CHAPTER: 3

STANDERDISATION OF ATTITUDE SCALE AND CONSTRUCTION OF TEST OF WEAKNESSES IN MATHEMATICS

3.0. INTRODUCTION

The present chapter provide the detail information regarding the construction and standardisation of attitude scale to measure attitude towards Mathematics well as construction of test of Mathematical weaknesses. The tool to measure attitude towards Mathematics was constructed by the method of Summated Rating scale given by Likert (1932).

3.1. Standardisation of Attitude Scale to measure Attitude towards Mathematics

The tool to measure attitude towards mathematics constructed and standardised by investigator. The tool was constructed by "The method of Summated Rating scale given by Likert (1932)". The steps are given bellow:

3.1.1. Identification of the Components of Attitude Scale to Measure Attitude towards Mathematics

For the identification of the component investigator has studied variety of literature. The first draft of Scale to measure attitude towards Mathematics contained 50 items with five components like,

- **A.** Usefulness of Mathematics
- **B.** Progress in the Mathematics Subject
- **C.** Perception related to mathematics teacher
- **D.** Involvement in the subject (readiness)
- **E.** Activity related to mathematics subject

After discussion with the experts and guide in second draft number of the statements was reduced by fourteen and second draft consisted of thirty six items with five components as mentioned above

(For draft of scale to measure attitude towards Mathematics with five components included thirty six statements refer **Appendix-V**)

Again second draft of attitude scale was given to the experts to check sufficient number of component, statements and formation of statements (letter to the experts **Appendix-VI**). After giving referred to the experts the draft of attitude scale for pilot study comprised of 36 items with three components like,

A. Usefulness of Mathematics

B. Interest in the Mathematics

C. Difficulty felt by students in the subject.

(For revised draft of scale to measure attitude towards Mathematics with three components included Thirty Six statements refer **Appendix-VII**)

3.1.2. Format and Nature of Statements

Each test item presents a statement. Statements were written that are favourable and unfavourable with respect to the attitude toward Mathematics. The item was provided with five options namely, strongly agree, agree, undecided, disagree, strongly disagree. There were positive polarity items to measure foreness and negative polarity items to measure againstness to attitude.

Wang (1932), Thurstone and Chave (1929), Likert (1932), Bird (1940) and Edwards and kilpatruk (1948) (it's cited by Edwards A, L. (1969)) have suggested various informal criteria for editing statements to be used in the construction of attitude scales. Their suggestions are summarized below:

1. Avoid statements that refer to the past rather to the present.
2. Avoid statements that are factual or capable of being interpreted as factual.
3. Avoid statements that may be interpreted in more than one way.
4. Avoid statements that are irrelevant to the psychological object under consideration.
5. Avoid statements that are likely to be endorsed by almost everyone or by almost no one.
6. Select statements that are believed to cover the entire range of the affective scale of interest.
7. Keep the language of the statements simple, clear and direct.
8. Statements should be short, rarely exceeding 20 words.
9. Each statement should contain only one complete thought.

10. Statements containing universals such as all, always, none and never often introduced ambiguity and should be avoided.
11. Words such as only, just, merely and others of a similar nature should be used with care and moderation in writing statements.
12. Whenever possible, statements should be in the form of simple sentences rather than in the form of compound or complex sentence.
13. Avoid the use of words that may not be understood by those who are to be given the completed scale.
14. Avoid the use of double negatives.

3.1.3. Development and Selection of the Statement

A well constructed Attitude Scale consists of a number of items that have been carefully edited and selected in accordance with certain criteria as the items contained favourable and unfavourable statements towards psychological object or situation.

These statements were examined by the experts in terms of their representing the behaviours denoted under each component. Through this procedure, total 36 statements with three components were selected for the try out form. The three components are as follow:

A. Usefulness of Mathematics
B. Interest in the Mathematics
C. Difficulty felt by students in the subject.

Table: 3.1show the distribution of statements with respect to the components and the polarity was follow.

Table: 3.1

The Distribution of Statements with respect to the Components and the Polarity

k\ m	(vFin	Component	Polarity
1	miri mt m&jb g(Ntn&> Xin yi[³y Äyvsiyn) ps>dg) miT[j$r) C[.	A	+
2	simi°y g(Ntn&> Xin ri[jbri[jni Jvnmi> upyi[g) C[.	A	+
3	g(Ntn) upyi[(gti jiNvimi> mn[rs C[.	A	+

4	g(Nt Äy(ktmi> sKt mh[nt krvin) T[v (vksiv[C[.	A	+
5	g(Ntni Xin vgr yi[³y Äyvsiy an[a¿yisn) ps>dg) kr) Skiy C[.	A	–
6	g(Ntni[a¿yis krvi[a[Tl[smyni[bgiD.	A	–
7	fkt j[Äy(kta[ni[kr) krv) hi[y t[mN[[g(Nt BNv&> jiea[.	A	–
8	dr[k Äy(kta[g(Nt BNv&> j$r) C[.	A	+
9	g(Ntni a¿yisY) tk< S(ktmi> vFiri[Yiy C[.	A	+
10	g(Ntn&> (SxN Jvnmi> j$r) nY).	A	–
11	g(Ntn&> (SxN fkt p\iY(mk kxi s&F) hi[v&&> ji[ea[.	A	–
12	g(Ntn&> Xin aºy (vPyi[mi> upyig) nY).	A	–
13	smj*(t vgrn) gNtr) pr Bir m*kvimi> aivti[hi[viY) g(Nt k>TiLijnk (vPy C[.	B	–
14	g(Ntni (v(vF p»Åni[ni jvib jit[m[Lvti (vPy vF& rsp\d bn[C[.	B	+
15	g(Nt (vPymi> mn[rs pDti[nY).	B	–
16	mn[g(Ntni (vÚini[k[g(NtSiiA#i)ai[(vS[jiNvin) ki[e eµCi nY).	B	–
17	miri g(Nt (Sxkn&> Äy(ktgt ¹yin miri (vPy p»Ry[ni[rs vFir[C[.	B	+
18	p\vZ(_i Úiri g(Nt BNvin) mji aiv[C[.	B	+
19	g(Ntn[lgt) nv) bibti[S)Kvimi> an[jiNvimi> mn[rs C[.	B	+
20	g(Ntni (vPyn[lgti j&di-j&di p&Atki[vi>cvi mn[gm[C[.	B	+
21	mn[g(Ntni aigL a¿yis (vS[jiNvin) eµCi nY).	B	–

22	g(Ntni[a¿yis krt) vKt[h&> ain>d an&Bv&> C&>.	B	+
23	mn[g(Nt BNvin) mji aivt) nY).	B	–
24	g(Ntni aigL a¿yismi> mn[rs nY).	B	–
25	g(Nt (vPymi> p&nrivt<n Yti> h&> sir) r)t[smJ Sk&> C&>.	C	+
26	p(rximi> g(Nt (vPymi> siri g&N m[Lvvi h&> p»yRn kr&> C&>.	C	+
27	h&> g(Nt BN) Sk&> C&.	C	+
28	h&> miri (m#ii[siY[g(Nt (vPymi> pDt) m&Æk[l) (vS[vit kr&> C&>	C	+
29	GNi p»yRni[krvi> Cti> g(Ntni p\Åni[ni jvib aipvimi> h&> m&Æk[l) an&Bv&> C&>	C	–
30	h&> g(Ntni (nymi[sir) r)t[yid riK) Skti[/Skt) nY).	C	–
31	mn[g(Ntmi>> nipis Yvini[By rh[C[.	C	–
32	g(Nt smjv&> sh[l&> C[.	C	+
33	g(Ntn) (nSin)ai[an[s*#ii[ni[upyi[g h&> sir) r)t[kr) Sk&> C&>.	C	+
34	g(Nt (vPymi> pDt) m&Æk[l)ai[d*r krvimi> mn[k>TiLi[aiv[C[.	C	–
35	mn[g(Ntmi> smj pDt) nY).	C	–
36	g(Ntn) s>Xiai[, (nSin)ai[. aikZ(tai[yid riKvi k>TiLijnk C[.	C	–

Where **A:** Usefulness of Mathematics

B: Interest in the Mathematics

C: Difficulty felt by students in the subject

Further to judge the aspect of correctness and appropriateness of language, these 36 statements were referred by the language experts. The attitude scale was given to 10 students who were purposefully selected of standard VII to see that whether they are able to comprehend the statements.

The statements were assigned the number from one to thirty six. The statements were randomly arranged to constitute the scale. So, randomization for the arrangement was carried out to avoid patterned responses. Table: 3.2 shows the revised draft of scale to measure attitude towards Mathematics with distribution of statements with respect to the components and the polarity was follow.

Table: 3.2

The revised draft of scale to measure attitude towards Mathematics with distribution of statements with respect to the components and the polarity

k\ m	(vFin	Component	Polarity
1	smj*(t vgrn) gNtr) pr Bir m*kvimi> aivti[hi[viY) g(Nt k>TiLijnk (vPy C[.	B	–
2	simi°y g(Ntn&> Xin ri[jbri[jni Jvnmi> upyi[g) C[.	A	+
3	g(Ntni (v(vF p»Åni[ni jvib jit[m[Lvti (vPy vF& rsp\d bn[C[.	B	+
4	miri mt m&jb g(Ntn&> Xin yi[³y Äyvsiyn) ps>dg) miT[j$r) C[.	A	+
5	g(Nt (vPymi> p&nrivt<n Yti> h&> sir) r)t[smJ Sk&> C&>.	C	+
6	g(Nt (vPymi> mn[rs pDti[nY).	B	–
7	g(Ntn) upyi[(gti jiNvimi> mn[rs C[.	A	+
8	p(rximi> g(Nt (vPymi> siri g&N m[Lvvi h&> p»yRn kr&> C&>.	C	+
9	g(Nt Äy(ktmi> sKt mh[nt krvin) T[v (vksiv[	A	+

	C[.		
10	mn[g(Ntni (vÚini[k[g(NtSiiA#i)ai[(vS[jiNvin) ki[e eµCi nY).	**B**	**–**
11	h&> g(Nt BN) Sk&> C&.	**C**	**+**
12	miri g(Nt (Sxkn&> Äy(ktgt ¹yin miri (vPy p»Ry[ni[rs vFir[C[.	**B**	**+**
13	h&> miri (m#ii[siY[g(Nt (vPymi> pDt) m&Æk[l) (vS[vit kr&> C&>	**C**	**+**
14	p\vZ(_i Úiri g(Nt BNvin) mji aiv[C[.	**B**	**+**
15	g(Ntn[lgt) nv) bibti[S)Kvimi> an[jiNvimi> mn[rs C[.	**B**	**+**
16	g(Ntni Xin vgr yi[³y Äyvsiy an[a¿yisn) ps>dg) kr) Skiy C[.	**A**	**–**
17	GNi p»yRni[krvi> Cti> g(Ntni p\Åni[ni jvib aipvimi> h&> m&Æk[l) an&Bv&> C&>	**C**	**–**
18	g(Ntni (vPyn[lgti j&di-j&di p&Atki[vi>cvi mn[gm[C[.	**B**	**+**
19	h&> g(Ntni (nymi[sir) r)t[yid riK) Skti[/Skt) nY).	**C**	**–**
20	mn[g(Ntni aigL a¿yis (vS[jiNvin) eµCi nY).	**B**	**–**
21	mn[g(Ntmi>> nipis Yvini[By rh[C[.	**C**	**–**
22	g(Ntni[a¿yis krvi[a[Tl[smyni[bgiD.	**A**	**–**
23	g(Ntni[a¿yis krt) vKt[h&> ain>d an&Bv&> C&>.	**B**	**+**
24	g(Nt smjv&> sh[l&> C[.	**C**	**+**
25	fkt j[Äy(kta[ni[kr) krv) hi[y t[mN[[g(Nt BNv&> jiea[.	**A**	**–**

26	mn[g(Nt BNvin) mji aivt) nY).	B	–
27	g(Ntn) (nSin)ai[an[s*#ii[ni[upyi[g h&> sir) r)t[kr) Sk&> C&>.	C	+
28	dr[k Äy(kta[g(Nt BNv&> j$r) C[.	A	+
29	g(Ntni a¿yisY) tk< S(ktmi> vFiri[Yiy C[.	A	+
30	g(Ntni aigL a¿yismi> mn[rs nY).	B	–
31	g(Nt (vPymi> pDt) m&Æk[l)ai[d*r krvimi> mn[k>TiLi[aiv[C[.	C	–
32	g(Ntn&> (SxN Jvnmi> j$r) nY).	A	–
33	mn[g(Ntmi> smj pDt) nY).	C	–
34	g(Ntn&> (SxN fkt p\iY(mk kxi s&F) hi[v&&> ji[ea[.	A	–
35	g(Ntn&> Xin aºy (vPyi[mi> upyig) nY).	A	–
36	g(Ntn) s>Xiai[, (nSin)ai[. aikZ(tai[yid riKvi k>TiLijnk C[.	C	–

Where **A:** Usefulness of Mathematics

B: Interest in the Mathematics

C: Difficulty felt by students in the subject

The format which was made, complete by providing relevant information regarding necessary directions to respond the scale with illustration. This format of attitude scale was used for the tryout study and is given in **Appendix-VIII**. Each statement distributed on the basis of component and polarity. To make a selection from the pool of total statements, a tryout study was conducted.

3.1.4. Response Mode

While an individual responds to the scale, he/she decided one of the five option namely, strongly agree, agree, undecided, disagree, strongly disagree and indicate it by putting a tick mark ' √ ' in the corresponding box. For this s/he would read each statement. S/he would place her/him self in the situation represented in the statements.

3.1.5. Tryout of Attitude Scale

To make a selection from the pool of 36 statements a try out was conducted on a sample of 400 students during the month of February, 2012. The school which were selected for the purpose of establishing norms were not included for this purpose.

First schools were selected randomly and all the students of selected schools were taken as sample. So, it is cluster sampling. For administration of the scale following schools were selected. The scale was administered on 400 students on selected schools shown in table: 3.3

For tryout study sample was selected from the following school in the academic year 2011-12.

Table: 3.3

List of the School with number of students for the Tryout study (phase-I)

Sr. No.	Name of the School	Rank of the School	Number of students
1	Shree Morarji Desai Prathmik Shala	2	22
2	Shree Chunilal Ghelabhai Shah Prathmik Shala	13	40
3	Sheth Thakordas Prathmik Shala	1	12
4	Shree Vasudev Smart Prathmik Shala	4	52
5	Shree Isvarbhai Ichharam Desai Prathmik Shala	219	50
6	Shree Ramnarayan Visvanath Pathak Prathmik Shala	153	50
7	Shree Gijubhai Badheka Prathmik Shala	122	76
8	Divan Bahadur Chunilal Maneklal Gandhi Prathmik Shala	11	26
9	Sardar Vallabhbhai Patel Prathmik Shala	7	31
10	Arya Bhatt Prathmik Shala	68	41
Total		**10**	**400**

Before giving the scale of attitude towards Mathematics students were made clear regarding the purpose of the test and it is to know their specific behaviour in the situation presented rather than evaluating their behaviour right and wrong.

3.1.6. Scoring Procedure

Scoring procedure suggested by Likert (1932) for positive polarity and negative polarity followed by investigator shown in Table: 3.4

Table: 3.4
Scoring Procedure

Options	For positive Statement Score	For negative Statement Score
Strongly Agree	5	1
Agree	4	2
Undecided	3	3
Disagree	2	4
Strongly Disagree	1	5

The guidelines given in Table: 3.4 followed for scoring, the responses were scored and the summated score in respect of each respondent was arrived. Accordingly, the maximum score attained on the scale was 177 and the minimum was 59.

3.1.7. Selection of Statements

For final selection of statements that would differentiate between the high group and the low group under mentioned procedure suggested by Likert (1932) was adopted.

The investigator considers the frequency distribution of score based upon the responses to all statements. Then 27% of the subject (NH=100) with highest total score and also 27% of the subjects (NL=100) with the lowest total score were selected for item analysis. They were termed as high and low groups.

In evaluating the responses of the high group and the low group of each statement‘t-values’ were computed by t-test.

The ‘t-value’ for thirty six statements as calculated by t-test is given in the following table:3.5.

Table: 3.5

The Mean, SD and t-values of thirty six statements

Statement No.	Mean		SD		t- value
	Upper	Lower	Upper	Lower	
1	3.77	2.72	1.3918	1.4218	5.2864
2	4.84	3.11	0.5607	1.5931	10.2488
3	4.80	3.04	0.4899	1.5028	11.1322
4	3.83	3.15	1.5169	1.4518	3.2381
5	4.44	2.95	1.1603	1.4925	7.8753
6	4.11	2.83	1.3483	1.3715	6.6528
7	4.85	3.02	0.4770	1.4831	11.7383
8	4.88	3.62	0.4956	1.9431	6.2780
9	4.33	3.18	1.1050	1.4098	6.4174
10	4.19	2.79	1.2385	1.2672	7.8873
11	4.72	2.93	0.6940	1.5701	10.4373
12	5.13	3.27	5.6562	1.5547	3.1708
13	4.37	3.23	1.1194	1.4343	6.2672
14	4.77	3.01	0.7856	1.6340	9.7023
15	4.68	3.04	0.7730	1.5357	9.5349
16	3.68	2.41	1.5289	1.3349	6.2562
17	1.59	1.43	0.9111	0.9562	1.2167
18	4.43	3.00	0.9824	1.4491	8.1761
19	3.82	2.76	1.5516	1.4431	5.0024
20	3.65	2.53	1.7051	1.4315	5.0292
21	3.51	2.67	1.6340	1.5624	3.7152
22	4.49	2.49	1.0344	1.2041	12.6024
23	4.79	3.03	0.5881	1.5521	10.5960
24	4.15	2.72	1.2913	1.6253	6.8882
25	3.47	2.76	1.7289	1.4908	3.1099
26	4.75	3.22	0.7399	1.6036	8.6636
27	4.54	3.01	0.8417	1.4247	9.2447
28	4.72	3.31	0.6940	1.5665	8.2216
29	4.14	3.21	1.2886	1.3950	4.8947
30	4.35	2.56	1.2600	1.3735	9.5979

31	1.65	1.5	0.9142	0.9795	1.1211
32	4.12	2.72	1.5118	1.4770	6.6225
33	4.28	2.73	1.1669	1.2873	8.9183
34	4.30	2.65	1.2207	1.4309	8.7580
35	4.37	2.68	5.0392	1.4689	3.2197
36	3.81	3.09	1.5601	1.5498	3.2757

For the selection of statements for the final format of scale of attitude towards Mathematics, the following criterion was followed:

The value of 't' is measure of the extent to which a given statement differentiates between the high and low group. As a crude and approximate rule of thumb that any t-value equal to or greater than 1.75 as indicating the average response of the high and low groups to a statement differs significantly (it's cited by Edwards A, L. (1969)) .

From the Table: 3.5 it is evident that statement number 17 and 31 did not satisfy the above mentioned criterion. So, they were rejected at the first sight. With this rejection of statements, 34 statements remained out of which 18 statements were of positive polarity and 16 statements were of negative polarity specified in **Appendix-IX**.

3.1.8. The final format of Attitude Scale

The distribution of the statements after item analysis on three different components with positive and negative polarity was as follow:

Table: 3.6

Distribution of the statements for the final format with polarity

Components	**Statement number with**		**Total number of statement**
	Positive Polarity	**Negative Polarity**	
(1) Usefulness of Mathematics	2, 4, 7, 9, 27, 28	16, 21, 24, 30, 32, 33	12
(2) Interest in the Mathematics	3, 12, 14, 15, 17, 22	1, 6, 10, 19, 25, 29	12
(3) Difficulty felt by Students in the Subject	5, 8, 11, 13, 23, 26	18, 20, 31, 34	10
Total number of	**18**	**16**	**34**

Statements			

3.1.9. Establishment of the psychometric properties of the Attitude Scale

In the present study, investigator has established reliability, validity, percentile norm and factor analysis in the part of psychometric property of attitude scale.

To establish psychometric property, first schools were selected randomly and all the students of selected schools were taken as sample. So, it is cluster sampling. For administration of the scale following schools were selected. The scale was administered on 200 students on selected schools shown in Table: 3.7.

Table: 3.7

List of the School with number of students to establish psychometric property (phase-II)

Sr. No.	Name of the School	Rank of the School	Number of students
1	KaviShree Dalpatram Prathmik Shala	132	69
2	Shree Rajaram Mohanrai Prathmik Shala	59	21
3	Shree B. K. Thakor Prathmik Shala	86	27
4	Kavishree Dulabhaya Kag Prathmik Shala	54	73
Total		**4**	**200**

3.1.9.1. Reliability

A test is reliable to the extent that it measures whatever it is measuring consistently. The reliability or stability of a test is usually expressed as a correlation coefficient. For the present study the Cronbach's alpha reliability and Split-Half reliability have been established by investigator.

A. Cronbach's alpha Reliability Test

Cronbach's alpha is a test reliability technique that requires only a single test administration to provide a unique estimate of the reliability for a given test. Cronbach's alpha reliability coefficient normally ranges between 0 and 1. The closer Cronbach's alpha coefficient is to 1.0 the greater the internal consistency of the items in the scale. The reliability statistics Table: 3.8 provide the actual value for Cronbach's alpha for 34 items.

Table: 3.8

Reliability Statistics (Cronbach's Alpha)

Cronbach's Alpha	No. of Items
.833	34

From Table: 3.8 show that the value of Cronbach's Alpha is 0.833 for 34 items, which indicates a high level of internal consistency for attitude scale. High value for Cronbach's alpha indicates good internal consistency of the item in the scale. So, attitude scale is reliable.

The reliability of the developed Scale was estimated by split-half technique.

B. Reliability of Attitude scale (The Split-Half Method)

In this method the test was divided into two halves only for the purpose of scoring not for administration. The correlation between these two sets of scores was found. After this Spearman Brown Prophecy Formula was used to estimate the reliability of the full length test.

Investigator has divided 34 statements of attitude scale in two halves in terms of their nature and polarity. Table: 3.9 shows the distribution of statements in two halves.

Table: 3.9

Distribution of the statement in two halves

	First half	Second half
Statement number	1, 2, 3, 5, 7, 10, 11, 14, 16, 17, 18, 23, 24, 25, 27, 31, 32	4, 6, 8, 9, 12, 13, 15, 19, 20, 21, 22, 26, 28, 29, 30 ,33, 34
Total	**17**	**17**

The correlation found between these two sets was 0.79. Investigator has used Spearman Brown Formula for Reliability of full scale to find out split – Half reliability.

Split – Half reliability of the full scale was 0.88 which shows very high reliability.

3.1.9.2. Validity

Validity of a test can be defined as the degree to which the test measures what it is intended to measure. A test which is meant to measure achievement in Mathematics should not measure achievement in science.

For the Attitude Scale following validity has been established:

(1) Face Validity

Face validity has something to do with the mere appearance of a test. A test is said to have face validity when by appearance it "looks like" measuring what it is meant to measure. Before construction of attitude scale investigator has studied literature for attitude scale as well as different types of attitude scale. While constructing Attitude Scale opinions of the experts have taken and incorporated. Thus, Face validity of attitude scale to measure attitude towards Mathematics was established.

(2) Content Validity

Content validity is evaluated by showing how well the content of the test samples the class of situations or subject matter about which conclusion are to be drawn. It also referred to as a logical or rational validity. The attitude scale was given to the experts for ensuring the content coverage of the scale. Their feedback were considered and incorporated. Thus, this way content validity was established.

3.1.9.3. Factor Analysis (Principal Component Analysis)

The factor analysis of a test is defined by its correlation with a factor, Called factor loading.

The output comprised of six tables and one chart. Under the title of factor analysis, the KMO and Bartlett's Test, communalities, total variance explained, scree plot, component matrix, rotated component matrix and component transformation matrix are displayed.

The adequacy of the data is evaluated on the basis of the results of Kaiser-Meyer-Olkin (KMO) measures of sampling adequacy and Bartlett's test of sphericity (homoginity of variance). Table: 3.10 give you an idea about the Kaiser-Meyer-Olkin (KMO) measures of sampling adequacy and Bartlett's test of sphericity.

Table: 3.10

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.821
Bartlett's Test of Sphericity	**Approx. Chi-Square**	2673.272
	df	561
	Sig.	.000

Table: 3.9 explained the KMO measure of sampling adequacy is 0.821, indicating that the present data are suitable for factor analysis. Similarly, Bartlett's test of sphericity (homoginity of variance) is significant ($p < 0.01$), indicating sufficient correlation exists between the variables proceed with analysis. Table: 3.11 give the total varience explained by every statement.

Table: 3.11

Communalities

Communalities

	Initial	Extraction
VAR00001	1.000	.584
VAR00002	1.000	.662
VAR00003	1.000	.468
VAR00004	1.000	.668
VAR00005	1.000	.609
VAR00006	1.000	.584
VAR00007	1.000	.655
VAR00008	1.000	.657
VAR00009	1.000	.630
VAR00010	1.000	.615
VAR00011	1.000	.584
VAR00012	1.000	.568
VAR00013	1.000	.726
VAR00014	1.000	.712
VAR00015	1.000	.575
VAR00016	1.000	.761
VAR00017	1.000	.676
VAR00018	1.000	.589
VAR00019	1.000	.742
VAR00020	1.000	.433
VAR00021	1.000	.638
VAR00022	1.000	.659
VAR00023	1.000	.509
VAR00024	1.000	.488
VAR00025	1.000	.757
VAR00026	1.000	.568
VAR00027	1.000	.720
VAR00028	1.000	.533
VAR00029	1.000	.637
VAR00030	1.000	.631
VAR00031	1.000	.748
VAR00032	1.000	.540
VAR00033	1.000	.602
VAR00034	1.000	.582

Extraction Method: Principal Component Analysis.

Table: 3.10 explained the KMO measure of sampling adequacy is 0.821. So, all the statements have reasonably good extraction value.

Table: 3.12

Total Variance Explained

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	7.531	22.150	22.150	7.531	22.150	22.150	7.241	21.296	21.296
2	4.242	12.476	34.625	4.242	12.476	34.625	2.685	7.896	29.192
3	1.762	5.181	39.807	1.762	5.181	39.807	2.154	6.335	35.527
4	1.490	4.381	44.188	1.490	4.381	44.188	1.742	5.123	40.650
5	1.409	4.146	48.333	1.409	4.146	48.333	1.553	4.568	45.218
6	1.289	3.790	52.124	1.289	3.790	52.124	1.540	4.529	49.747
7	1.194	3.512	55.635	1.194	3.512	55.635	1.447	4.257	54.004
8	1.125	3.309	58.944	1.125	3.309	58.944	1.389	4.087	58.090
9	1.068	3.140	62.084	1.068	3.140	62.084	1.358	3.994	62.084
10	.962	2.830	64.914						
11	.959	2.821	67.735						
12	.854	2.513	70.247						
13	.833	2.450	72.697						
14	.774	2.275	74.972						
15	.749	2.204	77.177						
16	.717	2.109	79.285						
17	.706	2.078	81.363						
18	.644	1.896	83.258						
19	.619	1.821	85.079						
20	.538	1.581	86.660						
21	.513	1.508	88.168						
22	.472	1.387	89.555						
23	.447	1.314	90.869						
24	.390	1.148	92.016						
25	.374	1.099	93.115						
26	.339	.996	94.112						
27	.322	.946	95.058						
28	.296	.869	95.927						
29	.292	.859	96.786						
30	.274	.807	97.594						
31	.246	.723	98.317						
32	.223	.655	98.971						
33	.188	.552	99.523						
34	.162	.477	100.000						

Extraction Method: Principal Component Analysis.

Nine factors (components) in the initial solution have an Eigen values over one they account for about 62.084% percent of the observed variation in the student's attitude towards Mathematics.

Scree Plot of Eigen values shows that nine factors are going to be extracted as shown in figure no: 3.1.

Figure: 3.1

Scree Plot

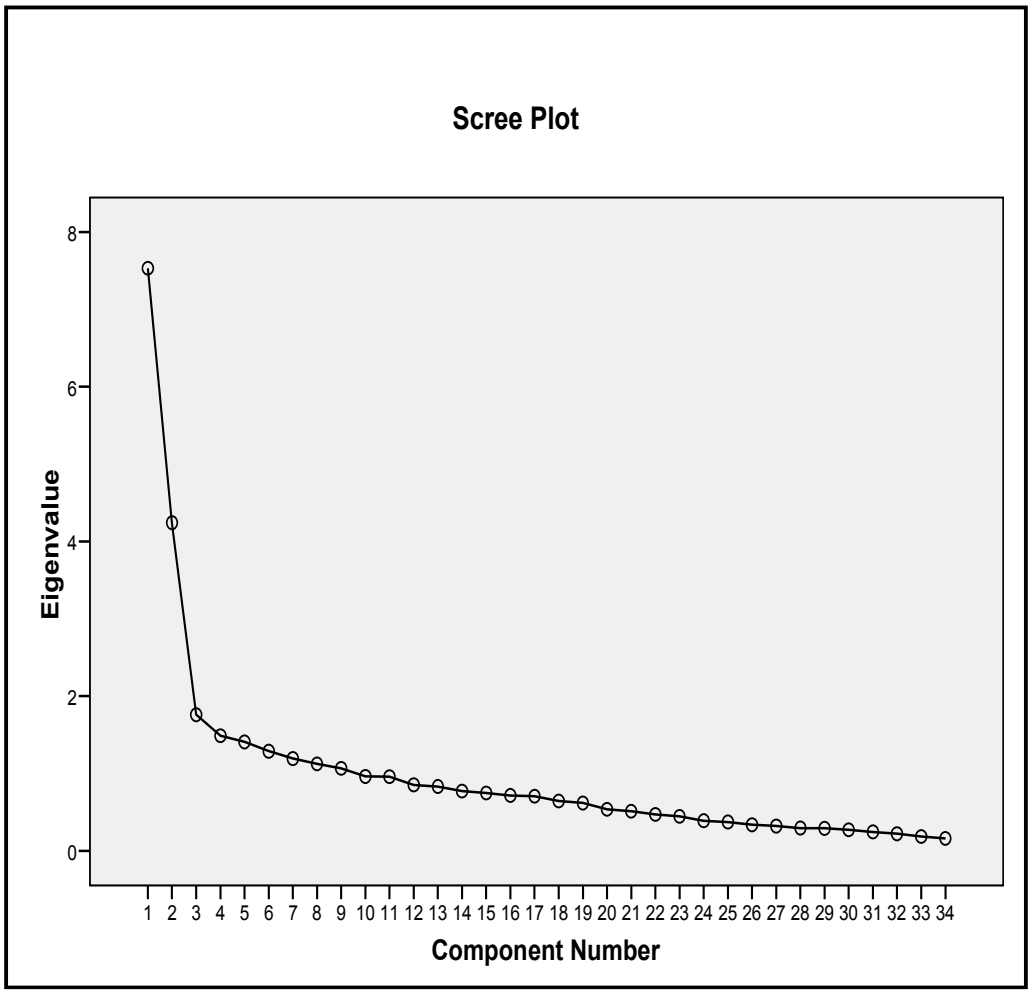

Table: 3.13

Component Matrix

Component Matrix[a]

	Component								
	1	2	3	4	5	6	7	8	9
VAR00019	.831			-.127	-.104				
VAR00031	.822						-.162		-.168
VAR00025	.801	-.137			-.148		-.172		-.199
VAR00030	.771		.126						
VAR00021	.770			-.117					
VAR00029	.738	-.117	.156		-.108			.154	
VAR00033	.726		.130	.109	-.106	.116		.131	
VAR00006	.691	-.125	-.134	-.115			.155	.155	
VAR00034	.652	-.149				.316		-.124	
VAR00032	.645			.131		.202		-.198	
VAR00010	.640		-.213			-.197	.228	.187	-.174
VAR00018	.610	-.189		-.165		-.285	-.104		.241
VAR00024	.569			.244				-.193	.228
VAR00020	.522			.146		.197	.217		-.206
VAR00001	.469	-.156	-.122		.181	-.130	.259	-.195	.409
VAR00014	.110	.635	-.214	.321	-.274	-.255			
VAR00011	.107	.607	-.353	.259					
VAR00015	.176	.577	-.153		.320	-.245			-.124
VAR00026		.559		.306		.212	-.157	.191	-.217
VAR00002		.550	.416	-.126			.267		.297
VAR00003	.181	.540	-.159			.160	-.206	-.170	-.103
VAR00012		.532	-.168	-.201	-.281	-.253	-.114	.231	
VAR00007	.208	.505	-.264	-.142		.414		.161	.249
VAR00023		.489			.366	.296		-.178	-.109
VAR00008	.142	.485	-.263	.322	-.330	-.206	.250		.115
VAR00004	.121	.438	.324	-.261	-.256		.285	-.371	
VAR00013	-.113	.145	.670	.364			.185	.104	-.242
VAR00028		.342	.427			-.134	-.188	-.397	-.101
VAR00016	.255			.527	.296	-.156	-.382	-.143	.367
VAR00022	.144	.432		-.116	.530		.377		
VAR00005	.225	.424		-.340	.436	-.107		.226	
VAR00027		.359	.313	-.149	-.246	.395	-.237	.249	.368
VAR00009		-.411	-.156	.360		.289	.422	.136	.136
VAR00017		.226	.426	.270	.264	-.255		.474	.102

Extraction Method: Principal Component Analysis.

a. 9 components extracted.

Table: 3.14

Rotated component Matrix

Rotated Component Matrix[a]

	Component								
	1	2	3	4	5	6	7	8	9
VAR00019	.839							.146	-.106
VAR00025	.832		-.123		.147				
VAR00031	.828		.106		.174				
VAR00030	.764			.101		.113			.141
VAR00029	.763		-.122		.136		.132		
VAR00021	.760		.107					.159	
VAR00033	.738					.148	.117		
VAR00006	.693			-.132				.227	-.147
VAR00034	.658	-.149	.103		-.141	.119	-.169		.223
VAR00010	.638	.223	.107	-.161		-.177		.165	-.237
VAR00032	.632			.115	-.121		-.123		.292
VAR00018	.569		-.114		.260			.395	.145
VAR00020	.553		.154		-.282	-.103			
VAR00024	.521			.123	-.164			.204	.351
VAR00014		.813		.161	.101				
VAR00008		.787		.102	-.110				
VAR00011		.621	.344			.117	-.127	-.179	.127
VAR00012		.500			.448	.237			-.241
VAR00003	.106	.341	.281	.166	.240	.208	-.279	-.235	
VAR00022			.763	.101			.180	.102	-.126
VAR00023		.111	.629	.137		.102	-.138	-.197	
VAR00005	.126		.547		.448	.181	.165	.167	
VAR00015		.417	.510		.302	-.148			.107
VAR00004		.195	.104	.732				.104	-.232
VAR00028				.623	.288			-.163	.166
VAR00002		.196	.226	.547		.396	.277	.173	
VAR00009			-.118	-.305	-.710			.111	
VAR00027				.165	.102	.808	.115	-.121	
VAR00007	.121	.334	.324			.606	-.200		
VAR00017			.141		.103		.787		.126
VAR00013				.407	-.232		.598	-.372	
VAR00001	.382		.118		-.129			.600	.193
VAR00026		.388	.276			.216	.166	-.506	
VAR00016	.164			-.123			.131		.826

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 23 iterations.

Table: 3.15

Component transformation Matrix

Component Transformation Matrix

Component	1	2	3	4	5	6	7	8	9
1	.972	.112	.100	.035	.061	.047	-.024	.120	.102
2	-.138	.632	.498	.326	.280	.319	.105	-.183	-.052
3	.059	-.438	-.113	.632	.004	.146	.582	-.167	.071
4	.002	.399	-.128	-.141	-.497	-.206	.325	-.312	.558
5	-.068	-.375	.759	-.223	.084	-.245	.170	.127	.342
6	.056	-.274	.246	-.062	-.503	.567	-.348	-.402	-.023
7	.009	.136	.246	.182	-.627	-.196	.184	.408	-.505
8	.066	.003	-.041	-.622	.104	.328	.598	-.087	-.352
9	-.142	.052	-.118	-.012	-.085	.552	.052	.689	.416

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Dispensable component analysis has identified nine factors which explained 62.084% variation. Out of thirty four factors nine factors contribute 62.084% variation. It can be renamed.

The statements (variables) constituting factor: 1 are 19, 25, 31, 30, 29, 21, 33, 06, 34, 10, 32, 18, 20 and 24 which contribute 22.15% variation. It can be renamed belief. The statements (variables) constituting factor: 2 are 14, 08, 11, 12, 03 and 26 which contribute 12.476% variation. It can be renamed ability in learning Mathematics. The statements (variables) constituting factor: 3 are 22, 23, 05 and 15 which contribute 5.181% variation. It can be renamed readiness for learning. The statements (variables) constituting factor: 4 are 04, 28 and 02 which contribute 4.381% variation. It can be renamed importance of Mathematics. The statements (variables) constituting factor: 5 are 9 which contribute 4.146% variation. It can be named value of Mathematics. The statements (variables) constituting factor: 6 are 27 and 7 which contribute 3.79% variation. It can be renamed interest in Mathematics. The statements (variables) constituting factor: 7 are 17 and 13 which contribute 3.512% variation. It can be renamed preparation for subject. The statement (variables) constituting factor: 8 is 1 which contribute 3.309% variation. It can be renamed attitude towards Mathematics teaching. The statement (variables) constituting factor: 9 is 10 which contribute 3.14% variation. It can be renamed utility of Mathematics in daily life..

3.1.9.4 Percentile Norms

Norms provide the user a standardized test with the basis for a practical interpretation and application of the results. Norms are the levels attained by a particular group of a person on a set. In the present study, investigator has established percentile norms. A percentile is best described as a comparison score. A percentile is a number between 1 and 100 that relates the student's performance to those of other students who have taken the test. In a set of numbers, the percentile for a given value indicates the percentage of numbers that are less than or equal to that value. The n^{th} percentile is that scale value or score point below which n percent of the cases in the distribution fall. The scale value of the variable is called the percentile point or percentile. For example, if a student scores 80% in a test and is in the 90^{th} percentile, this means that 90% of students had scores that were less than or equal to 80%.

In the present study, for attitude scale which was constructed for standard VII of Surat city, the percentile norms were derived. For the same purpose, mean, standard deviation, median, and percentiles for entire sample (N = 200) were computed.

Table: 3.16

Mean, Standard deviation, Median and Percentiles

of attitude score of the students for establishment of Norms

	ALL
Mean	128.86
SD	19.80940338
Median	130
P 10	103
P20	109
P 30	114
P 40	122.6
P 50	130
P 60	135
P 70	142

P 80	149.2
P 90	154.1

The lowest score obtained on attitude scale was 78 and highest score was 166. Average attitude score for entire sample was 128.86. In the distribution, 90% of students had scores that were less than or equal to 154.1. 80% of students had scores that were less than or equal to 149.2. 70% of students had scores that were less than or equal to 142.60% of students had scores that were less than or equal to 135. 50% of students had scores that were less than or equal to 130. 40% of students had scores that were less than or equal to 122.6. 30% of students had scores that were less than or equal to 114. 20% of students had scores that were less than or equal to 109. 10% of students had scores that were less than or equal to 103.The norms established in the present study may be applied in comparing the possession of attitude of any other student selected from the population.

3.2. Construction of Test of Mathematical Weaknesses.

The tool to measure mathematical weaknesses was constructed by the investigator. The steps like analysis of the content of standard VII, item selection and writing, validation to the experts and try out of the test were followed by investigator. The detailed process of construction of test of mathematical weaknesses is as follow:

3.2.1. Analysis of Content

First investigator has analysed whole content of Mathematics text book of standard VII published by Gujarat Council of Education, Research and Training (GCERT), Gujarat and found essential pre-knowledge for every sub-topic from Mathematics text-book of standard I to VI published by GCERT, Gujarat. Whole textbook of standard VII was divided into eight learning areas and each learning area contain the different topics of Mathematics related to different branches of Mathematics like Geometry, Algebra, Mathematics related to daily life. (Refer **Appendix – X**)

3.2.2. Item selection and writing

To study mathematical weaknesses investigator has taken opinion of three Mathematics teachers teaching Mathematics at primary level Gujarati medium school having minimum three years experience. It revealed that,

- Most of the students do not understand the instruction given.
- Students can not operate basic operations in Mathematics.
- Students can not apply pre-knowledge to solve the problem in Mathematics.

Based on this opinion and discussion with researchers and guide investigator has developed first draft of test of Mathematical Weaknesses with 31 questions with 105 items with respect to require basic competency. In order to include all types of items from the content of subject matter, content analysis was done (detail process given in 3.3.1). Investigator has not involved any question related to problem solving and which require any skill to use mathematical instrument.

3.2.3. Validation to Experts

After item selection and writing investigator has given the test of mathematical weaknesses to the experts for assured that each question measure the competency related to it or not, instruction given for the question and language of the test were appropriate or not. (Refer **Appendix-XI**)

3.2.4. Construction and try out

An initial pool of 103 items with 31 questions of 106 marks was prepared by investigator with all the general information for the student like name, standard, class, name of the school. All the items in the test of weaknesses have arranged from easy to difficult level (refer **Appendix-XII**). After construction and referring to the experts tryout study was conducted on a small sample of 20 students in February-2012.

The test was personally administered by the investigator in all the schools. No time limit was set for the test. Instructions were provided with the test and investigator oriented the students regarding the purpose and nature of the test. All the doubts raised by the students regarding instruction and related to response were solved by investigator. The time taken for the test was about two hours. After collecting the test paper from the students the papers were scored. One mark given for the right response and zero mark given for the wrong response.

3.2.5. Formation of final Form

On the basis of the responses given by the students and further discussion with maths teachers, test items based on addition and subtraction with the use of number line and

profit and loss were discarded from the first draft. So, final draft of test of Mathematical Weaknesses contains 95 items with 28 questions of 98 marks. (Refer **Appendix-XIII**)