EFFECTIVENESS OF DEVELOPED COGNITIVE LOAD THEORY BASED INSTRUCTIONAL MATERIAL ON CURRICULUM DEVELOPMENT IN TERMS OF ACHIEVEMENT, MEMORY, STYLE OF LEARNING AND THINKING AND REACTION FOR B.Ed. STUDENTS

Pre- Presentation Summary

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SUMMARY

1.0.0. INTRODUCTION

The present study entitled "Effectiveness of developed Cognitive Load Theory based instructional material on Curriculum Development in terms of Achievement, Memory and Style of Learning and Thinking for B.Ed. students." This study belongs to the area of instructional design technology. The main aim of the study was to check the effectiveness. The instructional material was based on concept of cognitive Load theory and was prepared from selected units of Curriculum Development and School Subject for B.Ed. students of self-financed institute of Indore city. In the present chapter, details about Cognitive Load Theory, Types of Cognitive Load Theory, Principles for reducing Cognitive Load, Rationale, Statement of Problem, Objectives, Hypotheses and Delimitations are given in separate captions.

1.1.0. BACKGROUND OF THE STUDY

In today's scenario, the teaching-learning process is becoming complicated for learner at all levels, the traditional method is used for teaching, which is least effective and students remain passive listeners due to which learner start observing it as a burden which leads to only short-term storage of memory in their brain, this further leads to lack of inculcation of knowledge in the students.

The main problem faced by the student is that they are unable to comprehend the subject matter properly as students are passively reading it. In traditional learning process, the teacher transmits the facts and assumes students as passive receptors of knowledge. This teaching-learning process is teacher-centred. Most of the time there is no proper interaction between the student and teacher and hence, due to lack of awareness and attention, learners face lot of difficulty in comprehending the text.

One of the interesting techniques of teaching-learning is instructional material. The main purpose of it is to transmit skills and help the learner in effective learning. Teaching through instructional material create interest and will help in clarifying difficult concepts. So, for this important area the present study entitled "Effectiveness of developed Cognitive Load Theory based instructional material on Curriculum Development in terms of Achievement, Memory and Style of Learning and Thinking for B.Ed. students" will be proposed.

1.1.1. CONCEPT OF COGNITVE LOAD THEORY

'Cognitive' means mental and 'Load' means burden, so this theory basically studies the mental load that the human brain faces when learning happens. Learners can remember information only if they can organize all that information into 'schemas' or category-based relationships. The Cognitive Load is the load imposed on working memory by information being presented.

The Cognitive Load Theory was developed by John Sweller in 1988, while studying problem solving. He suggests unnecessary Cognitive Load should be reduced by developing instructional material.

It is the concept that information should be presented at a pace and level of difficulty that corresponds to how the human brain processes information. When an instructor takes CLT into consideration, he or she purposely seeks to lower demands on the learner's processing capabilities in order to build comprehension and bring about more effective transfer of information into long-term memory (LTM).

Cognitive Load Theory (CLT) describes learning structures in terms of an information processing system involving long term memory, thereby associating indirectly with working memory. To understand this, first, we have to know what working memory is. Working memory performs the intellectual tasks associated with consciousness. However, it is extremely limited in both capacity and duration. The uniqueness of working memory is that information may only be stored in the long-term memory after first being attended to, and processed by, working memory. Long-term memory effectively stores all of our knowledge and skills on a permanent basis. The limitations of working memory, under some conditions, impede learning. Cognitive load theory came into the field of education in the early 1980s. The basic principle of cognitive load theory is that the quality of instructional design directly proportional to the consideration given to the role and limitations of the working memory. Hence, cognitive load theory has been used to develop several instructional strategies, which have been demonstrated empirically to be superior to those used conventionally.

1.1.2.TYPES OF COGNITIVE LOAD

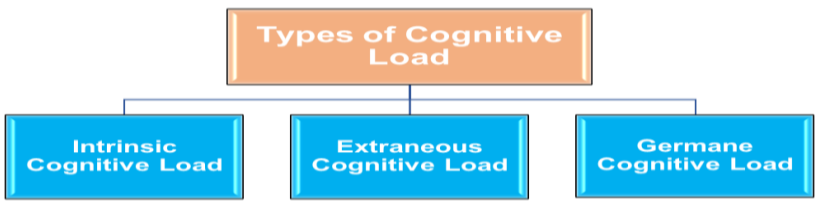

Fig 1: Types of Cognitive Load

- **Intrinsic Cognitive Load:** It refers to the need made by a learner by underlying aspect of information being gained. The intrinsic nature of such Cognitive Load is due to inherent difficulty of subject matter which should be reduced by several methods like breaking complex task into smaller, splitting subject matter into step-by-step task, providing worked example for new concept.
- **Extraneous Cognitive Load:** It refers to the way information is presented to the learner. It is produced by the interest enforced on students by the teacher. It is a negative load which voluntarily misguide student with distracting information for making task more complex. Extraneous Cognitive Load can be reduced by using effective presentation methods, illustrated diagram can be used instead of reciting lesson.
- **Germane Cognitive Load:** This third type of Cognitive Load is a positive load which is an outcome of composition of schemas & is considered to be desirable as it aids in process of learning skills & information. Germane Cognitive Load facilitates long term knowledge & skill acquisition. It is constructive & can benefit the learner to proceed information from working to long term memory.

1.1.3. PRINCIPLES OF REDUCING COGNITIVE LOAD

Richard E. Mayer, in his 2002 paper, described five principles that teachers can use to help reduce Cognitive Load and thus, increase retention and progress of their students. These principles will reduce extraneous load.

- **The Coherence Principle**

  It is simple. It gives emphasis on removing unnecessary information from teaching materials so students only see the essential information. For example, while using a slideshow or PowerPoint, the 'fun' pictures, gifs and videos included may not be worthful. So keep things simple and make the essential information the focus of teaching materials.

- **The Signalling Principle**

  This principle encourages to highlight important information using bold, italics or even arrows and other graphics. By directing the students to essential information, it will help in reducing their Cognitive Load and increasing the chances of having a successful germane load.

- **The Redundancy Principle**

  The presenter should avoid reading whole slide while giving presentation through ppt. The redundancy principle is all about avoiding this. It's important to have a combination of images, text and planned narration. If it is managed effectively, it will be reducing extraneous load.

- **Spatial Contiguity**

  It is similar to the Signalling Principle. The Spatial Contiguity Principle encourages teachers to place labels right next to the thing what they are describing. This is another simple way to reduce student's Cognitive Load, because they won't be spending cognitive energy having to match up words to the related images.

- **Temporal Contiguity**

  The Temporal Contiguity Principle relates to Spatial Contiguity because it highlights the importance of labels, as well as how and when images and labels are presented. Temporal Contiguity encourages labels and images to be presented at the same time, so students link these two things together in their working memory.

1.2.0. RATIONALE OF THE STUDY

It has been observed that the subject matter presented to the learner is utterly monotonous and it hampers the brain activity which result in ineffective learning. Sometimes the cognitive ability of learners/teacher trainee get frazzle due to junk of information. A learner should know the mechanics of learning. As knowledge is the driver of intellectual performance and is stored in illustrated form in long term memory. So, for this there is a need to search the innovative methods for effective learning.

In higher education mostly traditional method is used for teaching. It is teacher dominated method of instruction. The teacher transmits the facts and assumes the students as passive receptors of knowledge. So, there is a crucial need of new prototype of teaching and learning to escalate the learner active participation, approach and cognitive development. There is shortage of quality teachers and books for teaching curriculum development and school which is an essential subject in teacher training program. It helps B.Ed. Students to develop understanding of important principles of curriculum construction and to understand issues, trends and researches in the area of curriculum in India.So, for this subject there is a strong need to develop instructional material.

In present education system, student teachers are presented with so many subject matters due to that their brain suffers from overload of information. This hampers the

learning process because the brain cannot process all the information being presented. In a classroom there are many different mental processes happening as critical thinking, logical thinking and problem solving simultaneously, often in an unpredictable way.

According to Cognitive Load Theory, short-term or working memory has a limited capacity and can only handle so much information effectively at one time. If a person's working memory is overloaded, that person may not be able to process anything well, thus leading to poor understanding, retention, and learning (Sweller, 1988, 1994, 1999, 2011; Chandler and Sweller, 1991, 1992, 1996; Mayer and Moreno, 2003; Nguyen and Clark, 2005; van Merrienboer and Sweller, 2005). As working memory plays an important role in our day-to-day complex cognitive task, such as school cognitive task, as ideas for project making, contemt searching for assignment. Working memory is the limited capacity of storage which maintain information for brief period of time. "Learning is hampered when working memory capacity is exceeded in a learning task" (de Jong, 2009).

According to Dylan William Cognitive Load Theory is important thing for teachers to know. If a teacher is presenting complex information, they need to be judicious. While presenting the content to the learner so that the overload of information cannot occur. So teachers should use Instructional materials which are essential and significant tools, strategies to avoid overloading so that students will be able to organise learning material in such a way it can be transferred to the long term memory to make the teaching-learning process effective. According to Sweller(2019) instructional design should focus on avoidance of overloading of learner's mental effort when designing instruction. The teacher trainee should know the actual functioning of brain in the process of learning, they would become more flexible, skillful and successful teachers and the students will be more successful learners.

Cognitive Load Theory provides a theoretical framework dealing with individual information processing and learning (Paas *et al*. 2003a; 2004; Paas and Van Merriënboer 1994a; Sweller 1988, 2010; Sweller *et al*. 2011, 1998; Van Merriënboer and Sweller 2005).

The humans obtain most of their information from other people led to the borrowing and reorganizing principle (Sweller 2003, 2004; Sweller *et al*. 2011; Sweller and Sweller 2006). This principle states that long-term memory is built primarily by observing and imitating other people, listening to what they say and reading what they write. In other words, humans obtain most of their information by borrowing that information from other

people's long-term memory. The informations can just as easily be obtained from other, sufficiently knowledgeable people engaged in the same task during collaborative learning.

Most research demonstrating the borrowing and reorganizing principle is based on individual learning environments using worked examples (e.g., Cooper and Sweller 1987; Paas 1992; Paas and Van Gog 2006; Paas and Van Merriënboer 1994b; Renkl 1997; Sweller 1988; Sweller and Cooper 1985; Tuovinen and Sweller 1999) and animated models (e.g., Wouters et al. 2008, 2009, 2010).

Majority of studies have been done in abroad, and very few researches have done in India.The researchers done in India are Veena and kumar (2019), Shilna (2017) and Sawant and Kesarkar (2016).Sweller(2019) concluded instructional material based on Cognitive Load theory can be made using principles of Educational technology.

Various researcher such as Veena & kumar (2019),Johari & Azman(2022),Abdullah&Najeem(2022),Kim&choi(2021),Mohhamed(2019),Chang,Warden, Liang,Lin(2018),Maryem Rastami Siava(2017)found Cognitive Load theory to be effective in context of achievement and traditional teaching. Takir.A,Aksu.M (2012) found Instructional design based on Cognitive Load theory was effective for algebra teaching in Mathematics.

Liu,Wang,Koszalka & Wan(2022),Johari and Azman (2022),Kim and Choi(2021),Mohammed(2019), Takir & Aksu(2012), Agostinho,Ford.S, Roodenrys.K(2011)reduce Cognitive Load of learner in context of Achievement.

Most of the studies were done in context of Performance and cognitive load.Roy(2022),Inaty,Atallah & Causapin(2019),Marie(2018),Jianyun(2017),Lai,chen and Lee(2018),Gillmor Liu(2011).Most of the studies were done in context of Motivation and cognitive load such as Liu,Wang,Koszalka &Wan(2022),Hadie.S,Sulong.H,Hassan.A,Ismail.Z, Talip.S,Rahim.A(2018) and Lai,chen and Lee(2018).

Most of the studies were done in context of satisfaction and cognitive load. Bradford.G (2010) found no correlation between cognitive load and satisfaction.

Pin.O and Zaidatun.T (2008) found Self-instructional module based on Cognitive Load to be effective in increasing the Achievement of teacher trainee.While Ong.C, Tasir.Z (2015) found no effect on information retention among teacher trainee when taught with self-instructional module based on Cognitive Load theory.

Sawant and Kesarkar (2016),found Scaffolding tool found to be effective in reducing Cognitive Load. Shilna(2017),Milenković, Segedinac, and Hrin (2014) found

Cognitive Load based instructional strategy enhances Achievement of students in Chemistry. Akkaraju.S (2016) found flipped learning reduce cognitive load and have higher retention. Goktas &Turan(2016)and Karaca,Ocak(2017) found Flipped learning reduces Cognitive Load and increase the achievement of learner.

Monica & Hsiung (2012) found Concept Mapping Strategy significantly reduce Cognitive Load. Hadie.S,Sulong.H,Hassan.A,Ismail.Z, Talip.S,Rahim.A(2018) found higher level of cognitive engagement when taught with Cognitive Load-based lecture Model. Kate.M Erland Burkes (2007) found no statistical difference on measures of Cognitive Load.

Chen.I,Chang.Chi (2009) found Negative correlation between anxiety and Cognitive Load with listening comprehension.

Very few researcher found Cognitive Load Theory not effective as compared to Traditional Method. Price (2010) found Cognitive Load theory was not effective as compared to Traditional Method in teaching Music.

Some studies were done on memory and cognitive load theory.Tariq.S, Noor.S(2012) and Mohakud(2008) found no significant difference in working memory and achievement in context of gender. Mohakud (2008)Working Memory capacity and classroom Achievement were significantly related to Intelligence. Varshney (2015) found Positive Correlation of Working Memory and Long-term memory. Osamah Aldalalah (2012) found cognitive loads in the visual and audio working memory were reduced to facilitate increased capacity for better learning. Omowumi (2018) found that multimedia instructional packages help in reducing the level of Cognitive Load imposed on students' memory and Marie (2018) found that the Cognitive load theory was effective in accounting classroom and there is increase in student performance and retention of foundational accounting principles.

Various researches have been done on Style of Learning and Thinking. Soniyaben (2019) and Sharma (2011) found linear correlation among learning style and academic achievement in Sanskrit among school students. Bala, Verma (2017) found that girls give more emphasis to right hemispheric dimension and boys give more emphasis to whole and left hemispheric dimension. Banerjee (2017) Sundaram (2000), found no significant difference between government and private secondary school student (class IX) on right brain hemisphere and whole brain hemisphere of Learning and Thinking style of secondary school. Banerjee (2017) found a significant difference between the left brain hemisphericity of Learning and Thinking Style of the secondary school students of government and private schools. Garg (2015) studied the Style of Learning and Thinking in

Relation to Creativity of High School Students studying in class IX and found that Whole Brain students were found to be significantly more Creative than those of Right Brain, and Left-Brain students. Anjum (2014) studied the hemispheric dominance and mathematics achievement of X standard students of Aurangabad city and found that students have right hemispheric and whole hemispheric dominant Style of Learning and Thinking. No significant difference was found in left hemispheric Learning and Thinking Style of urban and rural students. Vengopal, Mridula (2007) found significant difference in the right and left (brain) hemisphere for information processing among children and also found that boys were more right hemispheric oriented and girls were more left hemispheric oriented in information processing.while Kowal(2021) found that male job applicants showed whole hemisphere dominance while recommended female applicants showed right hemisphere dominance. Raina & Vats (1983) observed that females had higher scores in right hemisphere styles of thinking in comparison to males.

Youssef.S (2017) found statistically significant difference in cognitive load associated and algorithm problems in analytical chemistry between adaptive and divergent learning style but found no significant difference between cognitive load and convergent learning style.

Majority of these studies were conducted by taking sample from school and few of them from the College, few studies also done on teacher trainees. Most of the studies were of Experimental research. It is commonly observed that some demographic variables were taken by the researchers. From all the above studies, it is concluded that instructional material based on Cognitive Load theory is very effective tool for educational purpose because it increases Achievement, Retention and student Performance. It makes teaching learning more interesting while reducing Cognitive Load among learners. It is a warm up activity. It develops Memory, and effective Learning styles in the B.Ed. Students.

The Cognitive Load theory is a scientific approach to the design of learning materials, so that they prevent information Load at a pace, and at a level of complexity that the learner can fully understand. The Cognitive Theory helps us in reducing the load of working memory so that the students can learn more effectively. The concept of Cognitive Load Theory can be applied to teaching-learning process and training in several ways in teachers training course. This is a better approach as it breaks the problem down into parts. This reduces the problem space and lightens the Cognitive Load, making learning more effective.

The Cognitive Load Theory is directly and indirectly related to the objectives of New Education Policy 2020, in special reference of chapter 23, use of technology and chapter 24 online and digital education, to fix proper use of technology, in reference to preparation of teaching material, digital repository and expansion and platform of online teaching and tools. This theory also give platform for preparation of teaching material for online teaching.

According to National Education Policy (NEP) 2020, point number 4.6. states that the key to overall thrust of curriculum and pedagogy reform across all stages will be to move the education system towards real understanding and learning how to learn-and away from the culture of rote learning as is present today. The goal will be to create holistic and well-rounded individuals equipped with key 21st century skills. All aspects of curriculum and pedagogy will be reoriented and revamped to attain these critical goals.

But there are very few researchers conducted on instructional material on Cognitive Load Theory in India. Very few researches are conducted on Cognitive Load Theory with Achievement, Long-Term Memory and Style of Learning and Thinking. These variables are yet to be studied. So, fulfilling this gap researcher decided to take this important area. It points out to the need of conducting more researches related to this important area. So the researcher has select the present title for the research.

1.3.0 STATEMENT OF PROBLEM

The problem for the present research is worded as follows:

Effectiveness of developed Cognitive Load Theory based Instructional material on Curriculum Development in terms of Achievement, Memory, Style of Learning and thinking and Reaction for B.Ed. Students.

1.4.0 OPERATIONAL DEFINITIONS

1.Cognitive Load Theory

'Cognitive' means mental and 'Load' means burden, so this theory basically studies the mental load that the human brain faces when learning happens. Learners can remember information only if they can organize all that information into schemas. The Cognitive Load is the load imposed on working memory by information being presented.

2.Cognitive load theory based Instructional Material

The strategies used for presenting the content of Curriculum Development which de-escalate the Cognitive Load.

3. Achievement

Achievement is the performance score of the sample on Criterion Reference test (CRT) which are based on Curriculum Development subject.

4.Memory

According to Sternberg Memory is the means by which we draw on our past experiences in order to use this information in the present.

5.Style of Learning and Thinking

Style of learning and thinking depend upon cerebral dominance of an individual in retaining and processing different modes of information in his own style of learning and thinking. Style indicate the hemispericity functions of the brain and students learning strategy and information processing are based on the preference of the brain area.(Ventataraman,1990).

6.Reaction

Reaction is the responses of experimental group students towards the statement related to Cognitive load theory based instructional material.

1.5.0. VARIABLES OF THE STUDY

The researcher considered following independent and dependent variables for the study

INDEPENDENT VARIABLES

The present study tries to establish the effectiveness of instructional material based on Cognitive load theory in comparison to traditional (Lecture) method of teaching. Therefore, the independent variable is treatment having two levels namely-Experimental Group (Instructional Material) and Control Group (Lecture Method)

The other independent variables are as follows:

- Intelligence having two levels i.e., High and Low intelligence
- Gender having two levels i.e., Males and Females
- Discipline having three levels i.e., Science and technology, Arts and Humanities and Commerce.

DEPENDENT VARIABLES

In the present study following were the dependent variables: -

1. Achievement
2. Long-term Memory
3. Style of Learning and Thinking (SOLAT)

1.6.0. OBJECTIVES

The following will be the objectives for the present study.

1. To compare the mean Pre-Achievement and Post-Achievement scores of B.Ed. Students treated with Cognitive Load Theory based instructional material.
2. To compare the mean Pre Memory and Post Memory scores of B.Ed. Students treated with Cognitive Load Theory based instructional material.
3. (a)To compare the mean Pre-Left Style of Learning and Thinking and Post-Left Style of Learning and Thinking scores of B.Ed. Students treated with Cognitive Load Theory based instructional material.

   (b) To compare the mean Pre-Right Style of Learning and Thinking and Post-Right Style of Learning and Thinking scores of B.Ed. Students treated with Cognitive Load Theory based instructional material.

   (c) To compare the mean Pre-Right and Left Style of Learning and Thinking and Post-Right and Left Style of Learning and Thinking scores of B.Ed. Students treated with Cognitive Load Theory based instructional material.
4. To study the effect of Treatment, Gender and their interaction on Achievement in Curriculum Development by taking Pre-Achievement in Curriculum Development as covariate.
5. To study the effect of Treatment, Intelligence and their interaction on Achievement in Curriculum Development by taking Pre-Achievement in Curriculum Development as covariate.
6. To study the effect of Treatment, Discipline and their interaction on Achievement in Curriculum Development by taking Pre-Achievement in Curriculum Development as covariate.
7. To study the effect of Treatment, Gender and their interaction on Memory by taking Pre Memory as covariate.
8. To study the effect of Treatment, Intelligence and their interaction on Memory by taking Pre Memory as covariate.
9. To study the effect of Treatment, Discipline and their interaction on Memory by taking Pre Memory as covariate.

10. (a)To study the effect of Treatment, Gender and their interaction on Left hemisphere Style of Learning and Thinking by taking Pre-Left hemisphere Style of Learning and Thinking as covariate.

    (b)To study the effect of Treatment, Gender and their interaction on Right hemisphere Style of Learning and Thinking by taking Pre-Right hemisphere Style of Learning and Thinking as covariate.

    (c) To study the effect of Treatment, Gender and their interaction on Right and Left hemisphere Style of Learning and Thinking by taking Pre-Right and Left hemisphere Style of Learning and Thinking as covariate.

11. (a)To study the effect of Treatment, Intelligence and their interaction on Left hemisphere Style of Learning and Thinking by taking Pre-Left hemisphere Style of Learning and Thinking as covariate.

    (b)To study the effect of Treatment, Intelligence and their interaction on Right hemisphere Style of Learning and Thinking by taking Pre-Right hemisphere Style of Learning and Thinking as covariate.

    (c)To study the effect of Treatment, Intelligence and their interaction on Right and Left hemisphere Style of Learning and Thinking by taking Pre- Right and Left hemisphere Style of Learning and Thinking as covariate.

12. (a)To study the effect of Treatment, Discipline and their interaction on Left hemisphere Style of Learning and Thinking by taking Pre-Left hemisphere Style of Learning and Thinking as covariate.

    (b)To study the effect of Treatment, Discipline and their interaction on Right hemisphere Style of Learning and Thinking by taking Pre-Right hemisphere Style of Learning and Thinking as covariate.

    (c)To study the effect of Treatment, Discipline and their interaction on Right and Left hemisphere Style of Learning and Thinking by taking Pre-Right and Left Style of Learning and Thinking as covariate.

13. To study the Reaction of B.Ed. Students towards treatment with Cognitive Load Theory based instructional material on Curriculum Development.

1.7.0. HYPOTHESES

The following will be the hypotheses for the present study:

1. There is no significant difference in the mean scores of Pre-Achievement and Post-Achievement scores of B.Ed. Students treated with Cognitive Load Theory based instructional material.
2. There is no significant difference in the mean scores of Pre Memory and Post Memory scores of B.Ed. Students treated with Cognitive Load Theory based instructional material.
3. (a)There is no significant difference in the mean scores of Pre-Left Style of Learning and Thinking and Post Left Style of Learning and Thinking scores of B.Ed. Students treated with Cognitive Load Theory based instructional material.

   (b) There is no significant difference in the mean scores of Pre-Right Style of Learning and Thinking and Post Right Style of Learning and Thinking scores of B.Ed. Students treated with Cognitive Load Theory based instructional material.

   (c)There is no significant difference in the mean scores of Pre-Right and Left Style of Learning and Thinking and Post Right and Left Style of Learning and Thinking scores of B.Ed. Students treated with Cognitive Load Theory based instructional material.
4. There is no significant effect of Treatment, Gender and their interaction on Achievement in Curriculum Development by taking Pre-Achievement in Curriculum Development as covariate.
5. There is no significant effect of Treatment, Intelligence and their interaction on Achievement in Curriculum Development by taking Pre-Achievement in Curriculum Development as covariate.
6. There is no significant effect of Treatment, Discipline and their interaction on Achievement in Curriculum Development by taking Pre-Achievement in Curriculum Development as covariate.
7. There is no significant effect of Treatment, Gender and their interaction on Memory by taking Pre Memory as covariate.
8. There is no significant effect of Treatment, Intelligence and their interaction on Memory by taking Pre Memory as covariate.
9. There is no significant effect of Treatment, Discipline and their interaction on Memory by taking Pre Memory as covariate.

10. (a)There is no significant effect of Treatment, Gender and their interaction on Left hemisphere Style of Learning and Thinking by taking Pre- Left hemisphere Style of Learning and Thinking as covariate.

    (b) There is no significant effect of Treatment, Gender and their interaction on Right hemisphere Style of Learning and Thinking by taking Pre- Right hemisphere Style of Learning and Thinking as covariate.

    (c) There is no significant effect of Treatment, Gender and their interaction on Right and Left hemisphere Style of Learning and Thinking by taking Pre- Right and Left Style of Learning and Thinking as covariate.

11. (a)There is no significant effect of Treatment, Intelligence and their interaction on Left hemisphere Style of Learning and Thinking by taking Pre- Left hemisphere Style of Learning and Thinking as covariate.

    (b) There is no significant effect of Treatment, Intelligence and their interaction on Right hemisphere Style of Learning and Thinking by taking Pre-Right hemisphere Style of Learning and Thinking as covariate.

    (c) There is no significant effect of Treatment, Intelligence and their interaction on Right and Left hemisphere Style of Learning and Thinking by taking Pre- Right and Left Style of Learning and Thinking as covariate.

12. (a)There is no significant effect of Treatment, Discipline and their interaction on Left hemisphere Style of Learning and Thinking by taking Pre- Left hemisphere Style of Learning and Thinking as covariate.

    (b)There is no significant effect of Treatment, Discipline and their interaction on Right hemisphere Style of Learning and Thinking by taking Pre-Right Style of Learning and Thinking as covariate.

    (c)There is no significant effect of Treatment, Discipline and their interaction on Right and Left hemisphere Style of Learning and Thinking by taking Pre- Right and Left hemisphere Style of Learning and Thinking as covariate.

1.8.0. DELIMITATIONS OF THE STUDY

The delimitation of the study are as follows:

1.The study comprised of only B.Ed. Students of self-financed college of Indore City only.

2.Only B.Ed. I semester students were taken for experiment.

3.The study comprised of achievement, Memory and Style of Learning and Thinking as a dependent variable and Intelligence, Gender and Discipline as independent variable.

4.The study comprised of only 185 students.

5.Cognitive Load theory based instructional strategy was used for the study.

1.9.0.SAMPLE

Purposive Sampling technique was used to collect the data. For this purpose, two self - financed B.Ed. Colleges were selected purposively in which paper third, subject Curriculum Development and School (CC3) was included in their syllabus of first semester. Then the treatment with Cognitive Load theory based instructional Material was assigned randomly to ILVA Commerce and Science College. While Annie Besant College was treated with traditional method (Lecture Method).

The colleges were self-financed and were affiliated to Devi Ahilya Vishwavidyalaya, Indore. The sample comprised of 185 students studying in B.Ed. College in the above-mentioned colleges. The treatment wise and Gender wise distribution of sample is given in table 4.1.

Table 2.1. Treatment wise and gender wise distribution of sample

S.No.	Name of College	Treatment	Gender		Total
			Male	Female	
1.	ILVA College	Cognitive Load theory based Instructional Material	27	66	93
2.	Annie Besant College	Lecture Method	15	77	92

From table 2.1., There were 93 students in experimental group. Out of this 27 were males and 66 were females. On the other hand, there were 92 students in control group. Out of this 15 were males and 77 were females. The age of students ranged from 20-35 years. The students belong to different socio-economic status. The students can read, write and understand English and Hindi language properly. The medium of instruction was English and Hindi both.

1.10.0.EXPERIMENTAL DESIGN

The present study was experimental in nature. The Non-equivalent control group design was used. According to Campbell and Stanley (1963), the layout of the design is as follows: -

0 X 0

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0 0

Where

O: - Pre and Post Observations

X: - Treatment

---: - Non-Equivalent Group

There were two groups; one designated as experimental group and other as control group. Both the group were pre-tested by administering Achievement, Long term Memory, Style of Learning & thinking. After the administration of pre-test, the treatment was started. The experimental group was taught through Cognitive Load Theory based Instructional Material on Curriculum development whereas the control group studied through traditional method (lecture method) The independent variable namely Intelligence was assessed during the experimentation in both the groups. The treatment was continued for 45 working days, @45 mins per period. At the end of the treatment, both the groups were post tested with the same tools, which were used for pre-testing. The Reaction Scale to assess the reaction towards the Instructional Material was administered only to the experimental group after the treatment.

Table 2.2.

Schematic representation of the Experiment

Activity	Experimental Group	Control Group	Time
Pre-Testing of Dependent Variable	1. Administration of Achievement Test. 2. Administration of Long-Term Memory. 3. Administration Style of Learning and Thinking.		40 mins 30 mins 30 mins
Treatment	Treatment with Cognitive Load Theory Based Instructional Material on Curriculum Development	Traditional Method	45 working days @45 mins per period to Control Group and for same duration learning with Cognitive Load theory based Instructional Material, was done by Experimental Group Students.
Testing of Independent Variables (During Experiment)	Administration of Intelligence Test	Administration of Intelligence Test	40 mins
Post Testing of Dependent Variable	1. Administration of Achievement Test. 2. Administration of Long-Term Memory. 3. Administration Style of Learning and Thinking.		40 mins 30 mins 30 mins
Reaction Scale	Reaction Scale was Administered after the treatment	-------	25 mins

1.11.0.TOOLS

The variables assessed in the study were Achievement, Memory, Style of Learning and Thinking, Intelligence and Reaction towards Cognitive Load Theory based Instructional

Material on Curriculum Development. For assessing the Long-Term Memory, Style of Learning and Thinking and Intelligence, standardized tools were used. On the other hand, Achievement Test and Reaction towards Cognitive Load Theory based Instructional Material on Curriculum Development was assessed with the help of tools developed by the investigator. The details of tools are given in following captions.

1.11.1. ACHIEVEMENT

The Achievement of B.Ed. Students in the subject "Curriculum Development and School" (CC3) of B.Ed. first Semester was assessed with the help of Criterion Reference Test.The test consist of 50 questions developed by researcher on 4 units selected for treatment namely, Unit 1: Introduction to Curriculum, Unit-2: Curriculum Construction, Unit-3: Curriculum Design and Unit4: Evaluation. The Achievement of student was assessed with the help of objective type test. The multiple-choice questions were prepared and there were four alternatives and out of these four only one was correct. The test consisted of multiple-choice question and match the column. For one correct answer, one mark was given and no mark was given for wrong answer. There was no negative marking. The maximum marks for the test were 50 and 40 minutes were given for completing the test.The achievement test is given in Appendix I.

1.11.2. MEMORY

The memory of students was assessed by the tool developed by B.B. Asthana (1982).The stimulus material is sixteen paired associates as given in column 2 of the data sheet. Column three of the data sheet indicates the number of rehearsal. In column four a two-digit number is given from which the subject has to count backward in threes, e.g., if 97 is given, the subject will count 94,91,88 and so on for two minutes. The last blank column is provided to note down the responses. The researcher shows some pairs of words one by one after giving a ready signal. Just after showing the pairs, researcher will speak a number say 1,2,3 or 4. The task of the subject is to speak the pairs presented loudly either once, twice, thrice or four times, depending on the number spoken by researcher. Immediately after this researcher will again speak number to them. Students have to note down on the page supplied to them and start writing backward number, starting from the number given to them with a difference of three e.g. If students are given 97, then they have to write down 97,94,91 and so on. The students have to continue this task till they are asked to stop. As soon as the researcher speak "Stop" they have to speak out the pair originally presented to them. The same procedure will be repeated 16 times.The memory tool is given in Appendix II.

1.11.3. STYLE OF LEARNING AND THINKING (SOLAT)

Style of Learning and Thinking of students was assessed by the tool developed by Venkataraman 2011.It consists of 50 questions with first (a) and Second (b) items. The first items indicate right hemisphere; second item indicates left hemisphere and checking of both the items indicates integrated hemisphere (or) whole brained. The reliability coefficient of correlation for the right hemisphere function was 0.89. For the left hemisphere function the coefficient of correlation was 0.65. There are two dimensions of the tool i.e., Learning Styles and Thinking Style. The Learning Style have 5 aspects i.e., Verbal, Content Preference, Class Preference, Learning Preference and Interest. The Thinking Style have 5 aspects i.e., Logical thinking, Divergent/Convergent Thinking, Creative and Problem Solving. The dimensions of Learning and Thinking style with description is given in table below.The Style of Learning and Thinking tool is given in Appendix III.

I DIMENSIONS OF LEARNING STYLES

S.No.	Learning Styles	Description	Items
1.	Verbal	Relating to or in form of words	1 to 5 items
2.	Content Preference	Preference of that has to be expressed	6 to 10 items
3.	Class Preference	Preference of branch of learning	11 to 15 items
4.	Learning Preference	Preference of way of learning	16 to 20 items
5.	Interest	The feeling of a person whose attention, curiosity is particularly engaged by something.	21 to 25 items

II DIMENSIONS OF THINKING STYLES

S.No.	Thinking Styles	Description	Items
1.	Logical Thinking	It is highest type of thinking.	26 to 30 items
2.	Divergent Thinking/Convergent Thinking	It is a thought process or method used to generate creative ideas by exploring many possible solutions.	31 to 35 items
3.	Creative Thinking	A way of looking to unique, original solutions.	36 to 40 items
4.	Problem Solving	It is the process of finding solutions to difficult problems.	41 to 45 items
5.	Imagination	It is the power of forming mental pictures.	46 to 50 items

1.11.4. INTELLIGENCE TEST

The Intelligence of students was assessed with the test developed by Dr. S.K. Pal and Dr.K.S. Mishra. There were 6 tests. Each test consists of 10 questions. The time duration is 4 mins to solve each test. Test I is related with ability of telling the meaning of words. It contains 1 to 10 items. The test II is related with analytical thinking. It contains 11 to 20 items. The test III is related with classification ability. It contains 21 to 30items.The test IV is related with Numerical ability. It contains 21 to 30 items. The test V is related with ability of code and transformation. It contains 41 to 50 items. The test VI is related with propositions with 2 statements and one inference is given. It contains 51 to 60 items. The test is made for college students, **and its age range from 18-35 years.** The reliability of the Intelligence is measured by test-retest method is 0.81.and by split half method is 0.95. The criterion related validity of the test is 0.68. The Intelligence test is given in Appendix IV.

1.11.5. REACTION SCALE

The researcher developed reaction scale towards Cognitive Load Theory based instructional material on Curriculum Development. It was used for assessing the reaction towards Cognitive Load Theory based instructional material on Curriculum Development of students of the Experimental group only. The scale comprised of twenty-five statements related to different aspects of instructional material on Curriculum Development such as helpful for understanding, helps in effective memorisation, easy to recall. Against each statement a five-point rating scale was given. The 5 points were 'Strongly Agree', 'Agree', 'Undecided', 'Disagree' and 'Strongly Disagree'. The students were instructed to read each statement carefully and choose one appropriate out of the given five alternatives. Both positive as well as negative statements were included in the reaction scale. The students were given 25 minutes to make their responses. The weightage for positive statements were 5,4,3,2,1 and for negative statements were 1,2,3,4,5. The reaction scale towards the Cognitive Load Theory based instructional material on Curriculum Development is given under Appendix-V.

1.11.6. PROCEDURE OF DATA COLLECTION

The present study was experimental in nature. The two self-financed B.Ed. Colleges were selected purposively. The process of data collection began by seeking the permission from the Principals of the selected Colleges. There were two groups which were selected randomly, one was designated as Experimental and the other as control group. ILVA College was selected to conduct experiment with Cognitve Load based Instructional material and Annie Besant College was assigned as Control Group.The students of the experimental group

were oriented about the objectives of the experiment with a purpose to establish rapport with them. After that the data was collected from both the groups for pre-test in respect of Achievement, Long term Memory, Style of Learning and Thinking from both the groups.The data in respect of above-mentioned variables i.e. Memory and Style of Learning and Thinking, was collected with the help of standardized tool. The data in respect of Achievement was collected with the help of researcher made test.The instructions mentioned in respective manuals were followed to get the reliable data. Further, the care was taken not to administer more than one test on a day.

After pre-testing Experimental Group was treated through Cognitive Load theory based Instructional Material on Curriculum Development for 40 working days @45 mins per period/day.The PowerPoint presentations of each topic was given to the students. Along with this, Experimenter responded to students question or problem faced by them during the treatment. During the experiment both the groups were assessed with Intelligence test. On the other hand, control group was continued with traditional method.

After the treatment, the tools administered before experiment were administered again for the post-test to both the groups. The reaction scale was administered only to experimental group. The scoring of variables was done as per the instructions given in the respective manual.

1.12.0.STATISTICAL TECHNIQUES

Objectives wise statistical techniques used for data analysis were as follows: -

1. For comparing the mean Pre- and Post-Achievement scores of B.Ed. students treated with Cognitive Load Theory based instructional material, the data was analysed with help of correlated‘t’ test.

2.For comparing the mean Pre and Post-Long Term Memory scores of B.Ed. students treated with Cognitive Load Theory based instructional material, the data was analysed with help of Wilcoxon signed rank test.(The assumptions of correlated‘t’ test were not fulfilled so the researcher proceeded towards non-parametric Wilcoxon Signed rank test)

3.For comparing the mean Pre-Left, Pre-Right and Pre-Right and Left Hemisphere and Post Left hemisphere, post right and Post Right and Left Hemisphere Style of Learning and Thinking scores of B.Ed. students treated with Cognitive Load Theory based instructional material, the data was analysed with help of Wilcoxon signed rank test.(The assumptions of correlated‘t’ test were not fulfilled so the researcher proceeded towards non-parametric Wilcoxon Signed rank test)

4. For studying the effect of Treatment, Gender and their interaction on Achievement in Curriculum Development by taking Pre-Achievement in Curriculum Development as covariate, the data was analysed with the help of TWO WAY ANCOVA. (The assumptions of ANCOVA were not fulfilled so the researcher proceeded towards Quade's Rank ANCOVA i.e. non parametric statistics was used).

5. For studying the effect of Treatment, Intelligence and their interaction on Achievement in Curriculum Development by taking Pre-Achievement in Curriculum Development as covariate, the data was analysed with the help of TWO WAY ANCOVA. (The assumptions of ANCOVA were not fulfilled so the researcher proceeded towards Quade's Rank ANCOVA i.e. non parametric statistics was used).

6. For studying the effect of Treatment, Discipline and their interaction on Achievement in Curriculum Development by taking Pre-Achievement in Curriculum Development as covariate, the data was analysed with the help of TWO WAY ANCOVA. (The assumptions of ANCOVA were not fulfilled so the researcher proceeded towards Quade's Rank ANCOVA i.e. non parametric statistics was used).

7. For studying the effect of Treatment, Gender and their interaction on Memory by taking Pre-Memory as covariate, the data was analysed with the help of TWO WAY ANCOVA. (The assumptions of ANCOVA were not fulfilled so the researcher proceeded towards Quade's Rank ANCOVA i.e. non parametric statistics was used).

8. For studying the effect of Treatment, Intelligence and their interaction on Memory by taking Pre-Memory as covariate, the data was analysed with the help of TWO WAY ANCOVA. (The assumptions of ANCOVA were not fulfilled so the researcher proceeded towards Quade's Rank ANCOVA i.e. non parametric statistics was used).

9. For studying the effect of Treatment, Discipline and their interaction on Memory by taking Pre-Memory as covariate, the data was analysed with the help of TWO WAY ANCOVA. (The assumptions of ANCOVA were not fulfilled so the researcher proceeded towards Quade's Rank ANCOVA i.e. non parametric statistics was used).

10. For studying the effect of Treatment, Gender and their interaction on Left hemisphere, Right Hemisphere, Right and Left hemisphere Style of Learning and Thinking by taking Pre Left hemisphere, Pre-right hemisphere and Pre right and Left Hemisphere- Style of Learning and Thinking as covariate, the data was analysed with the help of TWO WAY ANCOVA.(The assumptions of ANCOVA were not fulfilled so the researcher proceeded towards Quade's Rank ANCOVA i.e. non parametric statistics was used).

11.For studying the effect of Treatment, Intelligence and their interaction on Left hemisphere, Right Hemisphere, Right and Left hemisphere Style of Learning and Thinking by taking Pre-Left hemisphere, Pre-Right hemisphere and Pre-Right and Left Hemisphere Style of Learning and Thinking by taking Pre-Left hemisphere, Pre-Right hemisphere and Pre-Right and Left Hemisphere Style of Learning and Thinking as covariate, the data was analysed with the help of TWO WAY ANCOVA.(The assumptions of ANCOVA were not fulfilled so the researcher proceeded towards Quade's Rank ANCOVA i.e. non parametric statistics was used).

12. For studying the effect of Treatment, Discipline and their interaction on Left hemisphere, Right Hemisphere, Right and Left hemisphere Style of Learning and Thinking by taking Pre-Left hemisphere, Pre-Right hemisphere and Pre-Right and Left Hemisphere Style of Learning and Thinking by taking Pre-Left hemisphere, Pre-Right hemisphere and Pre-Right and Left Hemisphere Style of Learning and Thinking as covariate, the data was analysed with the help of TWO WAY ANCOVA.(The assumptions of ANCOVA were not fulfilled so the researcher proceeded towards Quade's Rank ANCOVA i.e. non parametric statistics was used).

13. For studying the Reaction of B.Ed. Students towards treatment with Cognitive Load Theory based instructional material on Curriculum Development Percentage was used. (Mean, SD, CV and percentile were used to assess the reaction scale)

1.13.0.FINDINGS

1. The treatment with Cognitive Load Theory based instructional material was found to be effective in enhancing the achievement of students.

2. The treatment with Cognitive Load Theory based instructional material was found to be effective in enhancing the memory of students.

3(a),(b)and (c).The treatment with Cognitive Load Theory based instructional material was found to be effective in enhancing left hemisphere Style of Learning and Thinking, Right hemisphere Style of Learning and Thinking and consolidated(Right & Left)hemisphere Style of Learning and Thinking of students.

4.1.The treatment with Cognitive Load theory based instructional material on Curriculum Development subject is found to be effective on Achievement than traditional teaching when Pre-Achievement was taken as covariate.

4.2. The Achievement of females is higher than male students when Pre-Achievement is taken as covariate.

4.3.There is a significant effect of Interaction between Treatment and Gender on Achievement when Pre-Achievement is taken as covariate.

5.2.High intelligence students have high achievement, as compared to low intelligence students, when Pre-Achievement is taken as covariate.

5.3.There is no significant interaction effect of treatment and intelligence on achievement of B.Ed. students when Pre-Achievement is taken as covariate.

6.2. There is no significant effect of discipline on Achievement of Curriculum Development subject on B.Ed. students.

6.3. There is no significant interaction effect of treatment and discipline on Achievement when Pre-Achievement is taken as covariate.

7.1.The treatment with Cognitive Load theory based instructional material on Curriculum Development subject is found to be effective for memory than traditional teaching when Pre-Memory was taken as covariate.

7.2. There is no significant effect of Gender on Memory of B.Ed. students when pre-Memory is taken as covariate.

7.3. There is no significant interaction effect of treatment and Gender on Memory when Pre-Memory is taken as covariate.

8.2.There is no significant effect of Intelligence on Memory of B.Ed. students when Pre-Memory is taken as covariate.

8.3.There is no significant interaction effect of treatment and Intelligence on Memory B.Ed. students when Pre-Memory is taken as covariate.

9.2. There is no significant effect of Discipline on Memory of B.Ed. students when Pre-Memory is taken as covariate.

9.3. There is no significant interaction effect of treatment and Discipline on Memory when Pre-Memory is taken as covariate.

10(a) The treatment with Cognitive Load theory based instructional material on Curriculum Development subject is found to be effective than traditional teaching in terms of Left hemisphere Style of Learning and Thinking of B.Ed. students. But the treatment with Cognitive Load theory based instructional material on Curriculum Development subject is not found to be significant in terms of Right hemisphere Solat and consolidated hemisphere Syle of Learning and Thinking when Right hemisphere Solat and consolidated hemisphere Style of Learning and Thinking is taken as covariate separately.

10(b) There is no significant effect of Gender on Left hemisphere Solat, Right hemisphere Solat and consolidated hemisphere Style of Learning and Thinking of B.Ed. students.

10(c) There is no significant effect of interaction between treatment and Gender on Left hemisphere, Right hemisphere and consolidated hemisphere style of learning and thinking of B.Ed. students.

11(b)There is no significant effect of Intelligence on Left hemisphere Solat, Right hemisphere Solat and consolidated hemisphere Style of Learning and Thinking of B.Ed. students.

11(c) There is no significant effect of interaction between treatment and Intelligence on Left hemisphere Solat, Right hemisphere Solat and consolidated hemisphere Style of Learning and Thinking of B.Ed. students.

12(b) There is no significant effect of Discipline on Left hemisphere Solat, Right hemisphere Solat and consolidated hemisphere Style of Learning and Thinking of B.Ed. students.

12(c) There is no significant effect of interaction between treatment and Discipline on Left hemisphere Solat, Right hemisphere Solat and consolidated hemisphere Style of Learning and Thinking of B.Ed. students.

13. Cognitive Load theory based Instructional Material was found to be effective in terms of reaction of students of Experimental Group.

1.14.0. EDUCATIONAL IMPLICATIONS

The findings of this study have implications for students, teachers, teacher educators, curriculum developers, text book writers and instructional designer.

The implications are as follows-

- **Implications for Students**

Cognitive load theory based instructional material is very beneficial for students. As per the finding of the present study Cognitive load theory based instructional material was found to be effective for enhancing Achievement, Memory and Left and consolidated hemisphere Style of Learning and thinking of students.

The students can use Cognitive Load theory based instructional material for enhancement of their achievement. They can use mind map maps for making their notes, the strategy used in CLT based instructional material for enhancing their achievement. The finding of the present study also states there is no significant effect of discipline on Achievement in Curriculum Development subject on B.Ed. students, therefore students can

use Cognitive Load theory based instructional material without bothering about their discipline.

They can use mnemonics as a strategy used in Cognitive Load theory based instructional material for enhancing their memory. The learner can revise the concepts while using mnemonics. The finding of the present study also states that there is no significant effect of Intelligence on Memory of B.Ed. students, therefore students can use Cognitive Load theory based instructional material without bothering about their Intelligence. They can use concept map and sentence technique for understanding the complex concept in an easy way. The left-brain dominant students can also use Cognitive Load theory based instructional material without bothering about their Gender and discipline as the finding states that there is no significant effect of Gender and Discipline on Left hemisphere Solat, right hemisphere Solat and consolidated hemisphere Style of Learning and Thinking of B.Ed. students.

- **Implications for teachers**

The findings of the present study have implications for the teachers. The finding of the study reveals that Cognitive load theory based instructional material on Curriculum Development was found to be effective as compared to traditional method of teaching in enhancing the Achievement, Memory and Style of Learning and Thinking of students. Teachers can develop effective instructional material according to the need and brain hemisphericity of their learners and deliver through any kind of platform like power-point presentation, online material etc. according to their availability.

They can use Cognitive Load theory based instructional material to make their teaching and learning more effective and efficient. The research findings have proved the effectiveness of Cognitive Load theory based instructional material in teaching-learning process. The teachers can use Cognitive Load theory based instructional material as new method for teaching which would help them in deescalating the cognitive load of students. They should teach the complex concepts in chunks which will reduce Cognitive Load.

They should not bother about the discipline, Cognitive Load theory based instructional material can be used for all discipline i.e. Science and technology, commerce, arts and humanities, as the finding states there is no significant effect of discipline on memory of students. It also helpful for teachers to develop the strategies suitable for students according to their brain hemisphericity.

- **For Teacher Educators**

The findings of the study suggest that Cognitive Load theory based instructional material was found to be effective for enhancing achievement, Memory and left hemisphere Style of Learning and thinking of students, thus there is a need of effective training to teacher educators, so that they can create their own content by using innovative strategies. Teacher Educators can use Cognitive Load theory based instructional material as an effective tool in teaching learning process.

The finding of the study states that discipline has no interactional effect with the treatment, thus proper training must be provided to the teacher educators for developing and managing content on Cognitive Load theory based instructional material in any discipline using various interface such as Powerpoint etc. Thus, teacher educators will train the future teacher in pedagogy and methodology of developing Cognitive Load theory based instructional material as an innovation in educational field.

- **Implication for Curriculum Developers**

The Curriculum Developers should include Cognitive load theory based instructional Material in curriculum. Along with books and other study material curriculum developers may develop cognitive load based instructional Material and may keep it in curriculum. As it was found effective in enhancing achievement and memory of student. Hence when it will be kept in curriculum; student's achievement will be definitely improved.

- **Implication for textbook writers**

The textbook writer should use strategies given in cognitive load based instructional material for writing the textbooks. They should create smooth transitions, use worked examples, charts for ensuring the easy recall. Which further deescalate the cognitive load of students. They can write their textbook without bothering about intelligence of students. They can develop mind map at the end of lesson.

- **Implication for Instructional Designers**

For instructional designers on basis of findings, the developed Cognitive Load theory based instructional material was found to be effective in terms of Achievement, Memory and enhancing Left hemisphere style and consolidated (right and left) style of learning and thinking and reaction of B.Ed. students, so it can be used by the instructional designers for making cognitive load theory based instructional material in any subject. As discipline and intelligence has no significant effect on achievement of B.Ed. students hence it will easy to

make Cognitive Load Theory based instructional material without bothering about discipline and intelligence level of students.

The instructional designer can make the self-learning material, program learning material using principles of cognitive load theory in any discipline. They can use the cognitive load theory based instructional material for distance learning also.

1.15.0. SUGGESTION FOR FURTHER RESEARCHES

The following suggestions of further researches are as follows.

1. The present study was related to the course Curriculum Development and School subject of B.Ed. first semester of self-financed colleges, affiliated to D.A.V.V., Indore. It may be extended to other courses like D.Ed. and M.Ed.
2. Cognitive Load theory based instructional material can be made for other subject like Learning and Teaching etc.
3. The study is restricted to colleges of Indore city only; it can be extended to different cities.
4. This type of research may be done by taking a large sample.
5. Effectiveness of Cognitive Load theory based Instructional Material can be studied on sample of secondary school of CBSE and M.P. Board.
6. In the present study Pre-Achievement-Memory and Pre-Right, Left, consolidated (right &left) hemisphere were equated as covariate. Some other covariate may also be studied.
7. Effectiveness of Cognitive Load theory based Instructional Material can be studied with use of different variables such as Study Habits, Attention, Logical thinking, Creativity, Motivation etc.

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