature, we can draw the following conclusion: intelligence is a multidimensional phenomenon that is evaluated by several factors, such as the system of operations with information (operational), as the sum of known information (by content) and what our intellectual activity leads to. to (that is, according to its results) is studied through such measurements. The study of various models of intelligence led to the following conclusions.

1) None of the existing models of intelligence rejects Spearman's concept of a common factor. Attempts to divide the intellect into different abilities ended unsuccessfully. Although Spearman's ideas are classically outdated and have been repeatedly criticized, they are still successfully developed abroad.

2) The properties of the intellect are not separate actions, but represent aspects of a single and unquenchable cognitive activity that is organically included in the human mental activity.

This does not negate the practical significance of certain intelligence factors identified by Guilford and other researchers, on the basis of which it is possible to develop narrowly focused tests that measure people's abilities for a certain type of professional activity.

3) Different approaches to the definition of intelligence and its structural analysis cannot fully explain why there is a difference in the mental development and abilities of a person. Intelligence is primarily the basis for setting goals, planning resources, and strategies to achieve goals.

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