

**CONSTRUCTION AND VALIDATION OF META-COGNITIVE SKILLS SCALE
(MCSS): A NEW AREA OF COGNITIVE-DEVELOPMENTAL INQUIRY**

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Abstract

This paper has been designed to construct and standardize the Meta-Cognitive Skills Scale for assessing the level of meta-cognitive skills among students. Different steps were being followed to develop and standardize this scale as planning and preparation, first try-out, second try-out, scoring, item analysis, reliability, validity, final form of the scale and interpretation of raw scores. Initially, 95 items were written both in English and Hindi languages for preliminary form covering the four meta-cognitive skills as planning, implementation, monitoring & evaluation and were given to 15 experts belonging to the field of Education, Sociology, Psychology and Language for further rating. Depending upon the unanimity among the experts, 61 items were retained and these items were administered to 110 students selected randomly from schools and colleges of Haryana. Final selection of the items was made on the basis of t-test computation. Only those items, which were found significant either at 0.05 level or 0.01 level of significance, were retained. Unpredictably, 19 items out of 61 items were not found significant and dropped out. Thus out of 61 items, 42 items (both in English & Hindi version) were retained for final form. Reliability of the scale has been measured by Test –Retest method (0.763) and Split-Half method (0.949). This scale was validated against face, content and constructs validity. Z-Score norms have been prepared to measure the level of meta-cognitive skills among students.

Key Words: *Item analysis, Meta-Cognitive Skills, Reliability, Validity*

INTRODUCTION

Constructivism has changed the traditional view of learning i.e. knowledge absorption into a view of learning i.e. active knowledge construction. Students' knowledge and credence regarding their study strategies has been a major source of concern to stakeholders in the education sector.

Majority of the students do not have the potential of knowing the limits of their own learning and memory capabilities. The ability of knowing which learning strategies are effective, planning an approach to a learning task and using effective learning strategies to process and learning new materials seem to be lacking among the students. It is quite obvious that in future, traditional education will fail in the world of volatility, uncertainty, complexity, and filled with ambiguity. Berliner (2008) [3]. Thus, it is becoming crucial to aware students how to learn new information along with the information itself to enable them more successful. This awareness of students to execute the information and ones' own cognitive process in learning is called meta-cognition.

Lai (2011) [15] argued meta-cognition as a multi-dimensional set of skills that involve “thinking about thinking.” Meta-cognition involves two main components: a) Knowledge about cognition and b) Regulation of cognition (Flavell, 1979) [10]. Knowledge about cognition includes knowledge about oneself as a learner and about the factors that might impact performance (declarative), knowledge about strategies (procedural), and knowledge about when and why to use strategies (conditional). Regulation of cognition is the monitoring of one's cognition and includes planning activities, monitoring or awareness of comprehension and task performance, and evaluation of the efficacy of monitoring processes and strategies. These regulatory activities associated with solving problems are termed as meta-cognitive skills (Brown, 1978) [5]. In other words, we can say that meta-cognitive skills are the techniques that instill meta-cognition allow students a sense of control over their own learning, alleviate anxiety, enhance motivation, reduce incompetence and unwarranted confidence, and hopefully generate life-long learners. Meta-Cognitive skills refer to an individual's awareness, evaluation and regulation of their own thinking activity.

The result of the previous research showed that younger children were poor in aspect of cognitive facts, in other words, in aspect of meta-cognitive skills (Flavell, 1979 [10] and Inoue, 2000 [12]). Landine and Stewart (1998) [16] investigated the relationship between meta-cognition and academic achievement of 12th graders. The results indicated significant positive relationship between meta-cognition and academic achievement of students. One of the studies examined positive significant relationship of meta-cognitive knowledge monitoring to self-regulated learning and academic success (Isaacson and Fujita, 2006) [13]. Cubukcu (2008) [9] investigated a study to determine whether instruction incorporating meta-cognitive skills has led

to an increase in the reading comprehension of expository texts. The findings of the study revealed that there was a significant increase in the reading performance of students exposed to meta-cognitive skills using systematic direct instruction. In another research, the investigator found positive relationship between meta-cognitive skills and academic achievements of higher secondary school students (Kristiani, Susilo, Rohman, and Aloysius, 2015) [14]. Mizakhani, Bagheri, Sadeghi, Mizakhani and Modanloo (2014) [17] studied the impact of meta-cognitive skills on academic achievement of school students. The results of the study revealed that planning, controlling, monitoring, evaluating and regulating skills were found to have significant roles in students' academic achievement. Meta-cognitive skills were found to be more effective in academic achievement of female students. Control skill was the only variable that could predict the academic achievement of students. Mozafari, Safari, Zohrehabasifard, Safari, and Sharafi (2016) [18] conducted a study to find out the correlation between meta-cognitive skill and academic achievement of high school students. The finding of the study revealed that there was positive correlation between meta-cognitive skill and academic achievement. Panchu, Bahuleyan, and Seethalakshmi (2016) [20] evaluated the role played by the components of meta-cognitive regulation on academic outcome in medical student in south India. Results of the study showed that most of the students had average meta-cognitive regulation and components like planning, comprehension monitoring and evaluation play a significant role in determining academic success. Implementation of meta-cognitive regulation strategies in day to day learning will be beneficial and make the students self-efficacious learners.

Students' meta-cognitive skills development is a precious educational goal because the skill can help them to be self-regulated learners. Self-regulated learners have a responsibility upon their own learning progress and adopt learning strategies to follow the demand of their work. It is believed that meta-cognitive skills play an important role on much type of cognitive activity including comprehension, communication, attention, memory and problem solving. The ultimate goal in enhancing students' meta-cognitive skills is to create self-directed, autonomous learners. Learning is considered as a constructive, cumulative, self-regulated, goal-oriented, situated, collaborative, and individually different process of knowledge building and meaning construction (Corte, 2000) [8]. Therefore, to obtain a desired level of learning, it is necessary to improve meta-cognitive skills which control one's own learning process. In order to design the

curriculum in accordance with the student's learning level, it is important to arrange the learning events appropriate with the learning process that takes place inside of the students' brain during the learning. A student with good meta-cognitive skills can focus his or her attention on learning unit; make a distinction between important and unnecessary information; use effective strategies to keep the information in long term memory and retrieve it when necessary.

Thus, with the development of meta-cognitive skills, it is also necessary to find out the appropriate tool which can measure their level of meta-cognitive skills. For this purpose, the Investigators reviewed the theoretical part of meta-cognition, meta-cognitive strategies and different meta-cognitive skills and thoroughly analyzed various inventories and scales i.e. Pintrich and De Groot, 1990[21]; Schraw and Dennison, 1994[26]; Schraw, 1994[24]; Schraw, 1997[25]; Purpura, 1999[23]; Toney, 2000[28]; Pintrich et al., 2000[22]; O' Neil and Abedi, 1996[19]; Biryukov, 2002[4]; Sperling et. al., 2002[27]; Al-Khawaldeh, 2003[1]; Govil, 2003[11]; Cooper, 2004[7]; Chen, 2009[6], and Altındağ and Senemoğlu, 2013[2]. Most of these inventories and scales were developed by foreigners rather than Indian authors. Keeping in mind the areas of meta-cognitive skills only four dimensions (Planning, Implementation, Monitoring and Evaluation) were finalized because there was not a single scale regarding these dimensions. Therefore, the investigators decided to standardize the present scale to measure meta-cognitive skills of students (both male & female) studying in secondary, senior secondary schools and U.G. colleges.

OBJECTIVE OF THE STUDY

The present scale was constructed for the purpose of analyzing the level of meta-cognitive skills among students that may be helpful for them to be aware of their knowledge, the ability to understand, control and manipulate their own cognitive process.

PROCEDURE FOR SCALE DEVELOPMENT & DATA ANALYSIS

To achieve the objective of the present scale, different steps were followed to develop and standardize the scale: Planning and Preparation, First try-out, Second try-out, Scoring, Item

analysis, Reliability, Validity, Final form of the scale and Interpretation of raw scores as shown below:

PLANNING AND PREPARATION OF THE SCALE

The present scale was planned to write statements in English and Hindi languages and administered to students studying in secondary, senior secondary schools and U.G. colleges. The nature of the scale was Likert-type i.e. the responses of the items were expressed in terms of the following categories: Strongly Agree, Agree, Undecided, Disagree and Strongly Disagree. Items relating meta-cognitive skills of students were identified and selected after scanning various inventories and scales developed by foreigner and Indian authors. Keeping in mind the area of meta-cognitive skills, 95 items were written in preliminary form covering the following areas as dimensions given below and presented in the table-1.

TABLE-1
Dimensions of Meta-Cognitive Skills Scale (MCSS)

Dimensions of (MCSS)	Operational Definitions	Items
Planning Skill	It is the ability to manage self and others, analyzing information and allocate resources including time, resources and surrounding circumstances to reach a specific goal.	24
Implementation Skill	It measures learner's willingness to apply him or herself to attaining the set goal. It also includes the capabilities to organize and execute the required actions.	23
Monitoring Skill	It refers to one's online awareness of comprehension and task fulfillment together with ability to engage in periodic self-testing while learning and result in the modification or expansion of one's existing meta-cognitive knowledge.	25
Evaluation	It is the ability to assess and reflect on both the processes	23

Skill	employed and the finished product after task completion.	
Total		95

FIRST TRY-OUT

In the beginning, it was decided to write 20 to 25 items under each dimension. Firstly, 95 items were written both in English and Hindi languages for the intact scale. These items were given to 15 experts belonging to the field of Education, Sociology, Psychology and Language for further rating. These items were reviewed carefully so as to prepare adequate items. Keeping in view the suggestions given by experts, a few items were deleted and few items were slightly modified to make the items more easily identifiable. Depending upon the unanimity among the experts, 61 items were retained for second draft as shown in the table-2.

TABLE-2

Dimensions of Meta-Cognitive Skills and No. of items in the First and Second Draft listed

Dimensions of MCSS	Number of Items in First Draft	Number of Items in Second Draft
Planning Skill	24	16
Implementation Skill	23	14
Monitoring Skill	25	18
Evaluation Skill	23	13
Total number of items	95	61

SECOND TRY-OUT

In order to determine item analysis and homogeneity of the items, the prepared scale was administered to randomly selected sample of 110 students (both male & female) studying in secondary, senior secondary schools and U.G. colleges.

ADMINISTRATION OF THE SCALE

The development of the scale is a part of investigation to bring out alteration in education system. The success of the research depends on the co-operation of students. They were expected to put correct mark in any one box labeled as Strongly Agree, Agree, Undecided, Disagree and Strongly Disagree. They were told that there is no right or wrong answer to any statement & answer each statement with honesty and sincerity and not to leave any statement unanswered. After establishing the rapport, subjects were provided the scale. In this way, the investigator collected the response sheets from the subjects of selected schools and colleges.

SCORING PROCEDURE

The scoring of MCS scale is easy and objective. There is no negative statement. Each item being a statement is followed by a five point scale: Strongly Agree, Agree, Undecided, Disagree, and Strongly Disagree. If a respondent responds 'Strongly Agree' he is given a score of 5 point. Similarly, 4, 3, 2, 1 points are given for responding Agree, Undecided, Disagree, and Strongly Disagree respectively.

TABLE-3
Scoring Procedure

Alternative Responses	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree
Score	5	4	3	2	1

ITEM ANALYSIS

The scale was administered to a randomly selected sample of 110 students from the schools and colleges of Haryana state. Subjects were requested to respond to each item honestly. Responses of the items were expressed in terms of the five options: Strongly Agree, Agree, Undecided, Disagree and Strongly Disagree. These items were scored as 5, 4, 3, 2 and 1 respectively. Based on the scoring of answer sheets, they were sorted in descending order of the scores of students. The top 27% were selected as upper criterion group of students and the bottom 27% were selected as lower criterion group of students. The scores of upper and lower criterion groups of

students were subjected to t-test computation. Only those items which were found significant either at 0.05 level or 0.01 level of significance were retained. Unpredictably, 19 items out of 61 items were not found significant and dropped out. Thus out of 61 items, 42 items covering four dimensions of meta-cognitive skills, were retained for final form of the scale as shown in the table-4.

TABLE-4

Item Analysis based on Mean Differences between Upper and Lower Criterion Group

Item	Group	Mean	t-values	Item	Group	Mean	t-values
1.	Upper	4.8	2.105*	32.	Upper	4.533	3.655**
	Lower	4.4			Lower	3.4	
2.	Upper	4.4	4.00**	33.	Upper	4.6	5.064**
	Lower	3.366			Lower	3.033	
3.	Upper	4.4	1.25 (NS)	34.	Upper	4.033	1.818 (NS)
	Lower	4.1			Lower	3.633	
4.	Upper	4.433	5.555**	35.	Upper	4.7	5.25**
	Lower	2.933			Lower	3.233	
5.	Upper	4.3	3.00**	36.	Upper	4.466	5.84**
	Lower	3.466			Lower	3.00	
6.	Upper	4.733	4.703**	37.	Upper	4.766	1.736 (NS)
	Lower	3.466			Lower	4.433	
7.	Upper	4.00	1.676 (NS)	38.	Upper	4.4	4.724**
	Lower	3.433			Lower	3.033	
8.	Upper	4.8	4.384**	39.	Upper	4.7	5.833**
	Lower	3.666			Lower	3.3	
9.	Upper	4.833	4.92**	40.	Upper	4.333	1.178 (NS)
	Lower	3.6			Lower	4.00	
10.	Upper	4.466	4.807**	41.	Upper	4.833	6.4**
	Lower	3.2			Lower	3.233	
11.	Upper	4.766	5.043**	42.	Upper	4.666	4.375**
	Lower	3.6			Lower	3.266	
12.	Upper	4.566	5.272**	43.	Upper	4.666	1.5 (NS)
	Lower	3.4			Lower	4.366	
13.	Upper	4.8	6.74**	44.	Upper	4.666	3.72**
	Lower	3.166			Lower	3.733	
14.	Upper	4.266	1.75 (NS)	45.	Upper	4.533	3.928**
	Lower	3.7			Lower	3.433	
15.	Upper	4.466	9.227**	46.	Upper	3.933	1.270 (NS)
	Lower	2.433			Lower	3.466	
16.	Upper	4.866	4.363**	47.	Upper	4.566	5.2**
	Lower	3.9			Lower	3.1	

17.	Upper	4.6	5.653**	48.	Upper	4.833	5.384**
	Lower	3.133			Lower	3.433	
18.	Upper	4.866	1.578 (NS)	49.	Upper	4.566	0.454 (NS)
	Lower	4.566			Lower	4.466	
19.	Upper	4.633	6.826**	50.	Upper	4.733	5.666**
	Lower	3.066			Lower	3.2	
20.	Upper	4.7	6.692**	51.	Upper	4.466	0.962 (NS)
	Lower	2.966			Lower	4.2	
21.	Upper	4.8	1.5 (NS)	52.	Upper	4.566	1.352 (NS)
	Lower	4.5			Lower	4.1	
22.	Upper	4.466	6.956**	53.	Upper	4.833	8.458**
	Lower	2.866			Lower	2.8	
23.	Upper	4.366	1.5 (NS)	54.	Upper	4.766	4.12**
	Lower	4.033			Lower	3.733	
24.	Upper	4.433	4.482**	55.	Upper	4.033	1.482 (NS)
	Lower	3.133			Lower	3.6	
25.	Upper	4.266	3.448**	56.	Upper	4.566	6.083**
	Lower	3.266			Lower	3.266	
26.	Upper	4.966	3.00**	57.	Upper	4.8	7.692**
	Lower	4.6			Lower	2.8	
27.	Upper	4.3	5.125**	58.	Upper	4.633	3.9**
	Lower	2.666			Lower	3.466	
28.	Upper	4.166	1.241 (NS)	59.	Upper	4.166	0.464 (NS)
	Lower	3.8			Lower	4.033	
29.	Upper	4.566	3.655**	60.	Upper	4.566	5.00**
	Lower	3.5			Lower	3.166	
30.	Upper	4.266	1.592 (NS)	61.	Upper	4.6	1.739 (NS)
	Lower	3.833			Lower	4.2	
31.	Upper	4.5	4.2**				
	Lower	3.666					

* *Significant at 0.05 level*

** *Significant at 0.01 level*

NS (Not-Significant)

FINAL FORM OF MCSS

In the final form of the scale, the items which were found significant either at 0.05 level or 0.01 level of significance were retained. The total number of significant items was 42. The final draft of the scale consisted of 42 items (both in English & Hindi versions) under four dimensions i.e. Planning Skill, Implementation Skill, Monitoring Skill and Evaluation Skill. Distribution of items and dimensions of meta-cognitive skills scale is given below in table-5:

TABLE-5

Dimensions of Meta-Cognitive Skills Scale along with their Item Numbers

Dimensions of MCSS	Item Numbers	Total Items
Planning Skill	1, 4, 7, 11, 14, 19, 22, 25, 30, 33, 37, 40	12
Implementation Skill	2, 5, 8, 17, 20, 28, 31, 36, 38	9
Monitoring Skill	9, 12, 13, 15, 21, 23, 26, 29, 34, 41, 42	11
Evaluation Skill	3, 6, 10, 16, 18, 24, 27, 32, 35, 39	10
	Total	42

STANDARDIZATION OF THE SCALE

To standardize meta-cognitive skills scale with 42 items in the final form, it was administered on a sample of 400 students (both male & female) studying in secondary, senior secondary schools and U.G. colleges.

RELIABILITY

Reliability of the scale had been measured by Test –Retest method and Split-Half method by administering the scale on a sample of 400 students. The coefficient of correlation through test-retest method was 0.763. Split-Half Reliability was found 0.949 which has been measured by Spearman-Brown Prophecy Formula. Dimensions wise reliability was also found out through Test –Retest method. In order to find out the reliability through test-retest method, the scale was administered on a sample of 100 and was re-administered after a gap of three weeks on the same sample. Results given below indicated that the scale was highly reliable.

TABLE-6
Reliability of MCSS through Test-Retest and Split-Half Method

Meta-Cognitive Skills	N	Test-Retest Reliability	N	Spearman-Brown Split-Half Reliability
	100	0.763**	400	0.949**

** Significant at 0.01 level of significance

TABLE-7
Dimension wise Reliability of MCSS

Dimensions of MCSS	N	Reliability Coefficients	Level of Significance
Planning Skill	100	0.859	0.01
Implementation Skill	100	0.795	0.01
Monitoring Skill	100	0.902	0.01
Evaluation Skill	100	0.885	0.01

VALIDITY

The validity of the Meta-Cognitive Skills Scale (MCSS) was calculated on the basis of face validity and content validity. To assess the face validity, MCS scale was presented to 15 experts for their opinions. Content validity was of primary importance for this scale where issues of the overlap between items were addressed by experts and also assessed the relevancy of the items to the category to which they belong. Inter-correlations among different dimensions of the scale had been found to be significantly high through Pearson Product Moment Correlation. The obtained 'r' values indicated high construct validity of the scale. The correlation coefficients between the dimensions of MCSS ranged from .709 to .924 which are given in table-8.

TABLE-8
Inter Correlations of the Dimensions of MCSS

Dimensions	Planning	Implementation	Monitoring	Evaluation	Whole MCSS
Planning	-----				
Implementation	0.744**	-----			
Monitoring	0.775**	0.722**	-----		
Evaluation	0.800**	0.709**	0.800**	-----	
Whole MCSS	0.924**	0.879**	0.919**	0.914**	-----

**** Significant at 0.01 level of significance**

NORMS

Raw Score and Z-Score norms for meta-cognitive skills scale have been prepared and presented in table-9. After scoring the scale, the sum total of score of 42 items shall be the raw scores. These raw scores were converted into z-scores. The Norms for interpretation of z-scores, level of meta-cognitive skills and the range of raw scores have been given in table-10. Grade and level also found out from the table of z-score. Very higher the score, very higher the meta-cognitive skills and very lower the score, very lower the meta-cognitive skills.

TABLE-9
Z-Score Norms for Meta-Cognitive Skills Scale
Mean: 150.50 SD: 25.26 N: 400

Raw Scores	Z-Scores						
91	-2.35	121	-1.16	151	+0.01	181	+1.20
92	-2.31	122	-1.12	152	+0.05	182	+1.24
93	-2.27	123	-1.08	153	+0.09	183	+1.28
94	-2.23	124	-1.04	154	+0.13	184	+1.32
95	-2.19	125	-1.00	155	+0.17	185	+1.36
96	-2.15	126	-0.96	156	+0.21	186	+1.40
97	-2.11	127	-0.93	157	+0.25	187	+1.44
98	-2.07	128	-0.89	158	+0.29	188	+1.48
99	-2.03	129	-0.85	159	+0.33	189	+1.52
100	-1.99	130	-0.81	160	+0.37	190	+1.56
101	-1.96	131	-0.77	161	+0.41	191	+1.60
102	-1.92	132	-0.73	162	+0.45	192	+1.64
103	-1.88	133	-0.69	163	+0.49	193	+1.68
104	-1.84	134	-0.65	164	+0.53	194	+1.72
105	-1.80	135	-0.61	165	+0.57	195	+1.76
106	-1.76	136	-0.57	166	+0.61	196	+1.80
107	-1.72	137	-0.53	167	+0.65	197	+1.84
108	-1.68	138	-0.49	168	+0.69	198	+1.88
109	-1.64	139	-0.45	169	+0.73	199	+1.92
110	-1.60	140	-0.41	170	+0.77	200	+1.96

111	-1.56	141	-0.37	171	+0.81	201	+1.99
112	-1.52	142	-0.33	172	+0.85	202	+2.03
113	-1.48	143	-0.29	173	+0.89	203	+2.07
114	-1.44	144	-0.25	174	+0.93	204	+2.11
115	-1.40	145	-0.21	175	+0.96	205	+2.15
116	-1.36	146	-0.17	176	+1.00	206	+2.19
117	-1.32	147	-0.13	177	+1.04	207	+2.23
118	-1.28	148	-0.09	178	+1.08	208	+2.27
119	-1.24	149	-0.05	179	+1.12	209	+2.31
120	-1.20	150	-0.01	180	+1.16	210	+2.35

TABLE-10

Norms for Interpretation of the Level of Meta-Cognitive Skills

Sr. No.	Range of Raw Scores	Range of z-Scores	Grade	Level of Meta-Cognitive Skills
1.	202 and Above	+2.01 and Above	A	Very High
2.	183 to 201	+1.26 to + 2.00	B	High
3.	164 to 182	+0.51 to + 1.25	C	Above Average
4.	138 to 163	-0.50 to + 50	D	Average
5.	119 to 137	-1.25 to - 0.51	E	Below Average
6.	100 to 118	-2.00 to - 1.26	F	Low
7.	99 and Below	-2.01 and Below	G	Very Low

CONCLUSION

It is quite obvious that traditional education will fail in this volatile world filled with ambiguity. Thus, it is becoming crucial to aware students how to learn new information along with the information itself to enable them more successful. This awareness and regulation of students to execute the information and one's own cognitive process in learning deals with their meta-cognitive skills. This paper is about the process of construction of the scale by following Likert technique. It is helpful for researchers and test developers to understand the steps for constructing and standardizing a scale. This paper helps in knowing the need for construction of a scale by reviewing the previous scales & inventories and in writing the statements after selecting appropriate dimensions. It will also be helpful to know the importance and procedure to be followed for finalizing the items for the scale.

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