

**CONSTRUCTION AND STANDARDIZATION OF A METACOGNITION INVENTORY Voice of Research
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Volume 1 Issue 2

September 2012

ISSN No. 2277-7733

Abstract

Metacognition has application for many arenas of school success. The essence of metacognition is awareness of one's cognitive processes, as well as an ability to develop a plan for achieving a goal and evaluating one's effectiveness of reaching that goal. The importance of metacognition for high quality learning and problem solving is widely accepted. For example, experts, as well as possessing deep understanding of their specific subject areas, have also been found to be highly metacognitive. Thus, in the field of educational research, researches regarding metacognition are very useful. In order to understand metacognitive processes better, individual differences in metacognitive activities should be examine. And for that purpose it is necessary to know or identify the level of student's metacognition.

key words : Metacognition, Intelligence, Secondary School Students

The concept of metacognition has recently become a popular area in education. Researchers and educators are deeply concerned about the type and levels of knowledge children are acquiring in schools. Passive transmission-reception of information and memorization of facts are not the kinds of learning that will be required for success in future. The students will be expected to think critically about what they have heard and read, identify relationships among ideas, engage in complex decision making and monitor their own thought processes. Studies explicitly show that metacognitive skills play an important role in effective learning that leads to academic success. Construction and Standardization of a Metacognition Inventory For the Students of Secondary Schools.

Definition of the key words

Construction:The Merriam-Webster's online Dictionary (2011), gives the meaning as, The arrangement and connection of words or groups of words in a sentence: syntactical arrangement.

According to Terry & Thomas (1977) construction means, Programmed instruction term for the construction of an answer either in writing or by performance actively, not by passive choice

The term construction indicates the process or act of preparing of a new item or a thing. All the items to be used in the process of standardizing must be constructed.

Standardization : According to Patel, R.S. (2011), Tests are subjected to stages of standardization and are therefore known as standardized tests.

Cronbach, L.J. (1984) defined it as, A standardized test is one which the procedure, apparatus and scoring have been fixed. So that precisely the same test can be given at different times and places

According to Anastasi A. & Urbina S. (2002) Standardization implies uniformity of procedure in administering and scoring the test.

In the above definitions, a psychological test was described as standardized measures. Therefore, it is a process of establishment of fixed procedure of administrating and scor-

ing a test and the establishment of the norms, reliability and validity of a test. Thus, it is a process of refining a measuring instrument through scientific procedures. When a measuring instrument passes through the procedure of standardization, it becomes a standardized instrument.

Metacognition : Weinert (1987) describes metacognition as, Second order cognitions: thoughts about thoughts, knowledge about knowledge or reflections about actions.

Flavell (1979) viewed metacognition as learner's knowledge of their own cognition, defining it as, Knowledge and cognition about cognitive phenomena and refined this definition by specifying classes of phenomena that constitute monitoring and control of cognition, such as metacognitive knowledge and metacognitive experiences.

Nelson (as cited in Efklides, 2008) defined metacognition as, A model of cognition that functions at a Meta level; metacognition represents the object level, that is cognition.

This definition underscore the functioning of metacognition at a "meta" level, which means that metacognition is a representation of cognition, and that metacognition and cognition are connected through the monitoring and control functions.

According to Brown (1987) Metacognition refers loosely to one's knowledge and control of own cognitive system.

Schraw & Sperling-Dennison (1994) defined Metacognition as the ability to reflect upon, understand and control one's learning.

The concept of metacognition can be described as a higher-order cognitive structure, i.e. knowledge and processes that control, execute, and evaluate cognition. Metacognition is a superior system that encompasses a person's self-awareness of his/her cognitive functions and facts and that enables a person to purposefully direct these functions and facts. In other words, it's a person's knowledge about his/her own knowledge, thoughts about his/her own thoughts, and or eye on his/her own cognitive process.

In the present study the term Metacognition refers to the "Knowledge and Control of own cognitive system which is composite of two main components Metacognitive Knowl-

edge and Metacognitive Regulation. The Metacognitive Knowledge

Includes three sub processes that facilitate the reflective aspect of metacognition; namely declarative knowledge, (i.e., knowledge about self and about strategies), procedural knowledge (i.e., knowledge about how to use strategies), and conditional knowledge (i.e., knowledge about when and why to use strategies.)

Metacognitive Regulation includes a number of sub processes that facilitate the control aspect of learning. These Four component skills of regulation are planning, monitoring, self-control and self-evaluation.

Inventory : Good (1973) defined inventory as, In the field of evaluation, a test or checklist used to determine the subject's or examinee's ability, achievement, aptitude, interest or likes, generally in a limited area.

According to Terry & Thomas (1977), General term for personality tests or questionnaires designed to expose personality characteristics.

According to Merriam-Webster's online Dictionary (2011), A list of traits, preferences, attitudes, interests or abilities used to evaluate personal characteristics or skills.

In the present study the inventory means the list of the statements with five point rating scale related to the metacognition designed to assess the student's Metacognitive awareness.

Metacognition Inventory : In the present study an inventory prepared by the investigator to assess the student's level of metacognition is known as Metacognition Inventory.

Secondary school:

Schools permitted to provide secondary education. (Secondary is from 8th Standard to 10th Standard).

Objectives : The objectives of the present study were as follows:

To construct and standardize two parallel forms of the metacognition inventory for the students of secondary schools of Gujarat State.

To establish a reliability and validity of the metacognition inventory for the students of the secondary schools of Gujarat State.

To establish norms of the metacognition inventory for the students of secondary schools of Gujarat state.

To study whether there exists any area difference with reference to the metacognition.

To study whether there exists any sex difference with reference to metacognition.

To study whether there exists any standard difference with reference to the metacognition.

Hypothesis of the Study : After stipulating the objectives as well as the title of the research study the researcher proposes the solutions of the problem of his research on an adhoc basis in terms of statements which are called hypotheses. These hypotheses are to be tested or verified from the evidences available in the form of collected data.

In the present study the researcher had prepared two paral-

lel form of the Metacognition Inventory; namely MCI-A and MCI-B. Therefore, the researcher had to test the hypothesis for both the forms of the Inventory separately. The hypotheses to be tested for both the forms were same. Hypothesis in the present study were as follows:

Hypotheses for Metacognition Inventory-A (MCI-A)

Ho₁ There will be no significant difference between the mean scores of MCI-A of girls and boys of secondary schools.

Ho₂ There will be no significant difference between the mean scores of MCI-A achieved by the students of secondary schools of urban and rural area.

Ho₃ There will be no significant difference between the mean scores of MCI-A achieved by students of standard 8 and standard 9.

Ho₄ There will be no significant difference between the mean scores of MCI-A achieved by students of standard 8 and standard 10.

Ho₅ There will be no significant difference between the mean scores of MCI-A achieved by students of standard 9 and standard 10.

Hypotheses for Metacognition Inventory-B (MCI-B)

Ho₆ There will be no significant difference between the mean scores of MCI-B of girls and boys of secondary schools.

Ho₇ There will be no significant difference between the mean scores of MCI-B achieved by the students of secondary schools of urban and rural area.

Ho₈ There will be no significant difference between the mean scores of MCI-B achieved by students of standard 8 and standard 9.

Ho₉ There will be no significant difference between the mean scores of MCI-B achieved by students of standard 8 and standard 10.

Ho₁₀ There will be no significant difference between the mean scores of MCI-B achieved by students of standard 9 and standard 10.

Limitations of the Study: The scope of the present study is limited to the Gujarati Medium secondary school students of 8th, 9th and 10th standard. In the present study among rural, semi urban and urban areas only rural and urban areas are included.

Research Design : The word population is used to denote the aggregate from which the sample is chosen.

According to Patel R.S. (2011), population means When statistical information or data is to be collected from any field then a group covering of all units on which data is to be collected is called a population

Here, the researcher had decided to construct and standardize the metacognition inventory for the students of secondary school of Gujarati medium of Gujarat State. Therefore, students of 8th, 9th and 10th standard of Gujarat State (Gujarati Medium) became the population of the present study. As per the records of Secondary and Higher Secondary Education Board total numbers of the students of 8th,

9th and 10th Standard for the educational year 2009-10 are mentioned in below table 1.1.

Table 1.1 Total Numbers of the Students of Secondary Schools of Gujarat State

Standard	Std 8	Std 9	Std 10	Total
Girls	3,53,457	2,97,477	2,57,334	9,08,268
Boys	5,18,111	4,36,329	3,68,592	13,23,032
Total	8,71,568	7,33,806	6,25,926	22,31,300

From the above mentioned table among 22, 31,300 students of secondary schools of Gujarat state there were 9, 08,268 girls and 13, 23,032 students were boys.

The inquiry based on a small fraction of units from the population is called a sample. The population for the present study was the 8th, 9th and 10th grade students of Gujarati Medium of the state of Gujarat, so as to ensure that the entire state is adequately represented in the sample from each district one school from rural and one school from urban area were selected randomly. Students of standard 8, 9 and standard 10 were selected using cluster sampling technique, from each school. There were some schools having more than one division of 8th, 9th and 10th standard. From such school one division of each standard was selected randomly and students of those classes were selected using cluster sampling technique. Thus, selection of schools and its divisions of standards were selected through random sampling method and students from those selected division were selected using cluster sampling method. No attempt has been made to maintain the equal ratio of boys to girls or rural to urban students. Among this sample some school students were randomly assign to complete the MCI-form A and others were randomly assign to complete the MCI -form B.

Table 1.2 Sample for the final run based on Area, Standard and Gender For Form A

Area	Standard 8			Standard 9th			Standard 10th			Total		
	G	B	T	G	B	T	G	B	T	G	B	T
Total Rural	221	416	637	234	342	576	192	341	533	647	1099	1746
Urban	271	273	544	306	190	496	209	207	416	786	670	1456
Total	492	689	1181	540	532	1072	401	548	949	1433	1769	3202

Table 1.3 Sample for the final run based on Area, Standard and Gender For Form B

Area	Standard 8			Standard 9th			Standard 10th			Total		
	G	B	T	G	B	T	G	B	T	G	B	T
Total Rural	173	277	450	196	289	485	168	279	447	537	845	1382
Urban	231	420	651	199	421	620	213	390	603	643	1231	1874
Total	404	697	1101	395	710	1105	381	669	1050	1180	2076	3256

Looking to the present investigation it would be a process of establishing present status of the level of metacognition of the students and establishment of Norms for metacognition the most suitable method would be survey. So that, investigator has selected survey method of research. The Metacognition Inventory Form A and Metacognition Inventory Form B. This tool was prepared and standardized by the researcher. Metacognition Inventory prepared by Mahesh Narayan dixit. Verbal and Non verbal Intelligence test published by Akash manomapan Kendra, Ahmedabad.

Construction of the Metacognition Inventory : The Metacognition Inventory was prepared in four stages; preparation of the first draft, pre pilot run of the inventory, pilot testing of the inventory and preparation of the final version of the inventory. In developing the items for the metacognition Inventory, initially empirical studies of metacognition and standardized instruments for assessing metacognition were reviewed (O'Neil and Abedi, 1996 ; Schraw and Dennison, 1994). The researcher studied the literature to understand the concept and nature of metacognition. After the discussion with the guide and experts following components were selected for the preparation of Metacognition Inventory.

Metacognitive Knowledge : Metacognitive Knowledge comprises of declarative knowledge, procedural knowledge and conditional knowledge.

Metacognitive Regulation : Metacognitive regulation comprises of planning, monitoring, self-control and self-evaluation.

After deciding the components of the Inventory, the next step was to construct its items. A pool of 132 statements was created for the first draft of the Metacognition Inventory. Afterwards on total 48 students of 8th, 9th and 10th standard from rural and urban area schools were selected for the pre pilot tryout of the Inventory. Out of 132 items 100 items were selected based on the pre pilot tryout. No statistical calculations were done at this stage. Pilot try out of the test was done at three different stages. Total 146, 173 and 154 students of standard 8th, 9th, and 10th were selected for the pilot tryout of the inventory. Based on the scores of the pilot tryout of the Inventory, statistical analysis (t-value) was carried out and two parallel forms of Metacognition Inventory-A and Metacognition Inventory-B were prepared. Both the forms have equal number of statements for each component. There were total 35 items in each form at the final stage.

Data Collection : In the present study the final version of the inventories were administered on the students of secondary schools of Gujarat State (Gujarati medium). The researcher had taken the help of the school teachers for the data collection. After the discussion with the guide a training programme was arranged to train the school teachers about how to administer the metacognition inventory and how to fill up the OMR answer sheets. They were also provided necessary documents and stationary for the data collection. Principals of such randomly selected schools were contacted in advance so as to intimate them of the final run and the schedule of the same. The data was collected according to the guideline provided in the training programme. After the completion of the inventory the OMR answer sheets were collected back and checked whether students have fill up all the necessary information properly or not. Thus, data was collected from the entire sample.

Data Analysis : After the completion of the data collection all the OMR answer sheets were checked by the researcher. Incomplete and answer sheets without personal information were rejected. Furthermore, answer sheets having a specific pattern of answering were also rejected. Then after all the answer sheets were sent for the scanning. With the help of OMR scanning software the researcher had got the raw scores with personal information in digital format. Data gathered were classified according to variables and frequency distributions were also prepared for different groups. Based on the frequency distribution of each group, statistical measurements as below were carried out.

Mean Median, Mode and Standard Deviation, Significance of difference of means between groups, Skewness and Kurtosis of each group, Presentation of graphs as required per group, verification of normal distribution of the scores and Establishing the norms, based on the significance of difference of means of the scores, determining their PR and T-scores.

Reliability of the inventory was calculated using the following methods

Test-Retest Reliability, Parallel-Forms Reliability, Internal Consistency Reliability, Split Half Reliability, Spearman and Brown Formula, Rulon/Guttman's Formula, Flanagan Formula and Cronbach's Alpha

The Validity of the Inventory was decided to be arrived at using The correlation between the scores of metacognition inventory (form A and B) and the score of metacognition inventory prepared by Mahesh Narayan Dixit. The correlation between the scores of Metacognition Inventory (form A and Form B) and the scores of Verbal and Non verbal Intelligence test published by Akash manomapan Kendra, Ahmedabad. Factor Analysis with the help of SPSS software.

Major Findings : Two parallel forms of the Metacognition Inventory were prepared. Major findings regarding both the inventory were as follows

Reliability of the Metacognition Inventory form A and B

Table 1.4 Reliability of the Metacognition Inventory

Sr.No.	Reliability	MCI-A	MCI-B
1	Test Retest Reliability	0.75	0.83
2	Parallel Form Reliability	0.81	
3	Cronbach Alpha	0.89	0.90
4	Split Half Reliability by Spearman and Brown Formula	0.86	0.89
5	Split Half Reliability by Rulon /Guttman's formula	0.86	0.89
6	Split Half Reliability by Flanagan's formula	0.87	0.88

From the above it can be said that reliability of the inventories are high. Hence the Metacognition Inventory form A (MCI-A) and Metacognition Inventory form B (MCI-B) are reliable.

Validity of the Metacognition Inventory

Table 1.5 Validity of the Metacognition Inventory

Sr.No.	Validity	
1	Correlation between MCI -form A and Metacognition Inventory prepared by Mahesh Narayan Dixit	0.74
2	Correlation between MCI-form B and Metacognition Inventory prepared by Mahesh Narayan Dixit	0.73
3	Correlation between MCI-form-A and Verbal Non Verbal Intelligence Test published by Akash manomapan Kendra, Ahmedabad.	.78
4	Correlation between MCI-form B and Verbal Non Verbal Intelligence Test published by Akash manomapan Kendra, Ahmedabad.	0.73

Factor analysis : was done with the help of SPSS Statistics 17 software.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy for MCI-A was 0.953 and for MCI-B it was 0.955 which indicated that the data was appropriate for the factor analysis. Bartlett's Test of Sphericity for MCI-A was 19467 and for MCI-B it was 22528. Both the values were significant at 0.000 levels. Which indicated that the data was appropriate for the factor analysis

Factor Extraction with principal component analysis method was carried out and the Factor extraction after the Varimax Rotation supported the seven factor theory (Eigen value greater than one) for both the forms.

From the result, it can be said that Metacognition Inventory-A (MCI-A) and Metacognition Inventory-B (MCI-B) are valid. Norms of the Metacognition Inventory were prepared based on area, standard and gender.

Findings based on the variables of the study

Findings for MCI-A based on the variables of the study

There is a significant effect of gender on the mean score of the MCI-A. Girls scored high on MCI-A with compare to the boys.

There will be no significant effect of the area on the mean scores of MCI-A achieved by the students.

Mean score of MCI-A is positively related to 8th standard. Mean score of MCI-A achieved by the students of 8th standard is lower than mean score achieved by the students of 9th and 10th standard. Mean score of MCI-A achieved by the students of 9th and 10th standard are not significantly different.

Findings for MCI-B based on the variables of the study

There is a significant effect of gender on the mean score of the MCI-B. Girls scored high on MCI-B with compare to the boys.

There is significant effect of the area on the mean scores of MCI-B achieved by the students. Students of the urban area scored high on MCI-B with compare to the students of rural area.

Mean score of MCI-B is positively related to 10th standard. Mean score of MCI-B of 10th standard is higher than 8th standard and 9th standard. Mean score of MCI-B achieved by the students of 8th standard and 9th standard are not significantly different.

Conclusion : In conclusion, the current study indicated that the Metacognition Inventory form A and Form B have satisfactory properties to use as a tool to measure the level of the metacognition of the students of secondary schools of Gujarat state. As the measure of metacognition is very useful for the further research in this field, this tool will provide the facility to measure metacognition to the future researcher. This tool may be very use full to the teachers, parents and counselors to guide students for their future.

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