HOW DOES MIND PROCESSES INFORMATION AND REPRESENTS KNOWLEDGE: AN EMPIRICAL STUDY

By

ANANTA KUMAR JENA * BHUJENDRANATH PANDA **

* Assistant Professor, Department of Education, Assam University, Silchar, India.
** Professor & Head, Department of Education, Regional Institute of Education (NCERT), Bhubaneswar, India.

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ABSTRACT

The study aimed to know how does mind-map software assess the representation of learners' knowledge and how brain tester software assess the performance of left, right, auditory, and visual lobes of the brain to represent information. It also aimed to study the differential effectiveness of audio, visual, and audio-visual information to represent knowledge. Mind map tool used to know the students' knowledge representation in science, and for that purpose, different audio, visual, and audio-visual tools used to know how learners process cognitive information; those were experienced in the study. There was no hypothesis to draw inferences but three working hypotheses or the research questions framed to find out the result. Every individual has an independent information processor in left, right, auditory, and visual lobe of brain to represent information. It was also resulted that audio-visual information was more effective to process and represent knowledge than audio and visual information.

Keywords: Mind Processes Information, Representation of Knowledge, Software.

INTRODUCTION

Mind Represents Knowledge

Theory of mind includes representation of knowledge and information those process in the central nervous system (Brüne & Brüne-Cohrs, 2006). However, the development of children's knowledge, and knowing, a process that involves an ongoing tension between objective and subjective perspectives (Burr & Hofer, 2002). Hedberg & Higgins, (2011) studied that the accessibility of stored knowledge has been found to decline over time after activation without further stimulation. Indeed, they found that for strongly prevention-predominant participants, knowledge accessibility actually increased over time after goal completion. Contrast to that, McGeer & Petit, (2002) investigated that a system which is to count as minded must represent its environment and must act in pursuit of its goals as those representations make it right to act; or at least it must do this in favourable conditions. Nevertheless, a system may comply with representation-related constraints, simply because that is how it is designed at the sub personal level to function (Caron, 2009). Flavell, Green, & Flavell (1990) studied an account of the early development of children's knowledge about the mind and report two studies designed to test a part of it. Young children begin their discovery of the mental world by learning that they and other people have internal experiences or mental states that connect them cognitively to external objects and events-experiences, such as seeing them, hearing them, and wanting them (Chaudhary, 1998). Purzycki (2013) argued that mind is an intuitive process that knowledge is distributed spatially; the farther away from spirits' place of governance a moral behavior takes place, the less they know and care about it. However, mental states, manifested by the children's use of mental, psychological and perception verbs, were not related to performance on the false belief task (Rakhlin, Kornilov, Reich, Babyonyshev, Koposov, & Grigorenko, 2011). As a whole we could say concepts are being widely used to explore organizing principles represents 'semantic waves' could help in knowledge-

building (Maton, 2013).

Mind Processes Information

Kiefer & Pulvermüller (2012) found that mind processes information in the form of concepts those are flexible, distributed representations comprised of modality-specific conceptual features. Conceptual features are stored in distinct sensory and motor brain areas depending on specific sensory and motor experiences during concept acquisition. Information processes in the anterior temporal lobe, the causal role of sensory and motor activation for conceptual processing and the grounding of abstract concepts in perception and action (Fekete & Edelman, 2011). Khrennikov (2011) proposed a model of Quantum-like (QL) processing of mental information. The crucial difference between a theory of mental representation based on structural resemblance and one based on physical resemblance is that the former is compatible with the implementation of mental representation in the brain (O'Brien & Opie, 2004). Fingelkurts, Fingelkurts, & Neves (2013) studied that phenomenal consciousness is realized by a particular level of brain operational organization and that understanding human consciousness requires a description of the laws of the immediately underlying neural collective phenomena, the nested hierarchy of electromagnetic fields of brain activity – operational architectonics. Gallistel, (2011) and Khrennikov, (2004) argued that neural pathways could go through the whole body; the mental space is produced by the completely neural system. Finally, they develop the probabilistic neural pathway model in that mental states are represented by probability distributions on mind. Stevens (2005) conducted four experiments to characterize the utilization of visual imagery and motor imagery during the mental representation of human action. Sauvage, Jissendi, Seignan, Manto, & Habas (2013) investigated the cerebral networks involved in execution and mental imagery of sequential movements of the left foot, both performed at slow and fast speed. They found that slow movements specifically recruited frontopolar and right dorsomedian prefrontal areas bilaterally, during both execution and mental imagery, whereas fast movements strongly activated the sensor motor cerebral cortex. Finally, they noted that anterior vermis, lobules VI/VII and VIII of the cerebellum were specifically activated during fast movements, both in imagination and execution. Mental activity to be reproducible (stable) in some brain areas and variable in others, which confirmed the concept that mental activity is maintained by cortical-subcortical functional system with links of different degrees of rigidity (Bechtereva, Gogolitsin, Ilyukhina, & Pakhomov, 1983). Visual brain areas are only involved if the problem information is easy to visualize and when this information must be processed and maintained in visual working memory. A regular reasoning process, however, does not involve visual images, but more abstract spatial representations-spatial mental models-held in parietal cortices. Only these spatial representations are crucial for the genuine reasoning processes (Knauff, 2006). Pulvermuller & Mohr (1996) studied the elements of higher cognitive processes, such as concepts, words and mental images, are realized in the brain as cortical cell assemblies, i.e. large and strongly connected neuron populations that form functional units. Dove (2009) studied and suggested that certain cognitive processes employ perceptual representations, but cognition is inherently perceptual.

1. Significance of the Study

All the mental processes depend on memory and cognition but all the conceptual representations gather in the form of knowledge in the long-term memory. Many researchers have conducted studies on cognitive science and all the sensory and motor system of the brain is focused on the long-term memory. Keifer and Pulvermüller (2012) found the conceptual featured are stored in distinct sensory and motor brain areas depending on speciation sensory and motor experiences during concept acquisition. Brüne and Brüne-Cohrs (2006) found the ontology theory of mind represents central nervous system and it has the ability to represents knowledge. Harvey & Harris (1996) investigated that mind accept the black board concepts to produce a flexible and extensible knowledge. Similarly, Hsu, Liang, Wu, Klein, and Jiang (2011) found mind integrates and represents

knowledge and processes information. Burr and Hofer (2002) found the general times line depicting the development of children's belief, about knowledge are subjective. The accessibility of stored knowledge found to decline over time after activation without further stimulation (Hedberg and Higgins, 2011). The self-regulation of mind represents its environment and represents knowledge in favourable condition (McGear and Pettit, 2002). Mind represents knowledge and process information through perception and observations (Esfahani and Kellett, 1988). Magnetic Resonance Imaging (MRI) and Position Emission Tomography (PTE) and other techniques are suitable to study the knowledge of language and multi lingual mind (Chaudhary, 1998). Knowledge and knowledge acquisition and representation of knowledge is due to the cellular neural networks and this embodied robotics (Mainzer, 2009; Rauhut & Lorenz, 2011). Training has certain effect on mental representations (Obersteiner, Reiss, & Ufer, 2013). The structural theory of mental representation is depending upon ones involvement with the theory. Similarly, consciousness is a phenomenon and it is an operational architectonics of brain organization (Fingelkurts et al., 2013). Stevens (2005) conducted experiments on mental representation of knowledge found motor action and visual imagery is responsible for mental representation of knowledge. However, allomorphic variation is the implication for lexical processing and representation of knowledge (Boudelaa, & Marslen-Wilson, 2004). Mental representation is a spatial relationship with hierarchical and non-hierarchical theory (McNamara, 1986). From the above literature it was very difficult to predetermine how mind represents knowledge or processes information. Few literatures were emphasized on neural network and neural co-ordination and few are on long-term memory responsible for representation of knowledge. Few studies emphasized an environment and learning approaches were responsible for knowledge representation. Therefore, it was difficult to determine whether mind and sensory organs were responsible for processing information and represents knowledge.

From the above literatures, it was justified that mind or the brain is the centre of information, but how does it process information? Does the mind map software able to assess how mind represents knowledge? If so, then to what extent and how does it processes information? How audio, visual, and audio-visual hardware and software processes cognitive information in mind for long term retention? Does the audio-visual cognitive information retain longer than audio and visual information?

2. Objectives of the Study

Objective-1: To study how mind-map software represents learners' knowledge.

Objective-2: To study at what extent brain tester software assess the performance of left, right, auditory and visual lobes of the brain to represent information.

Objective-3: To study the differential effectiveness of audio, visual, and audio-visual information to represent knowledge.

3. Methodology

3.1 Participants

Five elementary school students of class VII, age range 12.2-12.4, mean 12.3 and SD 5.6 was undertaken from elementary schools of India. The participants were exposed to mind-map software to assess their knowledge representing ability. Not only that, the brain tester software was used to assess the performance of left, right, auditory, and visual lobes of the brain to represent information. Audio, visual, and audio-visual information were administered among the students to assess their effectiveness of brain and knowledge representation.

3.2 Design of the Study

The recent study was empirical, a way of gaining knowledge by means of direct and indirect observation or experience with the students. Mind map tool was used to know the students' knowledge representation in science and for that purpose, different audio, visual, and audio-visual tools were used to know how learners process cognitive information, those were experienced in the study. There was no hypothesis to draw inferences, but three working hypotheses or the research questions were framed to find the result. The empirical evidences and

data were analyzed quantitatively through quantifying the evidence or making sense of it in quantitative form. The researcher answered the empirical questions based on evidence.

4. Instrumentation

4.1 Mind Map Tool

Mind Map software from some websites (e.g. http://www.mindomo.com, http://www.mapmyself.com, and http://www.thebrain.com) were collected to introduce with the students for the assessment of knowledge representation and to realize how the knowledge is being processed in their mind (e.g. Merchie & Van Keer, 2012). The online mind map tool has high reliability (.96) and validity (.86) published to assess the representation of knowledge. After that, the researcher installed the mind mapping software in the laptop. Before administration of instruction, pre-test was administered on digestive system of humans. After the end of the instruction, the researcher provided the mind map blank sheet to the learners to fill these requirements as the posttest. However, the offline mind map blank sheets prepared by the researcher to measure the learners' knowledge representation (i.e. Posttest). The reliability and validity of mind map blank sheet was .67, and .65, respectively.

4.2 Brain Tester Software

This is an installed software having random items related to alphabets, drawing, figures, statements, representation of feeling, and opinion of relationship between words (e.g. Oztop, Wolpert, & Kawato, 2005). It also contains liking and disliking least and long descriptive paint, game and sports related word, colour and word association observation of notes, relationship between numbers, sequence of numbers, figure of different gestures, and appealing graphical related word, personal feeling and also word related activities. Each item content has three options and each option were much related to the stem. The reliability and validity of the tool are 85 and .75, respectively.

4.3 Audio, Visual and Audio-Visual Tool

This was a tool having two sections. Section 1 contains short – story without any sound lent all the information the respondent will be observed and try to understand. In this section different symbol, relation of pupil, number association game, short film, and short lecture are included. In section 2, the similar items were presented both audio and visual forms. There is a gap between section 1 and section 2. After the end of the section 1, the respondents were tested to know the pathway to process the information, to represent the cognitive information in the form of output. In section 2 it is to measure the pathway to process the information, which comes from both audio and visual process to represent the cognitive information in the form of output.

5. Procedure of Experiment and Data Collection

Five seventh class students were randomly selected by the researcher for the mind map instruction to know their cognitive process and representation of knowledge. With proper permission, the researcher has provided an online tutorial to the learners and acquainted the students with the software, followed by instruction through mind map tool for a week in the remedial periods of the school. All the learning concepts of human digestive systems, the learners actively practiced through the mind map tool. After the end of the mind map instruction, the researcher installed mind map software in the system (computer) of the students to construct their own mental representation those were continued for next two weeks without the help of the researcher. Mind map blank sheet is used to take the posttest that the learners filled the requisite blanks of human digestive system. After posttest, Brain tester software was applied to five secondary school students to test their representation of knowledge and the function of Brain. This tool has more than 20 items, but the software will provide a certain amount of item to each individual. After the end of the brain testing experiment, the data gathered for analysis and interpretation to measure the representation of mind and that assessed the working memory of the brain with complete image of the brain of that individual. Visual and audio-visual tool can be installed in a DVD to hear or visualise the short story, memory game, and block construction. This tool content has 10 items, but varies from individual to individual, because according to the nature of the content, the

items would be changed. At the end of the audio and visual process, a questionnaire was administered to collect the data for analysis and interpretation. After the audio-visual observation, similar items are administered to know the difference between audio, visual, and audio-visual pathways of process of information. After the collection of data, the researcher has scored the pretest, posttest mind-map by providing one mark for each connection or proposition. Similarly, brain-testing software assessed the learners' right, left, visual and auditory lobes of Brain and scored directly. The software automatically calculated this score. Audio, Visual, and Audio-Visual tool has twelve multiple-choice type of items related to the G.K., Films, Politics, and Democracy. The researcher also scored it. For each correct response, one mark is provided to the students.

6. Analysis and Results

Objective-1: To study how mind-map software represents learners' knowledge.

Table 1 reveals that the pre-test mind map score (5.20 ± .83 mean) was smaller than (9.00 ± .70 mean). That reflected pre-test mean was smaller than the posttest mean of knowledge representation after, mind map instruction. The pre-test and posttest mean difference was significant. The t value (4 19.00 p < .00) was significant .05 levels (see table-2).

Objective-2: To study at what extent brain tester software assess the performance of left, right, auditory, and visual lobes of the brain to represent information.

Item no.1 (i.e. Of the three choices which sums to better reflect the relationship I:M?) was responded U:R that was option (b). Similarly, item no. 2, 3, & 4 were responded as 'more open', 'Neither', & 'US and Them', respectively. All these items were non-verbal reasoning and figure comparisons (see table 3). Brain Tester Software measured the percentage of representation of information by the left, right, auditory, and visual lobes of the brain of student no.1.

The Brain tester analysed the student no. 1's response. It resulted that right brain (60%) was working properly than the left-brain (40%). The right hemisphere was moderate dominant with a strong performance to receive auditory learning, but the right hemisphere intuitive, perceptive and somewhat random (see Figure 1). Nevertheless, the auditory style of learning subjects processes information sequentially along a single dimension. The hemisphere

	Mean	N	Std. Deviation	Std. Error Mean
Pretest Score	5.20	5	.837	.374
Posttest Score	9.00	5	.707	.316

Table 1. Mean & SD of Students' Representation of Knowledge

Test	Mean	S D	SEM	t	df	P
Pre-test score-Post-test score	3.800	.447	.200	19.000	4	.000

Table 2. t-test of Pretest and Posttest Scores of Students' Representation of Knowledge

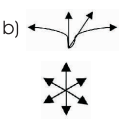
Sl. No.	Item	Options	Responds
1	Of the three choices which sums to better reflect the relationship I:M?	a) 1:1000 b) U:R c) 9:3	(b) U:R
2.	If I could change myself any way, I would income…	a) More balanced b) More Organized c) More Opened	c) More opened
3.	The relationship between Anger and rage can be symbolized by which of the following	a)  and W  b)  and c) Neither	c) Neither
4.	The pair of words below that sum to have the same relationship as the words I:IT are	a) US and Them b) PI and PIT c) Subject and Object	a) US and Them

Table 3. Response of the Student No.1 to the Brain Tester Items

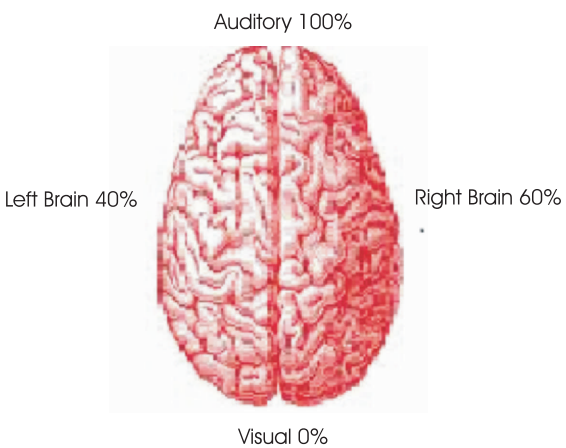


Figure 1. The Percentage of Representation of Information by the Left, Right, Auditory and Visual Lobes of the Brain of Student No.1 was Measured by the Brain Tester Software

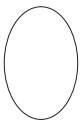
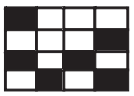
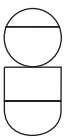
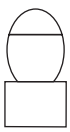
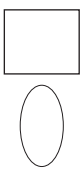
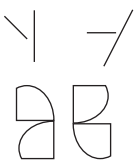
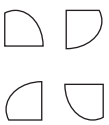
Sl. No.	Item	Response
1.	The figure I find the most appealing	(a)  (b)  (c)  (d) 
2.	 is most like	(a)  (b)  (c)  (d) 
3.	 Relates to  in the same the same way as which set of figures below?	(a)  (b)  (c)  (d) 
4.	Presented with   I would think of	(a)  (b)  (c)  (d) 
5.	? and !, would tend to think of	a. Ask and Demand b.  and  c. Neither (c)Neither

Table 4. Response of the Student (2) to the Brain Tester's Items

tendency aside, attempted to be reflective and set a rhythm on how take material. The difficulty is that the leaners does not tend to have it within her to impose organisation. The words come easily to her lips, sometimes surprisingly saw to her. However, she is more emotional than logical.

Table 4 reveals the item (i.e. no.1, 2, 3, 4 & 5) responded by the student no. 2. All the items were figure comparison types and all were non-verbal reasoning items. Each item has three options just related to the stem items. Student no. 2 responded a, c, a, c, & c respectively. Figure 2 shows the percentage of representation of information by the left, right, auditory, and visual lobes of the brain of student no. 2 exposed to Brain Tester Software.

Figure 2 depicts the percentage of representation of information by the left, right, auditory, and visual lobes of the brain of student no. 2. Somewhat right hemisphere dominated (55%) and it has a strong visual preference,

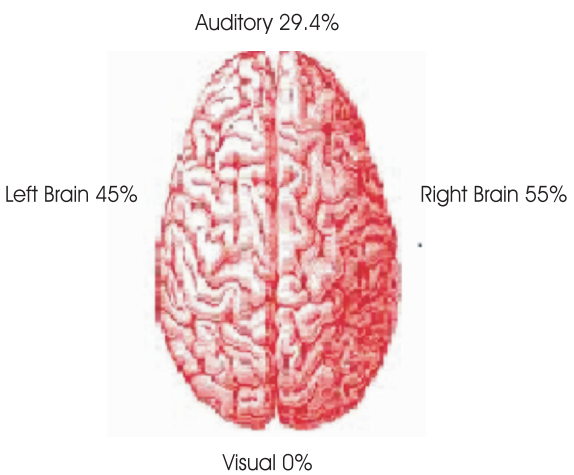


Figure 2. The Percentage of Representation of Information by the Left, Right, Auditory and Visual Lobes of the Brain of Student No.2 was Measured by the Brain Tester Software

and the learner was an artistic temperament. Particularly this learner has a dominant visual learner style and his working to absorbed are of the facts of the environment. This student was reflective about himself. The listening and

learning from materials presented in a purely verbal fashion was not the strong sweet. He became more efficient with spontaneity and creativity.

Table 5 reveals the response of the student in the brain tester software. Item no. 1 (i.e. *Out of these statements the one i.e. most true about me is*_____) responded and the selected option was (b) i.e. *I stand up for what I believe in.* Similarly, item no. 2 (i.e. *in my opinion the relationship i.e. more similar to the relationship between ON and ONE*) responded as '(b) TON and TONE' out of the similar types of distracters. With respond to item no. 3 (i.e. of the three choices, pick the one that first comes in mind when you see or hear the word blue), student no. 3 responded to the option (b) i.e. colour. Similarly, item no. 4, 6, 7, 8, & 10 like and dislike types of options that were student three responded as the b, c, a, b, & a, respectively. However, item no. 4 & 5 were colour comparisons type reasoning responded by the learner. Item no. 9 was sequence selection type non-verbal reasoning responded as the option (c) by student no 3. The percentage of left, right, auditory, and visual lobes of the brain of student no. 3 represents information measured by the Brain Tester Software (see Figure 3).

Figure 3 represents percentage of information that represents in the left, right, auditory, and visual lobes of the brain of student no.3 measured by the Brain Tester Software. This student has strong left hemisphere dominant and showed somewhat of a preference for

Sl. No.	Item	Option	Response
1.	Out of these statements the one i.e. Most true about me is_____	(a) I am Open to New and Diverse Idea. (b) I Stand Up for What I Believe in. (c) I Have an Impact Everyone I Meet.	(b) I Stand Up for What I Believe in.
2.	In my opinion the relationship i.e.More similar to the relationship between ON and ONE	(a) AN and ANE (b) TON and TONE (c) AN and WAN	(b) TON and TONE
3.	Of the three choices, pick the one that first comes in mind when you see or hear the word blue.	(a) Sad (b) Color (c) 	(b) Colour
4.	Which are like eat : ate is_____	(a) Ate : Eaten (b) Dance : Danced (c) Tea : Eat	(b) Dance: Danced
5.	Find the best match like gold : 	(a) Silver (b) Rose  (c) Pitch 	(b) Rose 
6.	Sing/ song	(a) Verb / Noun (b) Ping / Pong (c) Write / Book	(c) Write/ Book
7.	Which pain is most like anger-rage	(a) Like-lobe (b) Control-uncontrol (c) Worse-worst	(a) Like-lobe
8.	I like best is	(a) Titillating (b) Syzygy (c) Jube	(b) Titillating
9.	The sequence △△△△△△ is essentially the same as	(a) △△△△ △△ △△△ △△△ (b) △△ △△ △△ △△ △ △△△ (c) △ △ ▽ ▽△▽	(c) △ △ ▽ ▽△▽
10.	Connection between evil and devil is like a	(a) Good and God (b) Anniely and Phobia (c) Abstract and Concrete	(a) Good and God

Table 5. Response of the Student No. 3 to the Brain Tester Items

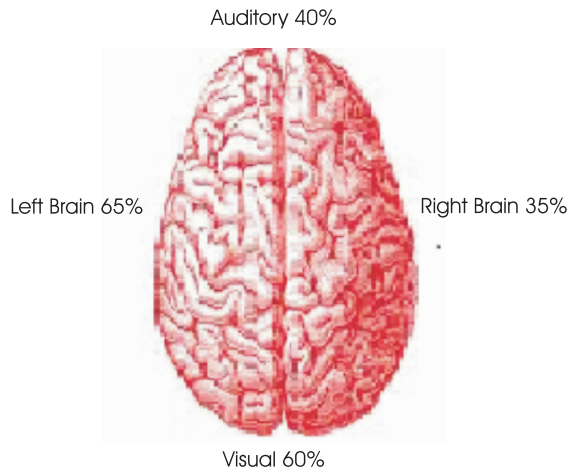


Figure 3. The Percentage of Representation of Information by the Left, Right, Auditory and Visual Lobes of the Brain of Student No. 3 was Measured by the Brain Tester Software

visual learning, a positive combination of style. The left hemisphere dominance implied that the student strongly organized logical, and his visual preference indicated that he was active in learning simultaneous multidimensional fashion. He was strong in engineering and computer graphics.

Table 6 analyzes the learner's response to the brain tester software. Item no. 1 (i.e. If I would change myself anyway. I would become), the respond was (a) More Organised. Similarly, with respond to the item no. 4 (i.e. in my opinion the relationship between ON and ONE --) the respond was (c) AN and WAN where as item no. 5 (i.e. Relationship of Pen and Ink is equal to) was responded as option (c) Mobile and Sim. All these items were reasoning type item and learner responded one from the three options. But, item no. 3 (i.e. ! and ?, I would tend to think of) responded as option (c) Neither and item no. 2 was figure completion type responded as option 'b'. Figure 4 reveals the

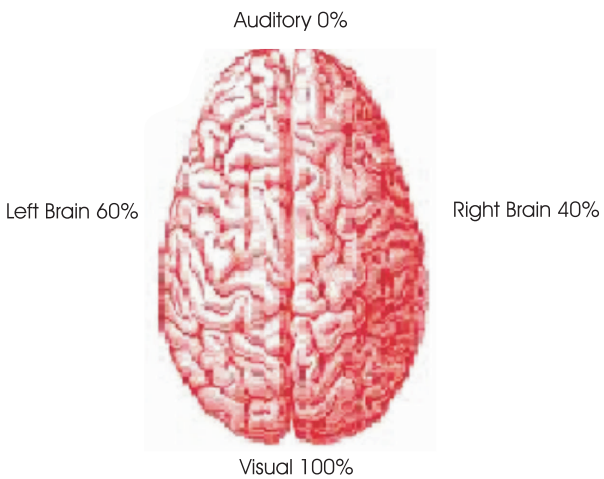


Figure 4. The Percentage of Representation of Information by the Left, Right, Auditory and Visual Lobes of the Brain of Student (3) was Measured by the Brain Tester Software

Sl. No.	Item	Option	Respond
1)	If I would change myself anyway. I would become ……..	(a) More Balanced (b) More Organised (c) More Opened	(a) More Organised
2)	The figure below I find the most appealing	(a)  (b) △△△ (c) 	(b) △△△
3)	! and ?, i would tend to think of	(a) Ask and Demand (b)  and  (c) Neither	(c) Neither
4)	In my opinion the relationship between ON and ONE	(a) AN and ANE (b) TON and TONE (c) AN and WAN	(c)) AN and WAN
5)	Relationship of pen and ink is equal to	(a) Paper and Pen (b) Pack and Packet (c) Mobile and Sim	(c) Mobile and Sim

Table 6. Response of the Student No. 4 to the Brain Tester Items

percentage of representation of information in the left, right, auditory, and visual lobes of the brain of student no. 3 exposed to the Brain Tester Software.

The tool analysed that the left-brain worked properly. The left-brain was intuitive perceptive and somewhat random (see Figure 4). Nevertheless, the auditory style of leaning subjects processing information sequentially along a single dimension. The hemisphere tendency aside, attempted to be reflective and set a rhythm to how lake materials. The word does not come to the lips of the responded. He takes time to respond. Thus, he was more logical than emotional.

Table 7 depicts the students' response to the brain tester software Item no. 1 (i.e. out the three choices pick the one which you like most?) responded correctly i.e. (a) Playing. Similarly, item no. 2 (i.e. which one you would not go for?) responded as option (a) Cooking, and both these items were simple and thought provoking. In item no. 3, (i.e. pick the one which comes in your mind first when you see the colour), student no. 5 responded option (c) Colour. The student responded option (b) Verb: Noun for item no. 4 (i.e. Ping: Pong). The percentage of representation of information in the left, right, auditory, and visual lobes of the brain of student no. 5 is shown in Figure 5.

Figure 5 depicts the percentage of information represented by the left, right, auditory, and visual lobes of the brain of the student. The student had a strongly left hemisphere dominated brain and he had given equal weightage to both auditory and visual learning. The left hemisphere dominant implied that the student was

Sl. No.	Item	Option	Response
1.	Out the three choices pick the one which you like most?	(a) Playing (b) Reading (c) Writing	(a)) Playing
2.	Which one you would not go for?	(a) Cooking (b) Playing (c) Boating	(a) Cooking
3.	Pick the one which comes in your mind first when you see the color	(a) Sad (b) Happy (c) Color	(c) Color
4.	Ping : Pong	(a) Sing : Song (b) Verb : Noun (c) Write : Book	(b) Verb : Noun

Table 7. Response of the Student No. 5 to the Brain Tester Items

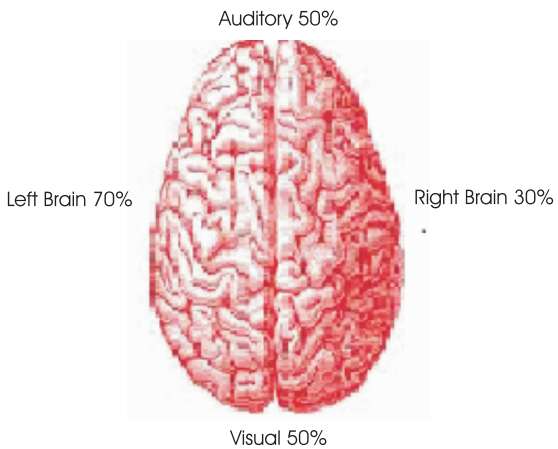


Figure 5. The Percentage of Representation of Information by the Left, Right, Auditory, and Visual Lobes of the Brain of Student

strongly logical, and very much organized than emotional, but she was good in graphics and engineering.

Objective 3: To study the differential effectiveness of audio, visual, and audio-visual information to represent knowledge.

Table 8 depicts the descriptive statistics of the effects the audio, visual, and audio-visual information of the students. The audio score (4.60 ± .54 mean), visual score (6 ± .70 mean) were locus than audio visual score (8.80 ± .83 mean). It resulted that the audio-visual information mind processes better and represents knowledge effectively than audio and visual information. Table 9 reveals the means difference between students (n=5) auditory, visual, and audio-visual information and representation of knowledge. The mean difference between audio and visual score was significant. The T

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Audio score	4.60	5	.548	.245
	Visual score	6.00	5	.707	.316
	Audio visual score	8.80	5	.837	.374

Table 8. Mean & SD of Audio, Visual, and Audio-visual Score of Represent of Knowledge

		Mean	SD	SEM	t	Df	P
Pair 1	Audio score-Visual score	-1.400	.894	.400	-3.500	4	.025
Pair 2	Visual score - Audio visual score	-2.800	.447	.200	-14.000	4	.000
Pair 3	Audio score - Audio visual score	-4.200	1.095	.490	-8.573	4	.001

Table 9. t-test of Audio, Visual, and Audio-visual Score of Represent of Knowledge

value of audio-visual score was (4 3.50 $p < .02$). Similarly the mean difference of visual and audio visual score was significant. The T value (4 14.00 $p < .00$) was significant. The audio and audio visual score mean difference (4 8.57 $p < .00$) was significant. It resulted that there existed significant difference in processing information and representing knowledge in audio, visual, and audio-visual process

7. Findings

It was found that there was a significant difference between pre-test and post-test score of knowledge representations. The mean difference of pre-test and post-test score was significant. That is why the mind map tool was effective to measure the representation of knowledge.

It was resulted that every individuals have their independent information processor in left, right, auditory, and visual lobe of brain to represent information.

Student 1- The right brain is working properly than the left brain, but the visual lobe performed 0% and auditory processes 100%.

Student 2- The right brain is 10% more working than the left-brain. But the visual lobe performed 70.6% and auditory lobe performed 29.4%.

Student 3- This student is strongly hemisphere dominance. The left-brain of the student was 65% working and right brain 35%, whereas, the auditory lobe works 40% and visual lobe works 60%.

Student 4- The brain tester tool has analysed that the left-brain is working properly. The left-brain of the student was working 60% and the right brain was working 40%. The auditory lobe was working 0% and the visual lobe was 100% working.

Student 5- The left-brain of the student was working 70% and the right brain was 30%. The auditory and visual lobe was working 50% in each.

It was also found that there existed significant difference in between the effectiveness of audio, visual, and audio-visual information to represent knowledge. Audio-visual information was more effective to process and represent knowledge than audio and visual information.

8. Discussion

In the recent study, the researcher investigated how mind represents knowledge and processes information. It was found that Mind Map was an effective tool to measure the representation of knowledge. However, the study resulted that there existed a significant difference between the pre-test and posttest score of knowledge representation because of treatment effect. This result was supported by (Chaudhary, (1988); Esfahani & Kellet, (1988); Flavell et al., (1990); Lesgold, (1993); McNamara, (1986). However, Gallese and Goldman (1998) argued that the mirror neurons are responsible for process of information. Still the concept information processing was under study by different researchers and different new information will become known later. To process the information, brain requires its different lobes and performs the left and right brain, auditory, and visual lobe to process information. In the recent study, 5 students' brain mechanism to process information was analyszd through Brain Tester software. It was resulted that the right brain is sometimes dominant over left-brain or vice versa. Similarly, the visual lobe of the brain performed better than the auditory lobe and the result was supported by Khrennikov, (2004); McGeer & Pettit, (2002); O'Brien & Opie, (2004); Papaxanthis, Pozzo, Skoura, Schieppati, (2002). But, the researchers like Boudella & Marslen-Wilson, (2004); Peled, (2005) did not support the results. In the present study, how visual, audio & audio- visual differentially is effective to represent the knowledge was studied. It was resulted that there existed significant difference in between the effectiveness of audio, visual, and audio-visual information to process and represent knowledge. Audio-visual information was more effective to process and represent knowledge than audio and visual information. Knauff, (2006) supported the result. Moreover, de Villiers, (2007) supported the result, and Laskey, (2008) rejected the result.

Conclusion

Mind is a storehouse of fact and information and all the information, facts; mind processes in its different lobes. Out of different lobes Hyppocampus, Cerebellum, Amygdala, and Basalganglia belongs to sub cortical structure of the brain those directly processes information.

Similarly, the cortical structure has four lobes (e.g. Frontal lobe, Temporal lobe, Perietal lobe, and Occipetal lobe). In the present study, the researcher experienced that the information processing of five students who were accumulated information through mind map tool helped them to increase their knowledge structure. To answer the research question, "where mind processes information and how", the researcher used Brain tester software that estimated the function of the brain. It was resulted that right and left brain did not process and represent knowledge equally. Similarly, out of Audio, Visual, and Audio-Visual information, it was found that Audio-Visual information retains information for a long time. Different researchers argued that the Frontal lobe of the brain mostly processes the audio information but Perietal lobe of brain represents knowledge through speech and reading. Similarly, occipital lobe of the brain was responsible to process the visual information, and the Temporal lobe of the brain was sensitive to hear the information. As a whole, all the four lobes of the brain processes and represents knowledge in right time and right way. In the present study, the researcher experienced that five students have different knowledge representation, like student 1 100% of auditory part of the brain was workable whereas 0% of visual information was not represented. In this situation one cannot say, that the visual part of the brain was not working. This was due to the effect of particular information or question. Similarly, this particular type of question highly fit for the right brain and for those right brain processes 60% more information than left-brain. Not only this, the student processed the information in the right brain, but most of the people or learners process and represent knowledge by both left and right brain. The left-brain worked properly, and represented knowledge in a slower form than the right brain. In teaching learning process, the teacher should take care to process information in the mind of learners through Audio – Visual information.

Educational Implications and Recommendations

The researcher suggested the following educational implications to the world of education.

- Teacher should try to teach through colourful Audio-Visual aids. For that purpose, smart classroom instruction, and on- line colourful instruction should be provided.
- Brain tester software should be distributed to each school to know the health of the brain or function of the parts of the brain.
- The teacher to teach science as well as social studies should use both on- line and off- line Mind Map tool.
- The teacher should use three-dimensional model, both Audio and Visual tools, in their general classroom.

The researcher has suggested the following recommendations:

- Mind Map, software specially used to process the knowledge in the mind of the student. However, it is recommended for the world of colleagues and friends, teachers, teacher educators to use other scientific tools to know how mind processes information and represents knowledge.
- Brain tester software is especially used to know the function of different parts of the brain those are processes and represents knowledge. The researcher recommended to the world of researcher to apply other software to know the function of brain.
- Audio, Visual, and Audio-Visual tools are used to know its impact on the process and representation of knowledge. However, the researcher recommended other researchers to use different techniques like mobile conferencing, and video conferencing, to know how mind processes and represents knowledge.

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ABOUT THE AUTHORS

Dr. Ananta Kumar Jena is presently working as an Assistant Professor in the Department of Educational Sciences under the School of Education, Assam University, Silchar, India. He has completed M.Sc. (Botany) from North Orissa University, India, and M.Ed. with Ph.D. from Utkal University, India.

Bhujendranath Panda is the Professor & Head of the Department of Education at Regional Institute of Education (NCERT), Bhubaneswar, India. He is expert in the field of Educational Psychology and Cognitive Sciences and has published more than 100 Research papers in National and International Journals.