FACTOR ANALYTIC STUDY OF COGNITIVE PROCESSING AND SELF PERCEPTION OF LEARNING DISABILITIES AMONG THE ELEMENTARY INCLUSIVE SCHOOL CHILDREN

By

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ABSTRACT

The present investigation was an attempt to explore the underlying construct of cognitive processing and self-perception of learning disabilities in elementary inclusive school children. A cognitive assessment test battery and self-perception of disabilities inventory was developed by the investigator and administered to 100 elementarysixth and seventh graders of Kerala, India. Varimax rotated exploratory factor analysis yielded four factors in cognitive processing and self-perception. It was concluded that these four dimensions could explain the empirical evidence to support the multidimensionality of cognitive processing as suggested by Das and his Colleagues (1994b) in PASS theory of cognitive processing. Further there emerged four factors in self-perception of learning disabilities among the elementary inclusive school children, which resembled the factors in cognitive processing.

Keywords: Cognitive Processing, Self Perception, Learning Disability.

INTRODUCTION

The theories of intelligence propagated by psychologists from time to time have tried to uncover the components or elements of intelligence. These theories can be grouped under two categories, namely, factor theories and cognitive theories. The factor theories included Charles Spearman's two factor theory, Thurston's group factor theory and Guilford's Structure-of-Intellect model (SI model). The cognitive theories of intelligence tried to analyse and describe intelligence in terms of certain fundamental cognitive processes. Cognitive theories includes Cattell and Horn's theory of intelligence, Arthur Jensen's theory of mental functioning, Joe Campion and Ann Brown' theory, Sternberg's Information Processing theory of Intelligence and PASS theory of cognitive processing.

The PASS model of processing, first proposed in1975 by Das, Kirby and Jarman challenges g-theory on the grounds that neuropsychological research has consistently demonstrated that brain is made up of separate interdependent functional units. Supported by decades of neuroimaging research and based on Luria's (1966) work, PASS theory divided intelligence into four interrelated cognitive processes- Planning, Attention, Simultaneous and successive processing. Naglieri (1997) stated that "planning processes provide the individual with the means to determine and use efficient solutions to problems using attention, simultaneous and successive processes and the individual's base of knowledge". Naglieri and Das (1997) defined attention as "a mental process by which the individual selectively focuses on particular stimuli while inhibiting responses to competing stimuli presented over time".

In PASS theory coding is operationalized through two processes namely simultaneous processing and successive processing. Simultaneous processing requires a person to see how different stimuli interrelate to form the perception of a whole of a construct. Successive processing on the other hand, requires that stimuli are organised in a serial temporal order where one stimulus

relates only to the stimulus that precedes it and they are not interrelated. For the present study the investigator is interested to know whether the Cognitive assessment test battery developed (self) based on PASS model of cognitive processes has certain dimensions underlying it and if so what are they. How are these artificial dimensions related to each other? Does self-perception of learning disabilities among the elementary school children has any construct underlying it.

Objectives

- To identify the dimensions of cognitive processing and self-perception of learning disabilities.

Method

Descriptive research design was employed in the present study which used survey method to collect the data. The survey method was useful to get first-hand information related to the study. The population of the present study were sixth and seventh graders of elementary inclusive school children of Kasaragod district, Kerala. The stratified random sampling method was adopted by the investigator to select the ten upper primary schools in Kasaragod district which included the government, aided and unaided and the subjects were selected then randomly. The study was mainly concentrated in northern Kerala, various Upper primary schools of Kasaragod district. Ten schools were selected by stratified sampling technique by the investigator for the present study. The subjects (n=100) were selected by random sampling technique. For collecting the data on cognitive processing a cognitive assessment test battery (CATB) constructed and standardised by the investigator. The CATB consisted of 12 subtests, they are Matching numbers, Planned codes, Planned connections, Number detection, Expressive attention, Receptive attention, Nonverbal matrices, Figure Memory, Spatial Relations, Word series, Sentence Repetition and Sentence Questions. The CATB was administered individually and time taken for each was noted down, and the responses were collected, coded classified and analysed using exploratory Factor analysis and varimax rotation.

Results and Discussions

Factor Analysis (FA) was used to discover the patterns of variations or relationships between the variables. This was achieved by generation of artificial dimensions (factors) and the variables in them correlate highly with several other variables. Here the FA was employed to condense, simplify and describe the large number of variables and also to see the relation between them. To find the artificial dimensions of cognitive processing the data matrix of 23 $\times$ 100 was considered for factor solution. In order to arrive at the new independent factors, the 23 $\times$ 23 correlation matrix of variables related to cognitive processing was considered and reduced to 23$\times$ 4 factor solution, which explained 68.872 % of variance of the original variables.

It was further rotated using normal varimax rotation procedure and the four factor emerged was considered for interpretation and description. The rotated factor matrix (23$\times$4) explained the simplified factor structure with factor loading for each variable. Here the signs of the loadings imply the direction of association. The size of each loading value indicates the degree of association of each variable with the appropriate new independent dimension. The four new independent factors which emerged explained 68.872% of the total variance. The share of the primary factor was found to be higher than that of the otherfactors. For the present study only factor loadings with a value of $\pm$0.40 or greater were considered for description and interpretation.

Hypothesis 1

There will be patterns of clustering of relationships in cognitive processing among the of elementary inclusive school children.

Factor 1 – Cognitive Processing

The first factor which is considered as the primary factor is the most important component among the four factors. The first factor is a general factor with highest percentage of variance accounting to 23.798%. The variables highly loaded in this factor are tabulated with their respective loadings in descending order. A total of 11 variables were loaded under this factor. This primary factor has high loading on most of the variables related to general

construct of cognitive processing i.e., planning, attention, simultaneous and successive processing.. Hence it is named as 'cognitive processing". In this general factor the variables related to Planning as shown in table No1.were Matching Numbers, Planned connections and Planned Codes etc., and those related to attention were Receptive attention, Number detection etc., and those related to successive processing were sentence questions. Simultaneous processing included items like - Nonverbal Matrices and figure memory (Table 1).

The positive loadings signifies that all the variables are positively associated with each other which implies the four dimensions namely planning, attention, successive and simultaneous processing are positively related. From the above table we can infer that the general construct of cognitive processing has four dimensions namely- Planning, Attention, Simultaneous and Successive processing. So the present study goes along with the theoretical description of cognitive processing by Das and his colleagues (1994b) which involves the four tasks namely planning the task, paying attention to it and simultaneously and successively processes the information to give the output.

Factor 2- Simultanoeus and Successive Processing

The variables related to successive and simultaneous processing shows highly significant positive loadings in the second factor. The positive loading is the result of the positive correlation of some of the variables with the rest of the variates. This second factor accounts for the second highest proportion of variance i.e. 20.588%. The variables with factor loadings in descending order are described

Total variables loaded highly in this factor were 6. The first four variables are listed in Table 2 i.e., Word series Part A, Word series B, Word series C and Sentence Repetition clearly indicates that it is related to successive processing and the last variable spatial relations with simultaneous processing. The predominance of above variables obviously becomes the basis for naming this component as 'successive and simultaneous processing'. The variable 'Expressive Attention' is also seen to be loaded here which indicates that attention is related to successive and simultaneous processing. From Table 2 we can conclude that Successive and simultaneous processing variables are positively associated with each other. It is seen from the table that successive and simultaneous processing goes together as predicted in PASS theory and further these two should act together in an individual so as to bring out the result.

Factor 3- Planning

The third factor accounts for a total variance of 14.082%. There were significant positive loadings in this factor also. Variables and its significant loadings are listed in descending order in the Table 3. Five variables were highly loaded in this factor. From the table it is evident that all the variables i.e., Matching Numbers Part A, B, C, D and Planned Codes are related to planning component of cognitive processing. Hence it is named as 'planning'. The positive loadings of the variables indicate that the variables present a positive relationship in Factor 3. Matching Numbers Part D is highly loaded in Factor 1 (0.638) and Planned codes part A is loaded highly in Factor 4 (0.619), but it is considered here that it also supports the other variables of 'planning' component of cognitive processing.

Variable	Significant Loadings
Receptive Attention Part B	0.799
Matching Numbers Part E	0.759
Number Detection Part C	0.684
Planned Connections Part B	0.666
Matching Numbers Part D	0.638
Receptive Attention Part A	0.618
Sentence Questions	0.590
Planned Connections Part A	0.586
Planned Code Parts B	0.563
Nonverbal Matrices	0.553
Figure Memory	0.471

Table 1. Variables and Significant Loadings in Factor1

Variables	Significant Loadings
Word Series Part B	0.854
Word Series Part C	0.845
Sentence Repetition	0.824
Word Series Part A	0.810
Expressive A Ttention	0.580
Spatial Relations	0.534

Table 2.Variables with Significant Loadings of Factor 2

It can be summarized from Table 3 that all the planning variables are loaded in a single factor and also they are positively associated with each other. From this we can say that children who performed well in matching number task have equally performed in planned codes task. And planning is central to every activity. A child has to plan his activity prior to the performance of the task and need attention, which help him to simultaneously and successively process the information.

Factor 4 - Attention

This factor which individually explains 10.404% of variance contains the following variables with high positive loading.

The number of variable loaded in this factor was four. Based on the loading pattern, this factor is called as 'Attention'. The first two variables i.e. Number Detection Part A&B and the last Receptive Attention listed in the table relates to attention aspect of the cognitive processing. And hence it was named as 'Attention'. The positive loadings of the variables indicate that they have positive relationship with each other. Receptive Attention part A is highly loaded in Factor 1 (0.618) and it is considered here in Factor 4 to support the other variables related to attention factor. It is evident from Table 4 that the variable planned code is loaded here which indicates that Planning is necessary condition for attention. It can be inferred from the table that the variables related to attention are positively related and for a child to be attentive he needs to have a plan in mind. Attention is very much necessary for a child to perform an activity and prior to it he has to have a plan in mind and so as to process the information to put forth the result.

Variable	Significant Loadings
Matching Numbers Part A	0.872
Matching Numbers Part B	0.861
Matching Numbers Part C	0.761
Matching Numbers Part D	0.527
Planned Codes Part A	0.455

Table 3. Variables and Factor Loadings for Factor 3

Variable	Significant Loadings
Number Detection Part A	0.828
Number Detection Part B	0.705
Planned Codes Part A	0.619
Receptive Attention Part A	0.410

Table 4. Variables and Factor Loadings for Factor 4

Hypothesis 2

There will be patterns of clustering of relationships among the self-perception of learning disabilities among the elementary school children.

For establishing the artificial dimensions of self-perception of learning disabilities after item extraction was prone to exploratory factor analysis and varimax rotation. The rotated factor matrix explained the simplified factor structure with factor loading. The total percentage of variance accounted was 54.7%. The share of the primary factor was found to be higher than that of the other factors.

Factor 1 - Skill of Cognition

The first factor is a general factor with highest percentage of variance accounting to 15.07%. The significant loadings with the items are arranged in Table 5, indescending order. A total of 9 variables (items) were loaded in this factor. This primary factor has highest loadings on Reading, writing, arithmetic, organisation, memory etc. so it is named as "perception of skill of cognition." Further the loadings were all positive which implies that there is positive association between the variables. This factor resembles the first factor in the artificial dimensions of Cognitive processing (Hypothesis 1) i.e., 'Cognitive processing'. Skill of Cognition involves perception and judgement on the part of the child. For the perception to be done he needs attention and planning skill and for the judgement the simultaneous and successive processing. Thus skill of cognition goes along with cognitive processing in an individual. It can be inferred from Table 5 that all the variables related to

Items	Significant Loadings
While Reading I have Difficulty In Understanding Important Things	0.735
While Speaking With Friends I find It Difficult to Speak about a particular thing	0.664
I have difficulty In solving Maths Word Problems	0.638
I don't get the right word to speak while speaking with friends	0.590
I have trouble in following directions that have more than one or two steps	0.553
I tend to be clumsy and unorganised	0.536
While writing copy book, Iam not able to write within the four lines	0.508
I have a poor memory	0.487
I find it difficult to Plan my time	0.480

Table 5. Items and Significant Loadings for Factor 1

reading, writing, arithmetic, memory and organisation are positively associated with each other. And for all these aspects cognitive skills are necessary.

Factor 2- Skill of Processing

Six items were significantly loaded under factor 2, which accounted for a variance of 14.27%. The items with their loadings are displayed in Table 6.

From Table 6 it is evident that the items are significant positive loadings and they are closely associated with each other. These items i.e., 'I am a poor speller', 'While writing I don't get ideas to put in', 'I am a poor reader', 'I am poor at basic mathematics', 'I make mistakes while reading', 'I can tell a story but cannot write it', reflect the processing skills in children. And hence it is named as "perception of skill of processing". Visual processing skills should be helpful when solving geometry problems that must be solved by looking at the problem as a whole, sequential visual processing skill should be instrumental in reading and writing and also when solving word problems and organizing calculations that must be solved in a sequential fashion. This factor resembles the Factor 2- i.e. 'Simultaneous and successive processing' in the artificial dimensions of cognitive processing of elementary school children. Visual sequential as well as simultaneous processing skills are necessary in mastering reading, writing, arithmetic etc. If these skills are impaired children cannot write or read properly. To summarize items in the second factor 'the skill of processing' are positively associated with each other. This factor resembles the second factor in the cognitive processing of elementary school children. Processing skills are very much essential in mastering the three r's.

Factor 3- Skill of Expression

Under factor 3 nine items got significantly loaded. The items were arranged in descending order of their loading values. This factor accounted for a total variance of 12.98 %. The items in the table below show positive loadings and so they are positively associated with each other.

Item	Significant Loading
I am a poor speller	0.787
While writing I don't get ideas to put in	0.737
I am a poor reader	0.654
I am poor at basic mathematics	0.649
I make mistakes while reading	0.606
I can tell a story but cannot write it	0.558

Table 6. Items with Significant Loadings Factor 2

The items in Table 7 reflect the expressive skills in children namely oral and written. And so it is named as "perception of skill of expression". Expressive skills are required to convey message to others through words, facial expressions, and body language or in writing. Expressive language skills or the ability to express one's thoughts, feelings and knowledge is extremely important in the educational setting. Poorly developed expressive language skills create a barrier to student participation and create difficulty in assessing how much the student actually has learned. Expressive language deficits are seen in children with autism and other learning disabilities. The skill of expression requires prior planning by the child. So the factor three i.e., Planning in the artificial dimensions of cognitive processing ability is related with this factor. If a child want to read or write (express) he has to plan first which part he has to read or write and how he has to do it either by part method or whole method and what are the aspects to be covered in it etc. So planning is an essential component in the 'skill of expression' whether it is oral or written aspect.

To conclude all the items in Factor 3 'skill of expression' has high loadings and is positively associated with each other. This Factor is related with the Planning aspect of cognitive processing ability in elementary school children. In school, expressive language difficulties will impact a student's performance both in written and spoken language. Without good expressive language, the child will have great difficulty in showing people what he or she

Items	Loading
I find it difficult to tell the alphabets in order	0.698
I find it difficult to tell the months of the year in order	0.663
It is difficult for me to write about myself	0.584
My homework is not neat	0.566
My homework is not neat	0.534
I have difficulty In solving Maths Word Problems	0.505
I reverse letters when I read	0.494
While writing, I give no space between words	0.466
I learn something today but do not remember it for the next day	0.455

Table 7. Items with Significant Loadings Factor 3

actually knows. A person with an expressive language issue may actually know the answer, but not be able to put it into words. Therapy can help with this problem using stories, games and a variety of other methods and strategies.

Factor 4- Skill of Memory

Six items were loaded under factor 4. The total variance accounted by this factor is 12.38 %. The items with their positive loadings are displayed in Table 8 in descending order. Most of the items resemble memorization skill in children and hence it is named as "perception of skill of memory". It is evident from the table that most of the items are positively loaded which implies that there is positive association between the items. Memorization is an important concept in learning. And so it is important in skill of reading, writing, maths etc. This factor is related with the fourth Factor i.e., Attention in cognitive processing ability of the elementary school children. If a child is attentive then he can store important things in the memory.

It can be inferred from Table 8 that items in Factor 4 reflect 'skill of Memory' which is positively associated with each other. And this factor is related with the Factor 4, 'Attention' of the cognitive processing abilities of elementary school children. Only if the child is attentive he can store information in the memory i.e., short term memory or long term memory. And also the stored up information which has to be coded and stored can be retrieved, recalled or recognised only if the child is attentive in this process. If the child is inattentive there may be gap in the information storage so that the correct retrieval won't take place.

Conclusion

The multivariate approach to the concept of cognitive processing enabled the investigator to bring out the underlying constructs of cognitive processing. This approach helped the investigator to summarize the underlying dimensions in the structure of the raw data – matrix. As a result it was possible to obtain four independent factors representing the construct of cognitive processing. These four factors have been named accordingly taking into account the loadings of the variable in each factor. These four independent factors have also brought out the significant relationships with most of the chosen variables of the present study. Therefore hypothesis No.1which describes 'patterns of clustering of relationships in cognitive processing' is retained. To summarize the elementary school children's cognitive processing skills falls under three dimensions namely cognitive processing, planning, Attention, and successive and simultaneous processing. There were positive loading in all the four independent factors, which implies that the variables are positively associated with each other. Thus proving the theory put forth by Das and his Colleagues (1994b).

Items	Loading
I cannot remember the words I have read	0.723
I while reading I interchange the letters in words	0.681
My note book is not neat	0.631
I forget what Iam saying right at the middle of saying it	0.512
It is hard for me to memorize things for school	0.499
I often do not write down the assignments and forget what to do	0.449

Table 8. Items with Significant Loadings for Factor 4

It is seen from the above discussion of the four independent factor solution of self perception of learning disabilities that the first factor which is a general factor items loaded were related to Reading, writing, arithmetic, organisation, memory etc. named as 'skill of cognition'. Next three factors were specific factors related to 'skill of processing', 'skill of expression' and 'skill of memory'. All the items in each of the independent factors were loaded positively which implies that there were positive association between the items. Hence there are patterns of clustering in self-perception of learning disabilities among the elementary school children. More over Factor 1,2,3 and 4 in self-perception of disabilities is related with Factor 1,2,3, and 4 of cognitive processing of elementary school children i.e., 'cognitive processing' is related with 'skill of cognition'; 'simultaneous and successive processing' with 'skill of processing'; 'Planning' with 'Skill of expression'; and 'Attention' with 'skill of memory'. The four factor solution which emerged from cognitive processing of elementary school children goes along with the theory suggested by Das and his colleagues (1994b) that is cognitive processing has four dimensions namely Planning, Attention, Simultaneous and Successive

Processing.

Recommendations of the study

Some of the recommendations put forth by this study are-

- PASS model can be used to assess the specific strengths and weaknesses in children's cognitive processing
- Knowing the strengths and weaknesses can be used for diagnosis and intervention at an early stage.
- Brain based Training can be given in those areas where children lack behind.
- Knowing the different dimensions of cognitive processing it is easier for the instructor to train the students in each area separately.

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