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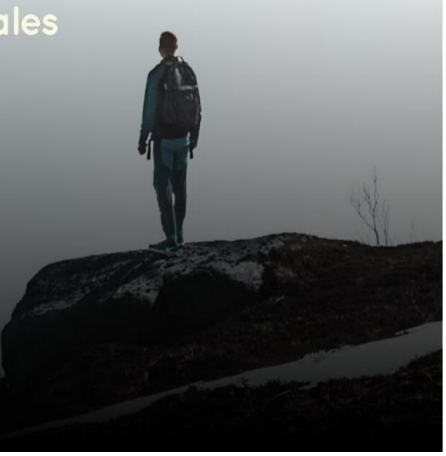

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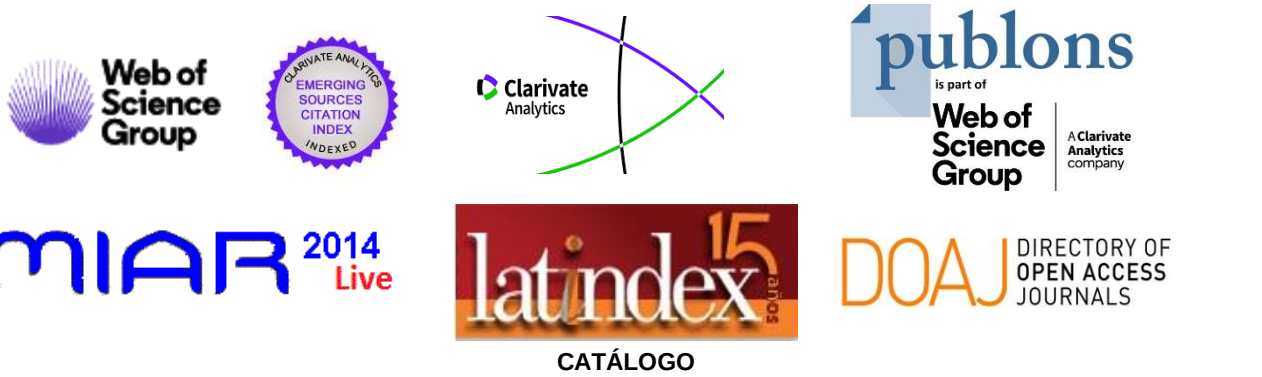

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MIND MAPS AS A MEANS OF VISUALIZATION OF EDUCATIONAL TASKS

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Abstract

The article deals with the problem of usage of means and methods of information presentation, which give possibility to visualize it effectively for further comprehension and structuring. The methodology of creating mind maps, criteria of their effective application in educational process are proved. As a part of experiment, the impact of the mind maps method on the results in education is studies. In this respect three spheres of educational tasks (according to B. Bloom): cognitive, affective and psychomotor are taken in consideration. The results of the investigation showed positive changes in educational results and effectiveness in the application of mind maps both of a traditional type and as a digital app.

Keywords

Visual thinking – Mind maps – Mindmapping – Bloom's taxonomy

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Introduction

In the modern world, a person perceives and processes huge flows of information. This requires the formation of the skills of its perception, processing, application, etc. Not occasionally, those services whichare well-structured, avoidlarge texts and instructions, are comprehended intuitively, gain more popularity.

As the result of scientific investigations concerning the peculiarities of thinking of modern generation (clip culture, transition from linear model of thinking to network, based on visual images, basis on short-term memory) the problem of usage of means and methods of information transmission thatprovide its effective visualization for further comprehension and structuring, became relevant. Classical approaches of realization of this problem are based on such properties of human mind, as associative character, hierarchical nature, visualization. From physiological view point, association sappearasa “constant feeling” produce dasa consequence of a sequential series of conditional reflexes[1], in psychology they are defined as logical connection between separate events, facts, objects or phenomena, reflected in mind and kept in memory[2].

P. Anokhin[3] said that the ability of mind to form associative connections dominates its ability to store information. Hierrarchical nature of mind lies in its ability to single out the main, key element that is fundamental for these associations among concepts, memories and ideas. As a result, a certain graph of images connected with the given concept appear.

Representative of generative linguistics N. Chomsky[4], explaining the nature of human speech, substantiates the appearance of certain “rules in mind”, which allow to transform transmitted and acquired information by means of its segmentation into semantic units (words) and establishing connections between these units. Thus, combining different theories, scientists justify functioning of a radiant (visual) thinking as a process which put a certain object into the center that gives an impetus to appearance of a range of associations which becomes a main image for the other associative process. Knowledge of the peculiarities of visual thinking is successively used by teachers in their professional activity to build associative clusters, schemes, tables, charts etc. However, theoretical and methodology problems concerning the relevance of realization of this or that method, validity of involvement of visual images for processing and systematization of information, are not fully investigated. That’s why, theaim of our article is to study the problem of qualitative selection of methods for visualization of educational information in the conditions of a growing flow of digital resources.

Literature review

Human perceives any information from the surrounding world due to his senses: vision, hearing, taste, smell, touch. Then it is processed, usually being transformed from one type into the other according to strict formal rules. The so-called information-processing theory is interdisciplinary in nature and describes the way a person learns and uses acquired information in his activity.

[1] Ivan Sechenov, Reflexes of the brain (Moscow: AST, 2014), 14.
[2] R. Nemov, Psychology. Book 1. General Fundamentals of Psychologists (Moscow: Vlados, 2004), 58.
[3] Petr Anokhin, Selected Works. Philosophical aspects of the theory of a functional system (Moscow: Science, 1978), 399.
[4] Noam Chomsky, Syntactic Structures (The Hague: Mouton,1957), 199.

A bright representative of the theory George A. Miller[5], speaking about the capacity of working (short-term memory) memory, singles out several aspects, such as: range of dimension of information perception, memory capacity, and speed of information re-coding. The study of the first two showed that there are limits in the amount of information which a person can process by his working memory. And segmentation of this flow into interrelated elements contributes to the growth of its capacity. In G. Miller's opinion, re-coding of information (for instance, verbal and symbolic in mathematics, sound and letter in linguistics, verbal and graphical for historians etc.) is a great means to increase the amount of information.

It was G. Miller[6] and his followers who proved that the capacity of working memory is limited by 7 units of information, and its segmentation into pieces helps to launch a specific mechanism of verification of the validity of this piece.

Further processing of information is connected with the search of the criteria according to which it can be classified, divided into types, i.e. structured. That means, that information units are presented (stored, transmitted, processed) not randomly, but logically according to certain order when one can monitor the interconnection between data.

> "Definite theoretical and practical conclusions are made in mindset on the basis of sensory information. This mindset represents the existence not only as separate things, phenomena and their properties, but defines connections between them, that are not usually given to a person directly during perception. Properties of things and phenomena, connections between them are presented in mindset in generalized form, in the form of laws, abstract systems, entities"[7].

Structured information is better perceived and comprehended by the person. Depending on the task that is set, systematization of information can include its analysis, structuring, arrangement, formalization, classification, clustering, typology ordering and combination of these procedures. In general it means a set of logically connected elements that represent an integral construction; form, device, the way of organization of anything.

Systematization and structuring of in formation are those psychological mechanisms due to which a person is capable of processing a great flow of information.

The most widely used are linear data structures (for instance, list, checklist), table and hierarchical data structures (in the form of graphics, schemes, charts). The growth of the amount of information which a person receives and processes in everyday life and in professional activity; its complication both in types of data (according to types, forms of representation, ways of organization) and in semantic abundance; usage of informational and communicative technologies promote to the appearance of a new tendency in science – information architecture, that studies methods and techniques of structuring of information; principles of information systematization and browsing aiming at helping people to find and process necessary data successfully.

[5] Horst Muller, Drawing up mental maps: a method of generating and structuring ideas (Moscow: Omega-L, 2007), 128.
[6] G. A Miller, «The magical number seven, plus or minus two: Some limits on our capacity for processing information», Psychological Review Vol: 63 (1956): 81.
[7] G. A Miller, «The magical…

The analysis showsthat in the process of thinking a person perceives the surrounding world in the form of structures, i.e. objects and connections between them. This psychological knowledge is used by teachers for a long time, when they accompany teaching material by visual images. These are illustrations, substantial pictures, schemes for understanding the solution of mathematical problems etc.

Nowaday snearly any explanation of a new material or reportis accompanied by a corresponding presentation or slides. And the usage of infographics helps to transmit information without taking into consideration linguistic barriers and age limits. In fact, visualization of information is an integral part of our perception as it is based on associative thinking and hierarchy of concepts. T.Buzan[8] suggested one of the effective ways of information structuring, systematization and visualization –mind maps, which are direct supplements and a form of graphical representation of visual thinking. Mind maps are based on the search of associations which arise in human mind with reference to certain concepts. An extensive set of associations allows not only to give a holistic description of the object, define its primary and secondary properties, but to stimulate subconscious memories. T. Buzan states that “mind map is a graphical expression of the process of mind mapping and, that’s why, it’s a natural product of human mind. This is a powerful graphical method that serves as a universal key to unleash brain’s potential. Mind mapshave 4 essential distingui shing features:

a) the subject of attention/ study is crystallized in a central image;
b) the main themes connected with the subject of attention/study radiate from the central image as branches;
c) the branches have the form of smooth lines and are marked by key words or images. Secondary ideas are represented as twigs of the relevant branch; the same order is used for topics of lesser importance etc;
d) the branches forma connected nodal structure”[9].

Giving characteristicstothecenterimage, T. Buzan comments: “Graphical image is in focus of vision and of our mind. It provokes the appearance of numerous associations and is extremely effective as a factor promoting better memorizing. Besides, the image simultaneously attracts on different levels of perception. If any word has a significant meaning for your mind map, it should be transformed into the image, using the priorities of dimensional pictures, colour palette and attractive form”. H. Mueller[10] in his book about mind mapss hows different spheres of Mind maping application: during brain storming session for collecting and structuring of ideas (in team or individually); in information management for management, structuring and organization; in organization of your activity and planning; in presentations: from data collection to syllabus; for record-keeping: creation of the body of knowledge to systematize the information read and heard; for visualization of the relations, connections, all aspects of one theme (of work or life).

Proposed methodology

To achieve the goal and solve research problems, a set of interconnected and interdependent methods was used: analysis and synthesis of scientific literature; empirical observation, questionnaires, testing, method of expert assessments, pedagogical

[8] T. & B. Buzan, Superthinking (Minsk: Potpourri, 2003), 320.
[9] T. & B. Buzan, Superthinking…
[10] Horst Muller, Drawing up mental maps…

experiment. There were monitored such students' competences as: defining cognitive goals; search for information; formation of concepts and establishing connections between them; structuring of knowledge; coding, re-coding and modelling; synthesis, analysis; classification, systematization and generalization; group activity in all aspects; communicative competence (communication and interaction; educational cooperation; discussion skills); personality development (self-discovery; self-understanding; self-regulation; creativity).

Result analysis

The sphere of mind map appliction is very wide: they allow to present a large amount of information in brief, perceive information visually as a single piece. Their regular use helps to develop and organize thinking; to form the skill of information structuring; to develop the skill to define the center and connections, think logically and in pictures. This particular feature of Mind mapping (visualization of the processes of thinking) enabled to form a hypothesis that this method makes it possible to define and correct cognitive processes, that are hidden from direct observation. Thus, the study of the impact of Mind mapping on the quality of educational results is the aim of our investigation. Apart from the aspects connected with the formation of students' general educational competence (defining of the aim and subject of investigation; search of information; analysis of concepts and establishing connections between them; coding and re-coding; generalization) affective and psychomotor spheres of personality were investigated. Taking into consideration B. Bloom's[11] taxonomy (1956), we presented educational process as students' transit through all stages of the development of high-order thinking: knowledge, comprehension, application, analysis, synthesis, evaluation (Fig.1).

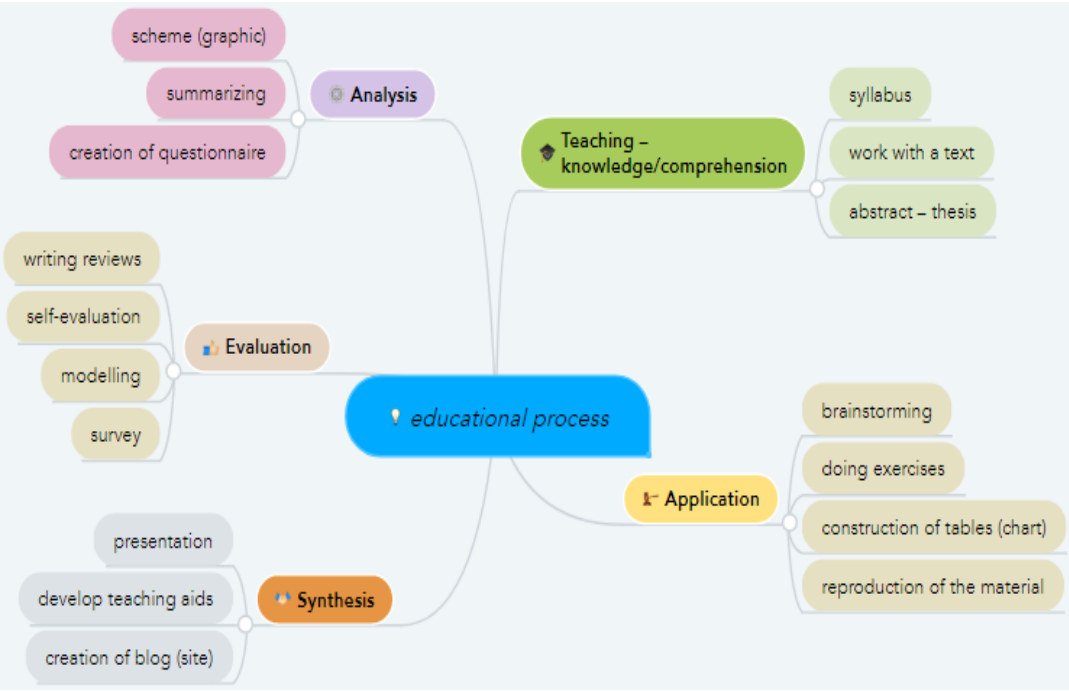

Figure 1
Mind map of the educational process (according to Bloom)

[11] B. C.Bloom, Taxonomy of educational objectives: The classification of educational goals (New York: Longman, 1956).

The use of Bloom's taxonomy is now relevant in organizing mixed and distance courses[12].

In our paper we do not deny the possibility of making mind maps in a traditional way. But in the era of digitization, changes of the mechanisms of information perception and processing, considering a natural need of youth to use various digital apps, we focused on computer programs which allow to make mind maps. The analysis of the existing apps gave us possibility to select the most interesting one which are easily used and effective in goals' realization. The most widely spread of them are: MindMeister, Bubbl.us, Cacoo.com, Comapping, Coggle, Dabbleboard, Fishbone, iMindMap, MAPMYself, Mind42, Mindomo, LOOPY, Wisemapping, XMind.

Anactiveuse of mind maps for two years with different categories of students enabled us to generalize some results. We observed qualitative positive changes in both cognitive sphere of development, affective and psychomotor spheres. Cognitive processes were evaluated on the basis of such structural changes, as: Remember (take necessary information from long-term memory), Comprehend (define the meaning of teaching messages, including oral, written and graphical communication), Apply (do or use procedures), Analyze (decompose objects into separate elements and describe the way they are connected with the whole), Create (combine elements to create new one), Evaluate (make conclusions on the basis of criteria) (Fig.2).

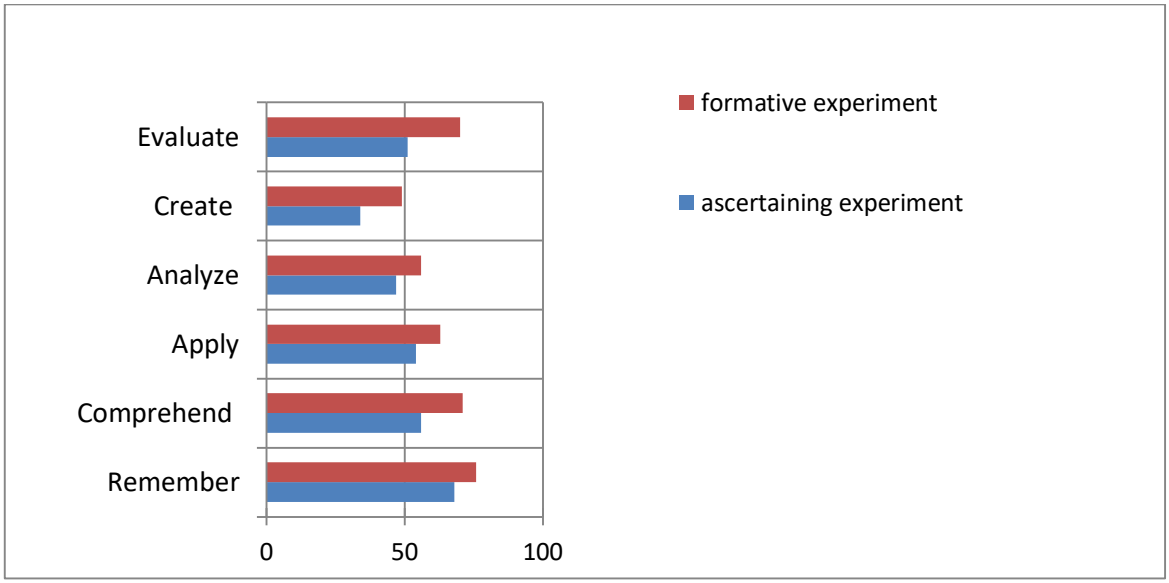

Figure 2
Qualitative changes in the cognitive sphere of development

Testing to determine the knowledge component in the control and experimental groups at the ascertaining stage (Table 1) and control stage (Table 2) allowed us to see the dynamics in the formation of students' knowledge using mind maps.

[12] O. Sagan; O. Los; O. Kazannikova y I. Raievska, «A System of Effective Tasks in Blended Learning on the Basis of Bloom"s Taxonomy», In E. Smyrnova-Trybulska (Ed.) E- Learning and STEM Education (Katowice-Cieszyn: Studio Noa for University of Silesia, 2019), 171-187.

№	Test	Group of students	n	X	δ	m	t
1	Knowledge of theory	control	24	6,1	1,3	0,3	0,5
		experimental	24	5,9	1,5	0,3	
2	Formation of skills	control	24	6,2	1,3	0,3	0,3
		experimental	24	6,3	1,5	0,3	

Table 1
The level of knowledge of students at the ascertaining stage

In our statistical calculations, we used the Student's test, n is the number of students in a group, X is the arithmetic mean, m is the standard error, δ is the standard deviation, t is the Student's coefficient, P is the probability of reliability (we take P = 0.05).

№	Test	Group of students	n	X	δ	m	t
1	Knowledge of theory	control	24	6,2	1,0	0,2	2,1
		experimental	24	6,8	1,0	0,2	
2	Formation of skills	control	24	6,4	1,0	0,2	2,5
		experimental	24	7,1	1,0	0,2	

Table 2
The level of knowledge of students at the control stage

As you can see, the results obtained indicate the effectiveness of using the mind maps technique.

Changes in the affective sphere are connected with obtaining or development of such students' qualities as self-confidence, leadership, responsibility, respect, reliability. Psychologists single out such levels of educational goals: Perception (awareness of behavior, relations; desire to achieve something); Reaction (feedback, changes in behavior as a result of introduction to new norms of behavior, relations); Values (approval and appreciation of new norms of behavior, relations); Conceptualization (comprehension, the formation of the system of values); Internalization (extension of a system of values on all spheres of activity) (Fig.3).

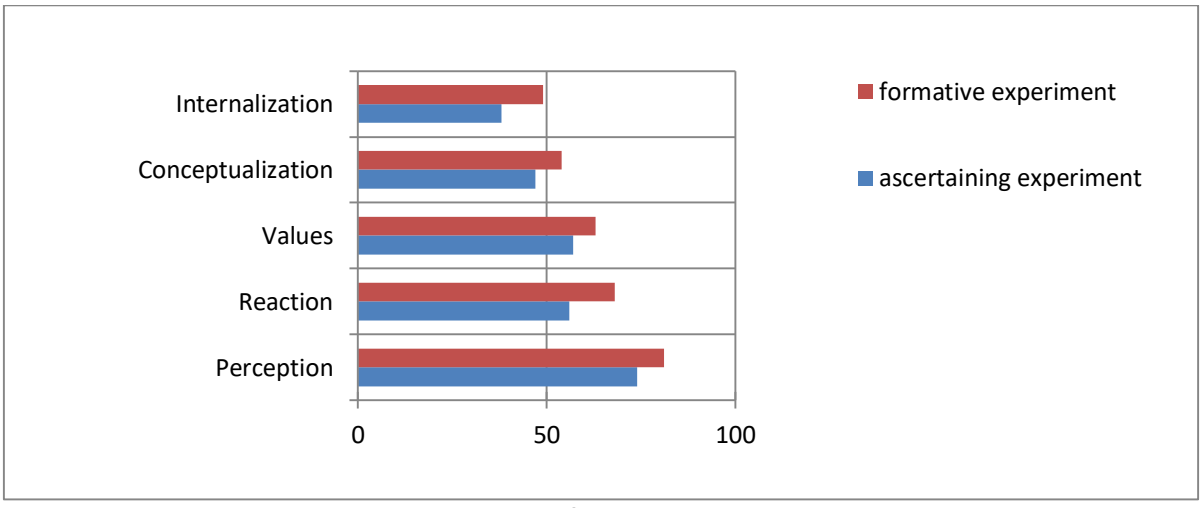

Figure 3
Qualitative changes in the affective sphere of development

Weused R.H. Dave's[13] taxonomy to describe educational tasks in psychomotor sphere: Imitation (reproduction of other patterns of behavior); Manipulation (implementation of the types of activity according to algorithm); Accuracy (accurate reproduction of the types of activity); Combination (integration of actions to solve non-standard problems); Naturalization (automated action) (Fig.4).

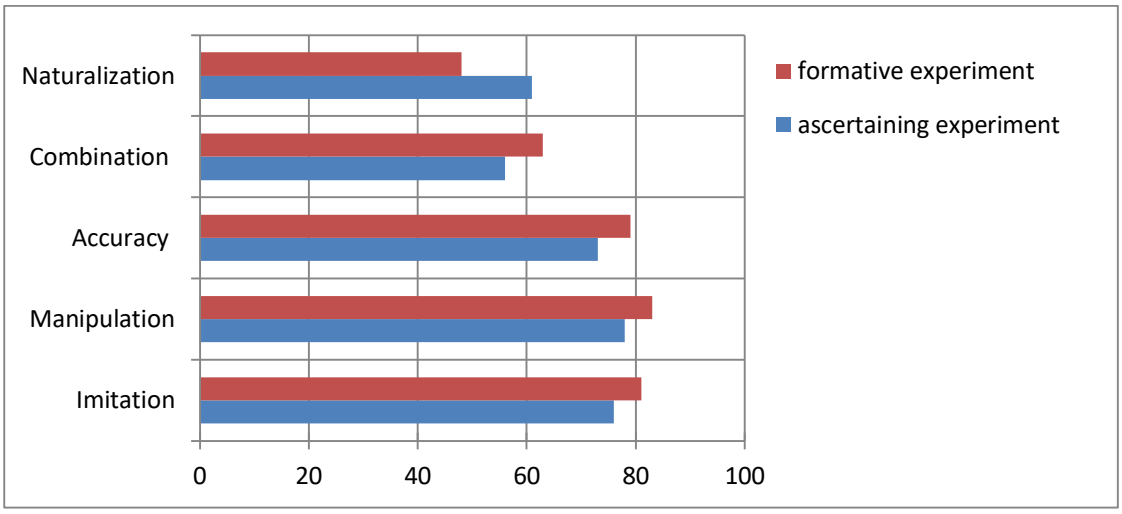

Figure 4
Qualitative changes in psychomotor sphere of development

Conclusion

Generalized resultsprove the effectiveness of mind maps application, because they improve speed and quality of processing of massive amount of information by students; develop the skills of information systematization and structuring, creative abilities. Besides, the use of mind maps as a teaching method and an instrument of personal development allows to increase students' motivation and cognitive abilities, form their communicative competence, encourage their personal growth. The perspectives of application of this method are rather wide. So, mind maps can be an effective instrument in automated monitoring of students' knowledge; in corrective work they facilitate opportunities of disabled people to express their thoughts with the help of schemes and pictures, and for teachers they are helpful in understanding student's personality in a better way, and choosing appropriate methodology.

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