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RELATIONSHIP BETWEEN FEATURES OF THINKING AND THE ABILITY TO KNOWLEDGE TRANSFER OF STUDENTS

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Abstract

The problems about student's ability to apply theoretical knowledge in real and non training situations are discussed in the article. The definition of knowledge and knowledge transfer are given, distinctive features of the declarative and procedural knowledge are described. Attention is paid to the efficiency of transfer declarative knowledge to the procedural level. Results of the investigation of relationship between the ability to knowledge transfer and cognitive characteristics of students are presented. The significant connections between ability to knowledge transfer and critical thinking level, level of logical thought and anticipation are shown. The conclusions about future direction of research are made.

Keywords. Declarative and procedural knowledge, knowledge transfer, critical thinking, logical thought, reflexivity, anticipation.

To mastery the professional activity successfully specialist need to have a lot of skills and knowledge. However, during the study, students cannot learn everything for the professional work. In this regard the question of knowledge transfer arises -

question about the ability to apply theoretical knowledge in real and non-training situations.

According to our observations, psychology students are often not able to transfer knowledge, and instead of applying the laws in solving practical problems they move to the level of common sense and folk psychology.

Knowledge is defined as the application and the effective use of information. Knowledge becomes something more than information after it has been recognized and understood through experience or training [15]. In the broad sense knowledge is identified with more or less adequate results of cognitive processes [7].

In one of the most well-known classifications knowledge are divided into procedural and declarative (Anderson J.R.) [1]. Declarative knowledge can be encoded if they are expressed in the form of symbols (writing or pictures), or may be embodied in a tangible form (machinery or equipment, tools). Procedural knowledge arises mainly through observation and action.

The transfer of procedural knowledge is defined as improvement or degradation in performance of some actions under the influence of the previous execution of other ones, or as an acceleration of the process of developing one skill under the influence of obtaining another one [7].

The knowledge transfer from one field to another is possible. G. Nicolis and I. Prigogine gave the examples how the models of physical and chemical systems that lead to transient phenomena, a large-scale order, symmetry breaking away from equilibrium, can be transferred to other areas to explain and understand the growth of malignant tumors, global climate change, the behavior of social insects and self-organization in human communities [13]. G. Edelman moved the principles of Darwinian evolution to explain the functioning of the brain, generating psychic phenomena and consciousness [3].

The study of the transfer of procedural knowledge rather than declarative in cognitive science is considered a priority and, in particular, the study of focused cognitive skills, such as knowledge and skills, because it is difficult to fix them in words, as opposed to declarative [6]. In our opinion, it is necessary to consider not

only the transfer "inside" of each type of knowledge, but also between them - the transfer of declarative knowledge into procedural. There are three main mechanisms that are based on the interaction of two types of knowledge - analogical transfer, knowledge compilation mechanism and constraint violation mechanism [14].

When learning takes place in a new area, the memory used the general, non-specific methods of interpretation of declarative knowledge. Acquisition of new skills going on by the compilation process, which helps to build a consistent set of specific skills for this sector. These new skills quickly are formed by the processes of composition and proceduralization. The process of composition consists of dividing common procedures for some more specific ones, the process of proceduralization consists of including the same declarative knowledge in a number of new operations [6]. Procedures of forming prototypes are involved in the process of knowledge transfer [16].

However, the transfer cannot be understood as the transfer process of sum of knowledge and values, it is necessary to examine it, first of all, as a structural phenomenon. [8]. In this regard, we develop a problem of psychological factors of knowledge transfer in relation to the individual psychological characteristics of personality. From our point of view, the efficiency of the transfer of theoretical knowledge into practice may be connected with several features of cognitive function, in particular, with the capacity for logical reasoning, critical thinking, reflection, and the propensity to anticipation abilities. The purpose of this study was to investigate the relationship between the ability to knowledge transfer and cognitive characteristics of students.

The study raised the following hypotheses: the efficiency of knowledge transfer is directly related to such cognitive features as a critical thinking, a level of logic, a tendency to introspection and a predictive ability. These assumptions are based on the fact that the effective knowledge transfer from the theoretical to the practical sphere requires careful processing the primary information. Critical thinking (the tendency to verification of the received information by the already existing knowledge and experience), high levels of logical thinking (otherwise theoretical law

will not be understood and correctly interpreted), reflection ("thinking about thinking") and predicting the probability of future use of assimilated theoretical information. Without such deep study the theoretical knowledge remains at a superficial level, tied only to the situation they are received (the classroom, the need to pass the exam). The high development of reflection determines the ability to perceive the content of proper mind and to analyze it, to understand the mind of other people, including the mechanisms of projection, identification, empathy [9].

It were formulated several tasks, which are based on the appropriate goals and hypotheses of the study: 1) developing the methodology to assess the knowledge transfer ability, 2) revealing the students' ability to the knowledge transfer, the level of critical thinking, the logical abilities, the reflexivity and the anticipation, 3) identifying the relationship between the ability to transfer and the critical thinking, 4) verifying the relationship between the ability to the transfer and the level of logical abilities, and 5) revealing the relationship between the ability to the transfer and reflexive subjects, and 6) find out the relationship between transfer efficiency and prognostic abilities of the test subjects.

Procedure. Study sample consist of 53 3rd year students from psychology department of V.N. Karazin Kharkiv National University, 7 males and 46 females, the median age is 19 years, the range is 18-24 years. All participants voluntarily and with interest took part in the research.

Psychodiagnostic methods:

1. We have developed a technique for diagnosing the ability to the knowledge transfer as a task the solution of which had to be written in the form of essay during 15 minutes. There was a brief description of the theoretical law of motivation optimum (by J. Freeman) in this task [5]: the activity efficacy increases as the increase of motivation to a certain level, with the further increase motivation successful activity is declining rapidly. Description of the law has been illustrated by the graph (bell-shaped curve of dependence between motivation level and activity efficacy). Subjects had to design some examples of the practical application of the J. Freeman law. Namely, they should to describe how they would use it or take into

account: a) in the process of staff management of the organization, and b) for the coaching advertising or travel agents, and c) for the training senior management. In this task it was modeled the transfer process of the declarative knowledge (theoretical law) to the procedural level (practical application). The method of content analysis was used to process the results. It was assessed the understanding of psychological mechanism on which the law is based, its correct application (planning to improve productivity through the proper motivation of employees), and also it was considered the number of proposed options of the law in each of the practical situations. Number of points for that task was varied from 0 to 3: 0 points - no evidence of knowledge transfer, 1 point - there are attempts to apply the law, but the proposed options do not match this pattern, 2 points - there is a partial transfer of the law in a practical situation, suggested 1 - 2 versions of its application to all situations, and 3 points - a full transfer of theoretical law to practice one or more options for each of the proposed situation.

2. L. Starkey Critical Thinking Test adapted by O.L. Lutsenko, D.O. Sysuyeva. It is an objective test of 27 tasks is time limited to 30 minutes. It gives 1 point for the correct solution of each task, so the maximum score on the test is 27 points, minimum - 0.

3. Test "Conclusion" from the J. Flanagan battery of general and special abilities in V.A. Chiker adaptation [2]. It is the objective test of 20 tasks with time limited of 30 minutes, including the logical and mathematical problems. Test results translate into percents, which represent quantity of correctly solved tasks from the general number of the tasks, so the maximum score is 100 points, and the minimum is 0 points.

4. Methods of assessing the level of reflexivity (by A.V. Karpov). This is the personality questionnaire of 27 tasks [9]. Answers organize in a 7-point scale, so the maximum score on the test is 189, the minimum is 27.

5. The test of prognostic competence (by V.D. Mendelevich). Procedure gives four indexes: (1) general anticipation (anticipating the course of events and self reactions to them), and three subspecies of anticipation, that are (2) personal-

situational anticipation, which reflects the communicative level of anticipation, (3) spatial anticipation, which reveals the ability to anticipate the movement of objects in space, coordinate self motion, and (3) temporal anticipation, which detect the ability to predict the course of time, to distribute it [12]. The test is a personality questionnaire of 81 tasks. It has 5-point answering scale, so the maximum score on the test is 405 and the minimum is 81.

It was used computer program MS Excel 2003 and StatSoft STATISTICA 6.0. for data processing.

Results. Analysis of the knowledge transfer ability task has shown that the full knowledge transfer have only 2.4% of the subjects (whose essays were rated by 3 points). The adequate, but not a full transfer is observed in 52.4% of students (whose essays were estimated by 2 points). And the partial transfer was demonstrated in 52.2% of cases (that was estimated by 1 point).

Critical thinking of students is quite high – the average score is $M = 20.2$ points, standard deviation is $S = 2,6$ points, the minimum is $\min = 15$ points, the maximum is $\max = 26$ points. That is, on average, students successfully cope with two-thirds of the tasks on the critical thinking. Logic thinking: $M = 67.7$ points, $S = 15.9$ points, $\min = 25$ points, $\max = 100$. As compared with the standards for the test it was found that only 8.3% of the surveyed people have a high level of logical thought, 58.3% have an average level, and 33.4% - low. Reflexivity of the research participants: $M = 123.0$ points, $S = 15.5$ points, $\min = 95$ points, $\max = 162$ points. As compared with the standards of this test it was showed that 16% of students have a low level of reflexivity, 82% - the average, and only 2% - high propensity for reflection. Anticipation of the most of students corresponds to the average norm: $M = 248.0$ points, $S = 21.0$ points, $\min = 185$ points, $\max = 307$ points. A comparison with the norms of this test showed that 23% of all students have insufficient of overall anticipation competence (i.e., poorly able to predict future events), 55% have insufficient personal and situational anticipation competence, 67% of the participants have insufficient temporal anticipation and 63% respondents have the insufficient spatial anticipation.

Further correlation analysis (using the Spearman's method) the ability to knowledge transfer and cognitive features of the studied individuals revealed two significant relationships, and one trend of significant relationship. There was a direct correlation between the ability to knowledge transfer and critical thinking: $r_s = 0.40$, $p = 0.010$, as well as between the ability to knowledge transfer and logical abilities: $r_s = 0.41$, $p = 0.008$. The tendency of reliable direct correlation was found between ability to knowledge transfer and personal and situational anticipation competence: $r_s = 0.28$, $p = 0.082$. Significant relationships ability to knowledge transfer with reflexivity, as well as general, temporal and spatial anticipation competence weren't found.

Discussion. Critical thinking is defined as "reasonable reflective thinking aimed at deciding what to trust and what to do" [4]. According to D. Halpern, a set of key skills required for critical thinking involves observation, the ability to interpret, analyze, and draw conclusions, the ability to evaluate. The obtained results indicate that the successful transfer of declarative knowledge to procedural level (in other words, the general, broad-based knowledge in a particular situation) and developed abilities to analyze, conceptualize, application, synthesize and / or evaluate the information are related. This conclusion is also confirmed by the availability of a positive relationship between the ability to transfer and logical abilities that lie in the ability to establish logical relationships between the characters, the ability to analyze, reasoning and inference, and also show fluency of thought.

Key characteristics of critical thinking, after D. Klooster [10], are the independence, information richness, the pursuit of good argument. Based on the relationship of critical thinking and the successful knowledge transfer it can be assumed that the effective knowledge transfer is accompanied not only by understanding the problem, but also handling knowledge, active asking questions and finding solutions. This confirms the interpretation of the knowledge transfer as an active process associated with the restructuring of existing declarative knowledge and applying them in new circumstances. Thus the research hypotheses were confirmed

by the connection of the knowledge transfer ability to with critical thinking and the development of logic.

The trend of the reliable connection of the ability to transfer and the personality-situational anticipation can be explained by the universal utility, necessity of this type of anticipation in the life of the modern people, in contrast to the temporal and spatial anticipation. Personal-situational prediction, according to N.P. Nichiporenko, presents a communicative level of anticipation and phenomenological finds itself in communication, but it also has other "non-communicative" nature, and as the ability could be paired with the personal properties that are manifested in the activity [12]. Thus another hypothesis about the relationship between the ability to transfer and prediction of situation was confirmed partially.

Not confirmed only the hypothesis about the association ability to transfer with the reflexivity, which may be caused by the effect of social desirability under filling personality questionnaire reflexivity, when participants can express themselves as thoughtful and reflective, actually are not being such, as it is socially desirable traits.

It should be noted that the theoretical knowledge (scientific laws) are mostly output by induction – from the specific situational observation to generalized rules defining the "behavior" of these particulars. The ability of knowledge transfer from theory to practice is related with the inverse process – the process of deduction, that is, the application of general rules for solving particular problems. Perhaps students, who are incapable of this type of transfer, do not understand that each general law was placed and confirmed in specific practical cases. Therefore, they do not realize the possibility of backward extrapolation it to particular cases. Perhaps the ability to such holistic, evolutionary understanding of the origin of the theoretical patterns associated with highly developed logical, critical and prognostic properties of people's cognitive sphere, their own ability to induction and generalization.

Conclusions. 1) The developed methodology for the assessment the ability to transfer the declarative knowledge into procedural is an effective assessment tool,

although not universal. The laws from technical and biological areas could be included in it for the increase of its universality.

2) Psychology students have insufficient capacity to knowledge transfer. Most of them have middle level of critical thinking, logic, reflection and anticipation.

3) The ability to knowledge transfer directly related to critical thinking, because critical thinking enhances the depth and thoroughness of perception and understanding of theoretical laws.

4) The ability to knowledge transfer directly related to the level of development of logical abilities, as the logic implies ownership process of induction and deduction, which lie at the heart of breeding theories and their subsequent use in practice.

5) There was no connection between the ability to knowledge transfer and reflexivity, measured by personality questionnaire. Diagnosed level of reflexivity could be distorted by the installation of social desirability.

6) There is a trend of significant correlation between the transfer efficiency and personal-situational anticipation of the subjects, which allows a person to predict the possible applications of the theoretical knowledge.

It is planned to study the knowledge transfer ability in a sample of employees and compare their results with those of the students. It is also planned to study transfer of another kind – procedural knowledge to declarative and transfer between different domains.

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