CHAPTER - II
DEVELOPMENT OF THE
PROGRAMME
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Dynamics of the programme development consists of three major stages, namely; the preparation stage, writing stage and empirical testing stage. These three stages are cyclic in character which means that instead of moving from one to another in a straight line fashion, they register a back and forth movement so that the programme may be recycled from one stage to previous stage. An attempt has been made to illustrate this dynamics of programme construction in Figure 2.1. This flow chart also presents a snapshot view of how the present programme was developed.

This chapter gives a detailed account of the stages which finally led to the development of the finished draft of the programme. The chapter has been divided into three major sections. The first section describes the preparation stage. The second section gives an account of writing the programme and the third section contains a description of empirical testing.

THE PREPARATION STAGE:

The first stage in programme development is preparation. The entire success of the programme development depends upon the care and explicitness that is given to the preparation stage. Time skimped in preparation is usually more than made up in delays during succeeding stages (Pipe, 1966).

Preparation stage of programme development involves a
FORMULATION OF BEHAVIOURAL OBJECTIVES \rightarrow SPECIFICATION OF TARGET POPULATION

CONTENT-ANALYSIS

DECIDING PROGRAMMING MODEL AND MODE OF PRESENTATION

PREPARATION OF CRITERION-TEST

VALIDATION OF CRITERION-TEST

WRITING OF THE PROGRAMME
- DESIGNING OF FRAMES
- SEQUENCING OF FRAMES
- EDITING

EMPirical TESTING OF PROGRAMME
- DEVELOPMENTAL TESTING
- VALIDATION TESTING

IMPLEMENTATION

REVIsION

FLOW CHART OF PROGRAMME DEVELOPMENT

Fig 7.4
number of steps, systematic account of which, is given below:

SELECTION OF THE TOPIC:

The first task in the preparation stage of programming is selection of the topic. Points made by Peter Pips (1966), Derek Rowntree (1966) and Ake Bjerstedt (1972) were given due consideration for the selection of the topic of the present programme. The topic "Hindi Vocabulary Building" was selected from the domain of Hindi Language because of the following reasons:

- The programmer has Master's degree in Hindi and Sanskrit as one of the subjects at graduation level and has studied. Therefore, he is thoroughly familiar with the content of the topic.

- The programmer has also sufficient teaching experience of teaching methodology of Hindi and Sanskrit to B.Ed. students.

- The importance of vocabulary is universally acknowledged and demonstrated in schools and outside for effective communication. It has now also been established by experimental evidence that in the classroom the achieving students possess the most adequate vocabulary and because of the verbal nature of classroom activities, knowledge of word-formation and ability to use them are essential for success in all school subjects.
Though students of High Schools in India get some knowledge of the suffixes in the form of numbers, gender and noun, adjective and verb formation in traditional teaching of Hindi, but they find difficulty in analyzing words into rootwords and suffixes or synthesizing suffixes with rootwords. In the absence of systematic knowledge of meanings of suffixes they can not get the meanings of words formed by the combination of suffixes with root-words. Sanskrit suffixes (Tatsama suffixes) in Hindi account for the building of innumerable Tatsama words in different combinations. Therefore, vocabulary programme utilizing Sanskrit suffixes may prove helpful in comprehending the mechanism of word-formation in Hindi to High school students.

The content of the selected topic is of a stable nature and is likely to be the core material for vocabulary-building in Hindi language.

Subject matter of the selected topic is marked as a relatively easily distinguishable logical structure and requires drilling on the part of the student for learning. Hence, it is particularly suitable for programme development.

The programme on "Hindi vocabulary building" is likely to be utilized by a great number of High school students belonging to Hindi speaking areas.
Programmes have been developed for teaching of vocabulary building in foreign languages and their effectiveness for learning has been established. James I. Brown and Edgar Dale, who have long been interested in studying vocabulary and are currently involved in the development of programmed materials, in their report (1965) have observed that programmed vocabulary seems to bring best results in generalizing about language.

There is no programme available in India on Hindi vocabulary building for students of any level.

ASSUMPTIONS ABOUT THE LEARNERS:

Pipe (1966) suggests that a programmer should describe as fully and as accurately as possible, the audience for whom the programme is to be written. The topic of the programme gives the breadth of the programme, whereas assumptions about the intended learners indicate its depth. This exercise tells the programmer a great deal about the way he should tackle his task. Specifically, assumptions about the learner help the programmer in determining the level of language, the kinds of examples, perhaps the speed of presentation and the amount of the practice for the programme.

In respect of the present programme following assumptions were made about the intended learners:

The beneficiaries of the programme will be the ninth class
students of both the sexes studying in Hindi medium schools.

The average age of the learners assumed for undertaking study through this programme is stipulated as fourteen.

The students are presumably from different socio-economic status and the sample thought of is mixed so far as urban and rural stratification is concerned.

Students belong to Hindi speaking areas and their mother tongue is Hindi.

Students will be devoting one hour at a time while studying the programme.

Students will be able to read, and write and understand Hindi prescribed upto VIII Standard.

FORMULATION OF BEHAVIOURAL OBJECTIVES:

Peter Pipe (1966) emphasizes that defining the objectives in behavioural terms is the most critical step in programming. He further states that by doing a thorough job at this step, a programmer overcomes many of the problems of programming. He recommends that behavioural objectives of the programme should not only be defined with care but in considerable detail.

and Julie Vargas, 1972) provide following persuasive reasons for the careful definition of behavioural objectives:

1. It gives a beacon to the instructor by which to set his course as he writes the programme.

2. It provides sound basis for selecting appropriate subject matter, teaching methods and the material to be used during instruction.

3. It gives a standard to measure the attainment of instructional objectives - a standard set by the instructor and not by an outsider. It makes possible to evaluate a course or programme efficiency and in turn it provides feedback to the instructor.

4. It provides a guideline for constructing tests and other instruments for evaluating student's achievement. It specifically suggests test items that clearly reflect the student's ability to perform the desired skills or that will reflect how well the student can demonstrate his acquisition of desired information and by this way it makes the job of test construction easier.

5. It gives student a plain statement where he is going and provides him the means to evaluate his own progress at any place along the route of instruction. Since the student knows before hand what he must learn in any given unit of instruction, he can organise his efforts into relevant activities. He also gets motivation for learning.
According to Robert Mager (1962) an objective is a statement communicating an intent, describing a change in a learner— a statement of what the learner is to be like when he has successfully completed a learning experience. It is a description of a pattern of behaviour (performance) we want the learner to be able to demonstrate. "Julie Vargas (1972) defines a behavioural objective as "a statement of what the student should be able to do upon completion of the instruction."

There is a number of schemes of writing behavioural objectives, but the approach recommended by Robert Mager (1962) has been widely used in programmed instruction owing to its workability and operational utility. According to Mager, writing of a well formed (ideal) behavioural objective requires each of the following operations:

1. Identification of the terminal behaviour (performance) which the instruction attempts to produce.

2. Definition of the desirable behaviour further by describing the important conditions under which the behaviour is expected to occur.

3. Specification of the criteria of acceptable performance by describing how well the learner must perform to be considered acceptable.

Although each of the above mentioned items might help an objective to be more specific, it is not necessary to include all
three in each objective (Robert Mager, 1962).

For the formulation of behavioural objectives of the present programme on "Hindi Vocabulary Building" procedure suggested by Robert Mager was followed. Due care was taken to render each instructional objective as explicit as possible and the objectives of the programme were spelled out in considerable detail. These behavioural objectives are being systematically presented in the following section.

UNIT - 1.

After the study of this unit the learner will be able to:

1. define the term 'suffix' correctly;
2. select the correct alternative for the location of a suffix in a root or root word, from the given list of alternatives;
3. select the correct alternative for the characteristic of a suffix with regard to its meaning, out of alternatives to choose;
4. select correct alternative for the characteristic of a suffix with regard to its use, from the given list of alternatives;
5. select correct alternative for the characteristics of a suffix with regard to the modification of meaning of a root or root word, from the given list of alternatives; and
6. recognize that significance of suffixes lies in the word formation after adding to the roots or rootwords.
UNIT - II.

After the study of this unit the learner will be able to:

7. list at least five suffixes borrowed from Sanskrit to Hindi;
8. separate a suffix from the given suffix-word;
9. separate a rootword from the given suffix-word;
10. analyze the given suffix-word into a rootword and suffix;
11. build new word by synthesizing the given root-word and a suffix;
12. form new word by adding appropriate suffix to the given root-word; and
13. write at least two examples of formed words from the given suffix.

UNIT - III.

After the study of this unit the learner will be able to:

14. recognize the meaning of a given suffix;
15. write the meaning of a given suffix;
16. write more than one meanings of a given suffix;
17. write the meaning of a given suffix-word; and
18. select correct alternative for the meaning of a particular suffix word out of the given alternatives to choose.
UNIT - IV

After the study of this unit the learner will be able to:

19. form at least three new words from the given root-word by using three different suffixes (one suffix at a time);

20. build new word from a given root-word and more than one suffixes (more than one suffixes at a time);

21. separate suffixes from the given suffix-word having more than one suffixes;

22. separate root-word from the given suffix-word composed of more than one suffixes;

23. select correct alternative for a root-word, a particular suffix-word composed of more than one suffixes, from the given list of alternatives;

24. analyze the given suffix-word composed of more than one suffixes into a rootword and suffixes; and

25. select correct alternative for the given rootword and suffixes of a particular suffix-word composed of more than one suffixes, out of the given list of alternatives.

ANALYSIS OF THE CORE CONTENT:

The analysis of the core material is an extremely valuable step in the preparatory stage of programming. According to Peter Pipe (1966), the development core material definitely takes the
programmer closer to rapid programming. Not only does it save
time in the actual writing of a programme, but it can also do a
lot for goodwill and serve as a valuable check point.

Before starting the writing of the programme, the investi-
gator developed a list of core content on "Hindi Vocabulary
Building". For this purpose, 50 Sanskrit suffixes (Tatsama
suffixes) were selected. These suffixes run as under:

tē, tva; vān; mān; tara; tama; maya; mātra; ṛ;
vat; tahn; ka; ma; la; ra; va; da; sāh; vala; tana;
sāt; cit; tva; thā; dha; dā; mā; vya; aka; atha; dama;
āmā; ālu; ita; ina; ima; ima; iya; iya; ila; istha; i; Ina;
Iya, ule; i, ika; eya; y; a; and tya. (= 50 suffixes).

The whole content of the intended "Hindi Vocabulary
Building" was thoroughly scrutinized and divided into four major
units. These units pertained to the concept of a suffix; analysis
of suffix-words into suffixes and rootwords and synthesis of root-
words and suffixes; meaning of suffixes and suffix-words, and
synthesis of one or more different suffixes with the single
rootword.

The contents to be taught unitwise are given below:

UNIT - I.

Definition of a suffix: A suffix is that part which is
added to the end of a root or a rootword.

Location of a suffix in a word: A suffix is added to the
end of a root or a root-word.
Characteristics of a suffix with regard to its meaning and use:
(a) a suffix does have its own meaning;
(b) a suffix does not have its independent use; and
(c) when a suffix is added to the end of a root or a root-word, it modifies the original meaning of that root or root-word.

Importance of suffixes: Importance of suffixes lies in the formation of new words from the roots or root-words.

UNIT - II.

Suffixes borrowed from Sanskrit to Hindi.

Use of Sanskrit suffixes only with Sanskrit words frequently used in Hindi.

Some words are formed by the simple addition of suffixes to root-words; such words can be analyzed into root-words and suffixes easily.

Some of the suffixes which are added to root-words without bringing any change into them are the following:
- tā; tvā; vān; mān; tara; tana; maya; mātra; vī;
vat; tāh; ka; ma; la; ra; va; sa; sāh; vala;
tana; sāt; cit; tra; thā; dhā; dā; mī; vya.
( = 28 suffixes).

Suffix: tā

e.g.: guru - gurutā; lagnu - lagnutā; vīra - vīratā; dhīra-
dhīratā; paśu - paśutā; mūkha - mūrkhatā; caturā-caturatā;
sundara - suñdaratā; dāsa - dāsatā; bandhu - bandhatā;
jana - janatā; vidvat - vidvattā; manat - manattā;
kavi - kavītā; sama - samatā; sīsū - sīsūtā;
mitra - mitratā; mama - mamatā.

**Suffix: tva**

e.g.: vyakti - vyaktītva; kavi - kavītva; satī - satītva;
nārī - nāritva; stri - strītva; śātru - śātrutva;
mātrī - mārtītva; brāhmaṇa - brāhmaṇatva; manusya - manuyatva;
prabhū - prabhiṭṭva; netr - netṛtva; kṛti - kṛśītva;
śāsa - śāṣatva; mama - mamatva; sva - svatva; astiṣṭitva;
nīja - nījatva; bandhu - bandhutva; bhṛātrī - bhṛātṛtva.

**Suffix: vān**

e.g.: bala - balavān; dhana - dhanavān; rūpa - rūpavān;
guna - gunavān; dayā - dayāvān; jñāna - jñānavān;
nisthā - nisthavān; bhāgya - bhāgyavān; vidyā - vidyāvān;
pratibhā - pratibhāvān; śīla - śīlavān; gandha - gandhavān;
rasa - rasavān; caritra - caritravān.

**Suffix: mān**

e.g.: ārī - ārīmān; buddhi - buddhimān; mati - matimān; gati - gatimān;
kṛti - kṛtimān; sakti - saktimān.

**The suffix vān** is added only to such rootwords as end in the vowel 'a' or 'ā'.

**The suffix mān** is added to the rootwords which end in a vowel other than 'a' or 'ā'.

**Suffix: tara**

e.g.: sundara - sundaratara; komala - komalatara; vidvat - vidvatatarā
mahat - mahattara; adhika - adhikatara; nyūna - nyūnatarā;
mrū - mroutara; laghu - laghutara; guru - gurutara; katu-
kātutara; nimna - nimnatara; kathora - kathora; ucca - uccatara;
suska - suskatara; Sarasā - Sarasatara; Ṛgūna - Ṛgūnatara;
śrestha - śresthatara.

Suffix: tama
E.g.: laghu - laghutama; mahat - mahattama; ucca - uccatama;
nimna - nimnatama; guru - gurutama; nyūnatama
adika - adhikatama; mrū - mydutama; sundara - sundaratama;
komala - komalatama; vidvat - vidvattama; kathora - kathoratama;
suska - suskatama; Ṛgūna - Ṛgūnatama; śrestha - śresthatama; katu - kātutama; Sarasa - Sarasatama.

Suffix: maya
E.g.: ānanda - ānandamaya; karunā - karunāmaya; dayā - dayāmaya;
prema - premamaya; svarna - svarnamaya; kāṭha - kāṭhamaya;
loha - lohamaya; māṇa - māṇamaya; sānti - sāntimaya;
jnāna - jnānamaya; jala - jalamaya; mañju - mañjunamaya;
rasa - rasamaya; sakti - saktimaya; anna - annamaya; dūkhna-
dukhnamaya; sukha - sukhamaya.

Suffix: mātra
E.g.: ksana - ksanāmātra; pala - pālamātra; nāma - nānamātra;
lka - lkāmātra; alpa - alpamātra; leśa - lesamātra;
jīva - jīvamātra; prāṇi - prānīmātra.
Suffix: **vī**

e.g.: tapas - tapasvī; yasas - yassvī; tejas - tejasvī;
urjas - urjasvī; manas - manasvī; ojas - ojasvī;
medhā - medhavī; māya - māyavī.

Suffix: **vat**

e.g.: brāhmaṇa - brāhmaṇavat; kamala - kamalavat; pītr - pītravat;
candra - candravat; laksā - laksāvat; mātr - mātravat;
atma - atmavat; pasu - pasuvat; pūrva - pūrnavat;
vioni - vionivat.

Suffix: **taḥ**

e.g.: svabhāva - svabhāvataḥ; sādhana - sādhanaḥat;
amā - amātah; tattva - tattvatāḥ; pūrṇa - pūrṇatāḥ;
ϕnāla - ϕnālaḥ; vastu - vastutāḥ; visēṣa - visēṣatāḥ;
parināma - parināmataḥ; mūla - mūlataḥ; yathārtta - yathārttaḥ;
samāya - samāyatāḥ.

Suffix: **ka**

e.g.: dasa - dasaka; sata - satakā; sapta - saptaka; mūla - mūlaka;
nāma - nāmakā; visaya - visayaka; ātma - ātmaḥ.

Suffix: **ma**

e.g.: madhya - madhyama; pañca - pañcama; sapta - saptaḥ;
astā - astama; sau - saima; dasa - dasama; adha - adhama;
nevā - nevama.

Suffix: **la**

e.g.: sīta - sītalā; śyāma - śyāmala; manju - manjula;
mrdu - mrdula; mamsa - mamsala; vatsa - vatsala;
bahu - bahuła.

Suffix:ka
e.g.: madhu - madhura; mukha - mukhara; kunja - kunijera;
pandu - pandura.

Suffix:ya
e.g.: kesa - kesava; raji - rajiva; mani - maniva; arna-arnava.

Suffix:sa
e.g.: karka - karkasa; roma - romasa; loma - lomasā.

Suffix:saḥ
e.g.: akṣara - akṣarasah; sabda - sabdasah; krama - kramasah;
parikti - pariktisah.

Suffix:vala
e.g.: sikhā - sikhāvala; ūrjas - ūrjasvala; dante - dantēvala;
kṛsi - kṛśivala.

Suffix:vana
e.g.: purā - purātana; cīram - cīrantana; adhuna - adhunatama;
adya - adyatana; sada - sanatana; nava - nūtana.

Suffix:śat
e.g.: agni - agnisat; bhasma - bhasmasat; ātma - atmásat.

Suffix:cit
e.g.: kim - kincit; kada - kadācit.
Suffix: *-ta*
E.g.: *anya* - *anyatra*; *sarpa* - *saravatra*; *eka* - *ekatra*.

Suffix: *-thā*
E.g.: *anya* - *anyathā*; *sarpa* - *sarvathā*.

Suffix: *-dhā*
E.g.: *bahu* - *bahunā*; *nava* - *navadhā*.

Suffix: *-dā*
E.g.: *sarpa* - *sarpadā*.

Suffix: *-mī*
E.g.: *vāk* - *vāgātā*.

Suffix: *-yya*
E.g.: *pitr* - *pitrīya*; *bhratṛ* - *bhratrīya*.

There are suffixes, before the addition of which the final vowel of a root-word is dropped. Some of such suffixes are as under:

*eka*; *atha*; *āhana*; *āmi*; *ālu*; *ita*, *ina*; *ima*; *imā;iya*; *ila*; *iṣṭa*; *in*; *īna*; *īya*; *ula* (= 16 suffixes).

Suffix: *-aka*
E.g.: *upadesa* - *upadesaka*; *pracāra* - *pracāraka*; *nimāma*-nimāmsaka
*siksā* - *siksaka*; *nidesa* - *nidesaka*; *nīdā* - *nīdaka*;
*nimsa* - *nimśaka*; *vicārā* - *vīcāraka*; *raksā*-raksaka;
*cikitsā* - *cikitsaka*; *anuvāda* - *anuvādaka*.

Suffix: *-atha*
E.g.: *jara* - *jarattha*; *karma* - *karmathā*.
Suffix: śamane
e.g.: pitṛ - pitāmaha; mātṛ - mātāmaha.

Suffix: śāmi
e.g.: sva - svāmī

Suffix: śālu
e.g.: daśa - daśālu; lajjā - lajjälū; krpa - krpaḷū;
srādha - srauchālu; ṛṣyā - ṛṣyāḷu; niḍā - niḍāḷu.

Suffix: śita
e.g.: śīkṣā - śīkṣita; ghṛṇa - ghṛṇita; surbhi - surbhit;
vicāra - vicārita; anākura - anākurita; cintā- cintita;
upaksa - upakṣita; pīda - pīdita; palla - pallavita;
ānanda - ānandita; pramāṇa - pramāṇita; mīndā- mīndita;
niyama - niyamita; apekṣā - apekṣita.

Suffix: śāna
e.g.: mała - malina; barha - bharina; phala - phalin.

Suffix: śāma
e.g.: svarna - svarnima; rakte - raktima; pascā- pascima;
antara - antarima; agra - agrima.

Suffix: śāmā
e.g.: kāla - kālmā; lālā - lālīmā; laghu - laghīmā; aruna- arunīm;
nila - nilīmā; mrō - mrōcīmā; guru - garīmā; manah- manīmā.

Suffix: śīya
e.g.: yajña - yajñīya; ksatra - ksatriya.
Suffix: ila
e.g.: pānka - pānkle; jāta - jatile; svapna - svapnila;
phena - phenile; chūma - chūmila.

Suffix: istha

e.g.: bala - balistha; svādu - svādīstha; ghanā - ghanistha;
oja - ojistha; lagnum - laghishta; guru - guristha.

Suffix: Ṣ

e.g.: dhana - dhani; gura - guñi; sukna - sukni; kroḍha-kroḍhi;
dhunkha - dhunkhi; prama - prami; yoga - yogī; rna - rni;
artha - artni; bala - bali; sāhase - sāhasi; sāmyama-
sāmyami; udyama - udyami.

Suffix: īna

e.g.: kula - kulīna; grāma - grāmīna; sarvānga - sarvāṅgīna;
yuga - yugīna; nava - navīna; kāle - kālīna; prāc - prācīna;
ervāc - ervācīna.

Suffix: īya

e.g.: bhārata - bhāratīya; sīvga - sīvṛgīya; śivara-śivārīya;
sthāna - sthānīya; pṛṣanta - pṛṣṭīya; parvata- parvatīya;
pūrva - pūrṇīya; rastra - rastrīya; pustaka - pustakīya;
yūropa - yūropīya; kendra - kendīya; kṣetra- kṣetṛīya;
sva - svakīya; para - paraśīya; rāja - rājākiya.

Suffix: ula

e.g.: mātr - mātula.

There are suffixes which, when added change the first and
the last vowel of a root-word. Some of such suffixes are
as follows:
i, ika; eya; ya and a (= 5 suffixes).
**Suffix: ।**

When the suffix । is added to a root-word, the first vowel ə changes to ए, and the final vowel is dropped.

*e.g.*: Dasharatha - Dāsaratha; Marut - Māruti.

**Suffix: ।क**

When the suffix ।क is added to a root-word, the first vowel ə changes to ए, and the final vowel is dropped.

*e.g.*: dharma - dharmika; parivēra - parivarika; darsana-dārsanika; rasayana - rasayanika; varṣa - varṣika; pakṣa - pakṣika; samskṛti - samskr̥ti; alankāra - alankārika; saiktāna - saiktānika; prakṛti-prakṛtika; saṁjñā-saṁjñika; adhyātma - adhyātmika; tarka - tārkika; saṁpradāya-saṁpradāya; ।क - śarīra - śarīrika; saṁsāra - saṁsārika; manas - manasika; ।ा - ।ासika.

When the suffix ।क is added to a root-word, the first vowel ə changes to ए and the final vowel is dropped.

*e.g.*: dina - daिनika; vijnana - vaिज्ञanika; vidhāna - vaिधनika; pīṣa - paिषिकa; vicara - vaिसरika; siddhānta - saिद्धानितika; lōcā - lोचिकa; vikalpa - vaिकल्पika; itīhāsika - itīhāsika

When the suffix ।क is added to a root-word, the first vowel ə changes to ए, and the final vowel is dropped.

*e.g.*: nīti - nātika; jīva - jaिवika.

When the suffix ।क is added to a root-word, the first vowel ə changes to ए and the final vowel is dropped.
e.g.: veda - vañika; senā - sañika; geva - davika;
dena - datika; vetana - vaitanika.

When the suffix *ika* is added to a rootword, the first vowel *u* changes to *au*, and the final vowel is dropped.

* e.g.: purana - paauranika; pusta - paustika; buddhi-buddhika; kuta - kautumbika; mukha - mañkika; ujça-auriṣkika; udyoga - auyogika.

When the suffix *ika* is added to a rootword, the first vowel *u* changes to *au*, and the final vowel is dropped.

* e.g.: bhuogola - bhaugolika; bhuta - bhautika; mula - mauli.

When the suffix *ika* is added to a rootword, the first vowel *o* changes to *au*, and the final vowel is dropped.

* e.g.: loka - laukika; yoge - yaugika.

When the suffix *ika* is added to a rootword, the first vowel *ā* remains unchanged, and the final vowel is dropped.

* e.g.: māsa - māsika; sānitya - sānityika; vāstava-vāstavika; kāla - kālikā; sāhasa - sāhasika; mātra - mātrika; māyā - māyika; bhāsa - bhāsika; ātma - ātmi.

**Suffix: eva**

When the suffix *eva* is added to a rootword, the first vowel *a* changes to *ā*, and the final vowel is dropped.

* e.g.: Gāṅgā - Gangeya; bhāgini - bhāgineya; patha-pātheya; agni - āgneya; Atri-Ātreya; atithi - ātitheya.

When the suffix *eva* is added to a rootword, the first vowel *i* changes to *ai*, and the final vowel is dropped.
e.g.: Vinatā - Vainataya.

when the suffix eya is added to a rootword, the first vowel u changes to au, and the final vowel is dropped.

e.g.: purusa - paursyeya; Kanti - Kaunteya.

when the suffix eya is added to a rootword, the first vowel e remains unchanged, and the final vowel is dropped.

e.g.: Rādhā - Rādheya; Mārkanda - Mārkandeya.

Suffix ya

when the suffix ya is added to a rootword, the first vowel a changes to ū, and the final vowel is dropped.

e.g.: pandita - pānditya; catura - cāturya; Gānaka - Gānakya; Garga - Gārgya; kathina - kāthinya; Aditi-Aditya; saphale - sāphalya; gambhirā - gāmbhirya; lavana-lāvanya; samipa - sāmipyā; pradhāna - pradhānya; svatantra- svātāntrya; svastha - svāsthyā; vapi - vapiya; adhipati - ādhipatyā.

when the suffix ya is added to a rootword, the first vowel i changes to ā, and the final vowel is dropped.

e.g.: nipuna - naipunya; Diti - Dāitya; vidhavā - vaidhavya; vicitra - vicitrā; sīthila - sīthilya; viṣama-vaṣamya.

when the suffix ya is added to a rootword, the first vowel I changes to ā, and the final vowel is dropped.

e.g.: dhīra - dhniryā; dīna - dainya; Āśvara - āśvarya.

when the suffix ya is added to a rootword, the first vowel e changes to ā, and the final vowel is dropped.
When the suffix "ya" is added to a rootword, the first vowel \( u \) changes to \( au \), and the final vowel is dropped.

**Example:**
- Kumāra - Kaumārya;
- sundara - saundarya;
- sujana - saujanya;
- puronita - pauronitya;
- udāra - audārya.

When the suffix "ya" is added to a rootword, the first vowel \( o \) changes to \( au \), and the final vowel is dropped.

**Example:**
- Soma - saumya;
- cora - caurya.

When the suffix "ya" is added to a rootword, the first vowel \( a \) remains unchanged, and the final vowel is dropped.

**Example:**
- dārune - dārunya;
- gāsa - gāsya;
- brāhmaṇa - brāmangya;
- bāla - bālya;
- alasa - ālasya;
- raja - rājya;
- grāma - grānyya;
- prāc - prācya.

**Suffix: a**

When the suffix "a" is added to a rootword, the first vowels \( a \rightarrow \tilde{a} \), \( i \rightarrow \tilde{i} \), \( u \rightarrow \tilde{u} \); and \( e \) change to \( e \), \( ai \), \( au \) and \( ek \) respectively; and the final vowels \( a \rightarrow \tilde{a} \), \( i \rightarrow \tilde{i} \), are dropped, while \( u \) - \( \tilde{u} \) change to \( au \).

**Example:**
- Vasudeva - Vāsudeva;
- Rāghava - Rāghava;
- Kāsyapa - Kāsāyapa;
- pasupati - pāsūpata;
- laghu - lāghava;
- Āsavatī - Āsavatā.
When the suffix *tva* is added to a rootword, the first vowel a and y change to ā and au respectively, while the final vowel remains unchanged.

*Example:* pasćāt — pascāttya; daksinā — daksinātya; puras-paurastya.

---

If the meaning of a suffix is known, the meaning of a word formed with its help can be easily made out.

The suffix *tā* denotes "the quality of being."

*Example:* laghutā; gurutā; sundarātā; mūrkhatā; vīratā; manusyātā.

The suffix *tva* indicates "the quality of being."

*Example:* vyaktitva; strātva; purusatva; bandhutva; nārītva; satītva.

The suffix *vān* conveys the sense of "having, possessing."

*Example:* balavān; dhanavān; gunavān; rūpavān; dayāvān; jñānavān.

The suffix *mān* gives the meaning of "having, possessing."

*Example:* Srimān; matimān; saktimān; bodhimān; āyuṣmān; kirtimān.
The suffix *tāra* has the sense of " in comparison to, or as compared to":

e.g.: suksesātāra; ayūnatāra; mahattāra; nimmatāra; udcatāra; mgutāra.

The suffix *tama* communicates the sense of " of all, in comparison to all"

e.g.: Komalatama; urhmatama; ṣunikatama; laghatama; gurutama; alapatama.

The suffix *maya* is added in the sense of "consisting of"

e.g.: śāntimaya; ambakāramaya; jñānamaya; ānandamaya; sukhamaya; duññhamaya.

The suffix *maya* also means "made of"

e.g.: annamaya; kāsthamaya; lomamaya; svarnamaya.

The suffix *mātra* is added in the sense of "as much as, mere."

e.g.: ānamātra; āganamātra; āsāmātra; pālamātra; alpaṃātra.

The suffix *mātra* also connotes the sense of 'whole, entire, all'.

e.g.: prāṇimātra; manuvyāmatra.

The suffix *vi* means "having, possessing".

e.g.: tejasvi; tapasvi; madhavi; ojasvi; mayavi; yaśasvi; urjasvi.

The suffix *vot* means "as, like, similar to, resembling to."

e.g.: Kamalavat; candavat; ātmavat; pasvat; pitvat; laksnavat.

The suffix *tah* indicates "in the manner of"

e.g.: vastutah; tattvatah; pūrnatah; mūlatah; aṃsatah; yathārthaḥ

* Skt. Prānimātra
The suffix ka conveys the sense of "belonging to, relating to"

* e.g.: viśayaka; mūlaka; ātmaṇa; nāmaka.

The suffix ka also communicates the sense of "the group or collection of"

* e.g.: saptaka; dasaka; sātaka.

The suffix ma denotes the sense of "connected with, related to"

* e.g.: adima; madhyama; adhama.

The suffix ma also means "in sequence"

* e.g.: pañcama; saptama; āstama; navama; dasama.

The suffix le means "having, possessing."

* e.g.: māṁsala; sītāla; vatsala.

The suffix ra gives the meaning of "having or possessing."

* e.g.: madhura; kuñjara; pāṇjura; mukhara.

The suffix va means "having or possessing."

* e.g.: Kesāva; maniva; rājīva; arṇava.

The suffix sa gives the sense of "having, in possession of."

* e.g.: romasa, lomasā.

The suffix sah expresses the sense of "each."

* e.g.: aksarasah, sabdasah; paṅktisah.

The suffix vela conveys the sense of "having or possessing."

* e.g.: sikhāvala; dantavala; ārjasvāla.

The suffix tana means "related to."

---
e.g.: purātana; adyatana; cirantana; sanātana; prāktana; 
adunātana.

The suffix sat connotes the sense of "changed or 
reduced to."

e.g.: bhasmasat; agnisat; atmasat.

The suffix cit denotes the sense of "uncertainty."

e.g.: kīścit; kadācit.

The suffix tra is added in order to convey the sense of 
"locality."

e.g.: anyatra; saravatra; ekatra.

The suffix tha denotes "manner or kind"

e.g.: sarvathā; anyathā.

The suffix dā is used in a temporal sense.

e.g.: sarvadā.

The suffix dhā conveys the sense of "numeration or kind"

e.g.: navadā; bahudā.

The suffix mā means "having command of".

e.g.: vāgāmī

The suffix vya is employed to communicate the meaning 
"the son of".

e.g.: bhāvya bhṛatyava.

The suffix vya also means "the brother of".

e.g.: pitrivyā.

The suffix ake means "the doer of".

e.g.: kimāṃsaka; anuvādaka; himsaka; raksaka; cikitsaka; 
nindaka.
The suffix _atha_ is added to convey the sense of "possessing"

e.g.: Kārmattha; jeraatha.

The suffix _ājōeda_ communicates the sense of "the father of".

e.g.: pitāmaha; mātāmaha.

The suffix _āmi_ means "having command of".

e.g.: svāmi

The suffix _ālu_ has the meaning of "having or possessing."

e.g.: ṭreyālu; dayālu; lajjālu; ṛṇapalu; sṛddhālu; niṣrālu.

The suffix _āte_ gives the meaning of "possessing".

e.g.: ānandita; taramgita; pīditā; puspita; ṛṇakurika; cintita.

The suffix _ima_ conveys the sense of "possession".

e.g.: Malina;

The suffix _ima_ is used in the sense of "Related to".

e.g.: antima; agrima; pascima; raktima; svarnima; antarima.

The suffix _ima_ denotes "the quality of being ".

e.g.: Kālimā; nīlimā; mrudimā; garimā; mahimā; laghimā.

The suffix _iya_ means "relating or belonging to ".

e.g.: yajñiya; kṣatriya.

The suffix _ila_ is used to convey the meaning of "possessing".

e.g.: pāṅkila; phenila; dhūmila; svāpnila; jaṭila.

The suffix _īstha_ is added in the sense of "having the greatest quality / quantity of ".

e.g.: balīstha; ghanīstha; garīstha; svāditstha; lāghistha.

The suffix _ī_ conveys the sense of "possessing ".

e.g.: dhanī; guṇī; bali; kapatī; sāhasī; jhanī.

The suffix ina expresses the sense of "related to".

e.g.: pṛacīna; yugīna; arvacīna; kulīna; grāmīna; sarvāṅgaīna.

The suffix iva gives the meaning of "relating to".

e.g.: pṛātiya; sthāniya; kendriya; bhāratīya; parvatiya; rājākiya.

The suffix ical is used in the sense of "the brother of".

e.g.: mātula.

The suffix a means "the son of".

e.g.: Dāsarathī; Māruti.

The suffix ikā denotes the sense of "related to".

e.g.: sāmājika; pārivārika; ārthika; dainika; ādhyātmika.

The suffix ikā also signifies the sense of "the knower of 'or 'one who knows".

e.g.: tārkika; ālāṁkārika; naiyyāyika; dārsānaka; tāntrika.

The suffix eya gives the meaning of "the son of".

e.g.: vainateya; Gāngeya; bhāgineya; Kaunteya; Rādhaya.

The suffix eya is also used in the sense of "related to".

e.g.: āgneya; pāuruṣeya; pātheya; ātitheya.

The suffix ya connotes the meaning "the son of".

e.g.: Cāṇākya; Sāndalya; Aditya; Daitya.

The suffix ya also expresses "the quality of being".

e.g.: pānditya; saundarya; cāturya; vaidhayya.

The suffix ya also conveys the sense of "related to".

e.g.: grāmya; prācyā.
The suffix ṣ has the sense of "the son of".  
*e.g.*: Vasudeva; Pārtha; Pāṇḍava.

The suffix ṣ also has the meaning of "the descendent of".  
*e.g.*: Rāghava; Kāurava;

The suffix ṣ also connotes the sense of "the follower of".  
*e.g.*: Saiva; Vaisnava; Baudha.

The suffix ṣ is also employed in the sense of "related to".  
*e.g.*: pārthiva; naisa; saura; pāṣupata.

The suffix tya is added so as to convey the sense of "related to".  
*e.g.*: pāscāttya; dāksinātya; paurastya.

**UNIT - IV.**

Different words are formed from a single rootword by adding different suffixes; *e.g.*:

<table>
<thead>
<tr>
<th>Rootword</th>
<th>Suffix</th>
<th>Word formed</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) guru</td>
<td>ṣ tā</td>
<td>= gurutā</td>
</tr>
<tr>
<td></td>
<td>+ tva</td>
<td>= gurutva</td>
</tr>
<tr>
<td></td>
<td>+ imā</td>
<td>= gairinā</td>
</tr>
<tr>
<td></td>
<td>+ īśṭha</td>
<td>= garistha</td>
</tr>
<tr>
<td></td>
<td>+ a</td>
<td>= gaurava</td>
</tr>
<tr>
<td></td>
<td>+ tara</td>
<td>= gurutara</td>
</tr>
<tr>
<td></td>
<td>+ tama</td>
<td>= gurutama</td>
</tr>
<tr>
<td>(ii) laghu</td>
<td>ṣ tā</td>
<td>= lagnutā</td>
</tr>
<tr>
<td>(ii)</td>
<td>laghu</td>
<td>+ tva</td>
</tr>
<tr>
<td>--------</td>
<td>----------</td>
<td>-------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ imā</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ tara</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ tama</td>
</tr>
<tr>
<td>(iii)</td>
<td>Sundara</td>
<td>+ tā</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ ya</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ tara</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ tama</td>
</tr>
<tr>
<td>(iv)</td>
<td>adhika</td>
<td>+ tā</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ ya</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ tara</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ tama</td>
</tr>
<tr>
<td>(v)</td>
<td>kathina</td>
<td>+ tā</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ ya</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ tara</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ tama</td>
</tr>
<tr>
<td>(vi)</td>
<td>nava</td>
<td>+ la</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ Īna</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ tana</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ dhā</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ ma</td>
</tr>
<tr>
<td>(vii)</td>
<td>mṛdu</td>
<td>+ tā</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ tva</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ a</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ tara</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ tama</td>
</tr>
</tbody>
</table>
Some words are formed by adding more than one suffixes to a rootword at a time, e.g.:

<table>
<thead>
<tr>
<th>Rootword</th>
<th>Suffixes</th>
<th>Wordformed</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) nava</td>
<td>+ ïna + tā</td>
<td>= navinatā</td>
</tr>
<tr>
<td>(ii) nava</td>
<td>+ tana + tā</td>
<td>= rūtanatā</td>
</tr>
<tr>
<td>(iii) madhu</td>
<td>+ ra + ima</td>
<td>= madhurima</td>
</tr>
<tr>
<td>(iv) madhu</td>
<td>+ ra + ya</td>
<td>= madhurya</td>
</tr>
<tr>
<td>(v) mela</td>
<td>+ ina + ya</td>
<td>= mālīnya</td>
</tr>
<tr>
<td>(vi) itināsa</td>
<td>+ ika + tā</td>
<td>= aitināsikatā</td>
</tr>
<tr>
<td>(vii) karka</td>
<td>+ sa + tā</td>
<td>= karkasatā</td>
</tr>
<tr>
<td>(viii) purā</td>
<td>+ tana + tā</td>
<td>= purātanatā</td>
</tr>
<tr>
<td>(ix) madhya</td>
<td>+ ma + ika</td>
<td>= madhyamika</td>
</tr>
<tr>
<td>(x) prāc</td>
<td>+ ina + tā</td>
<td>= prācinatā</td>
</tr>
<tr>
<td>(xi) manu</td>
<td>+ a + Iya + tā</td>
<td>= mānaviyatā</td>
</tr>
<tr>
<td>(xii) pāṣu</td>
<td>+ a + ika + tā</td>
<td>= pāsavikatā</td>
</tr>
</tbody>
</table>
It is worth mentioning that in carrying out the analysis of the core content and then in developing its logical sequence, a number of main sources of information had been tapped. Apart from the prescribed Hindi text books, text books on grammar, syllabuses, students' work books, examination question papers & teachers' guides of IX standard, some experienced Hindi teachers and linguists of Hindi & Sanskrit were also consulted so as to ascertained the technical accuracy and to ensure a complete and authentic picture of the core content.

DEVELOPMENT OF CRITERION TEST:

To measure the achievement of programme's objectives, the development of appropriate instruments (Hartley, 1972). It has also been realized by a number of researchers (Ebel, 1972; Cronbach, 1970; Gagne, 1967; and Hambelton, 1974) that traditional norm referenced tests - standardized achievement tests are less useful within the context of new instructional models (viz., Programmed Instruction, Computer Assisted Instruction, Mastery Learning, Individualized Instruction and Project Plan etc.) and in some cases completely inappropriate since they are mainly designed to estimate each individual's ability level related to that of other individuals.

The test which is constructed to measure whether the students have achieved behavioural objectives after undergoing a
sequence of instruction is usually termed as criterion test. Of the various definitions proposed for criterion-test (e.g. Kriewall, 1969; Popham and Musek, 1969; Ivens, 1970; and Jackson, 1970), the definition given by Glaser and Nitko (1971) is very flexible and is applied most frequently to-day by programmers. According to Glaser and Nitko (1971) a criterion test is one "that is deliberately constructed to yield measurements that are directly interpretable in terms of specified performance standards."

A criterion test was constructed to evaluate the effectiveness of the programme under reference and to use in the experimental study. The following section gives a detailed account of its preparation.

In the planning stage of criterion test, suggestions given by Gronlund (1973) were given due weightage. The first step in the planning for the criterion test was to delimit the achievement area to a reasonable size. It was done after the discussion with experienced teachers of the subject. The instructional programme on 'Hindi vocabulary building' was decided to cover fifty Tatsam suffixes. After having delimited the task domain behavioural objectives were formulated, following the procedure recommended by Mager (1962). It may be mentioned that the list of objectives was confined to such learning outcomes as they could be measured by a criterion test. Just after
formulation of objectives, a list of core content was developed. The subject matter to be taught through the programmed instructional sequence was thoroughly analyzed with the help of subject matter experts and experienced teachers. The entire content was divided into four major units. The standard of acceptable performance was subsequently fixed up for the evaluation of criterion test. Such a standard is typically expressed in terms of percentage of the test items as the students are expected to answer correctly. At a first glance, 100 percent mastery might seem to be the ideal criterion for a mastery test. However, the research work of Block (1971) has suggested that 80 to 85 percent of correct answers is more realistic standard. He noted that setting an standard too high, might be wasteful of the time of the teacher as well as of the students, and might have a negative effect on a student-motivation. The lower limit tends to provide more opportunities for student success and thus increases the amount of positive reinforcement. Hence, keeping in view Block’s (1971) observations, 85 percent standard of performance was set up for the evaluation of the criterion test.

The next step in planning of criterion test was to prepare a table of specification. The table of specification provides greater assurance that the test will measure a representative sample of the content included in the instruction as well as in the objectives of the programme. Here, the investigator took the decision about the number of items to be prepared along with the relative weightage to be given to each content area and the whole
range of behavioural objectives. At least one item was to be written for each instructional objective and in some cases more items for one objective, considering their relative importance. Table 2.1 indicates the specifications for criterion test containing the relative weightage given to each unit content area and instructional objective.

**TABLE - 2.1**

**TABLE OF SPECIFICATIONS FOR CRITERION TEST SHOWING RELATIVE WEIGHTAGE GIVEN TO EACH UNIT/ CONTENT AREA AND INSTRUCTIONAL OBJECTIVE.**

<table>
<thead>
<tr>
<th>Unit/Content Area No.</th>
<th>Serial No. of Instructional Objectives</th>
<th>No. of Items</th>
<th>Total No. of Items %</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>Concept of a Suffix</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Analysis of suffix-</td>
<td>7</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>words into rootwords</td>
<td>8</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>and suffixes;</td>
<td>9</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Synthesis of the rootwords and suffixes.</td>
<td>11</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Meaning of suffixes</td>
<td>14</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>and suffix-words</td>
<td>15</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>17</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Synthesis of one or</td>
<td>19</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>more different suffixes</td>
<td>20</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>with the root-words</td>
<td>21</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>22</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>23</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>80</td>
<td>80</td>
</tr>
</tbody>
</table>
Table 2.1 indicates that criterion test was supposed to have 80 items, out of which 7.5% pertaining to unit I; 42.5% items to unit II; 37.5% items to unit III; and 12.5% items to unit IV.

When the table of specifications was completed, the investigator constructed test items to measure the behaviour described in a particular outcome as directly as possible. Since different test-items call forth different types of behaviour. The effort was made to choose an appropriate format. The items included in the criterion test were multiple-choice; true false; completion and short answer type. Table 2.2 gives the details of weightage which was given to different types of items.

### Table 2.2

**Weightage Given to Different Types of Items in Criterion Test**

<table>
<thead>
<tr>
<th>Unit No.</th>
<th>Multiple Choice</th>
<th>True-false</th>
<th>Completion</th>
<th>Short Answer</th>
<th>Total</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>1</td>
<td>-</td>
<td>1</td>
<td>6</td>
<td>7.5%</td>
</tr>
<tr>
<td>2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>34</td>
<td>34</td>
<td>42.5%</td>
</tr>
<tr>
<td>3</td>
<td>6</td>
<td>7</td>
<td>6</td>
<td>11</td>
<td>30</td>
<td>37.5%</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>-</td>
<td>3</td>
<td>5</td>
<td>10</td>
<td>12.5%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>12</strong></td>
<td><strong>8</strong></td>
<td><strong>9</strong></td>
<td><strong>51</strong></td>
<td><strong>80</strong></td>
<td><strong>100.00%</strong></td>
</tr>
</tbody>
</table>

% 15.0% 10.0% 11.25% 63.75% - 100%

Table 2.2 shows that the criterion test contained 15 percent multiple-choice, 10 percent true-false, 11.25 percent completion and 63.75 percent short-answer type items.
Each test item was written on a card. The specific learning outcome was stated at the top of the card and the test-item was placed beneath it. The items of criterion test, thus prepared, were carefully edited and reviewed for the content, relevance, the learning outcomes, technical accuracy and language. The help of the subject matter experts and measurement experts were duly taken up at this stage.

Finally, the preliminary draft of criterion test was prepared by arranging the items in different sections in respect of their formats. Directions were written for the test as a whole and for each separate item-type, time allowed for answering and the procedure for recording the answers. The scoring key was also prepared. Preliminary draft of criterion test was duplicated and care was taken to ensure that copies were legible and free of typographical errors.

The first draft of the criterion test was tried out on a randomly selected group of 20 students of IX class from the two Hindi medium schools of Meerut City. The test was administered before and after the completion of instructional programme, during developmental testing. The sample included both boys and girls. The structure of the sample is given in Table 2.3.

<table>
<thead>
<tr>
<th>TABLE - 2.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>STRUCTURE OF THE SAMPLE FOR PRELIMINARY TRYOUT OF THE CRITERION TEST</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No. of subjects</th>
<th>Sex</th>
<th>Mean Age in years</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>Boys</td>
<td>13.7</td>
<td>IX</td>
</tr>
<tr>
<td>10</td>
<td>Girls</td>
<td>13.6</td>
<td>IX</td>
</tr>
</tbody>
</table>
Before administering criterion test on a representative sample of students, the investigator made an attempt to provide them physical and psychological environment conducive to their best efforts and the control of factors which might interfere with valid measurement. The students were told that test results were to be used to improve the instructional programme and these would not affect their promotion to the next higher class. The time limit provided to the students was liberal so as to get an idea of the average time limit to be fixed for the final draft of the criterion test.

The scoring of pre and post-tests was done according to the scoring procedure already decided. One mark was awarded to each correct item and zero mark was assigned to each incorrect item. No correction for guessing was applied since correction for guessing was unnecessary with the typical classroom test where pupils had sufficient time to consider all the questions (Gronlund, 1976; p.276).

ANALYSIS OF CRITERION TEST:

Popham and Housek (1969) state that "..... our earlier measurement designed for a system of test construction and test improvement has purposes other than measuring quality of instruction. Mechanisms such as 'Item analysis procedures' and 'internal consistency estimates' as well as the standard notions of 'validity' and 'reliability' are not pertinent to the kind of measurement procedures which just be used to assess the
attainment of measurable instructional objectives."

The item analysis procedure used with norm-referenced tests require variability in test scores, whereas variability in test scores is irrelevant in criterion-referenced tests. Therefore, it was considered desirable to apply alternative measures of item analysis recently developed for criterion test instead of using traditional indices of 'item difficulty' and 'discrimination power'.

(A) CRITERION DIFFICULTY OF THE TEST ITEM:

Beegs and Lewis (1975) have suggested a measure, known as 'criterion difficulty of the test item'. The criterion difficulty of the test item refers to the number of individuals who respond incorrectly to an item divided by the total number of individuals who respond.

As the criterion difficulty index approaches 1, the majority of the students are unable to respond the item and therefore, do not understand the information. As this ratio approaches zero, the majority of the individuals responding to the item understand the concept underlying the item and respond correctly. Thus, the index of criterion difficulty ranges between zero to one.

This index of criterion difficulty of the test item was computed for the post-test scores only by using the following formula:
\[ \text{Dc} = \frac{\text{No of individuals who respond incorrectly to an item}}{\text{Total No of individuals who respond to an item}} \]

Where -
Dc is an index of criterion difficulty of the test item.

Table 2.4 shows the values of 'Dc' for all the 80 items of criterion test.

**Table - 2.4**

VALUES OF 'Dc' FOR ITEMS OF THE CRITERION TEST

<table>
<thead>
<tr>
<th>Sl. No. Item</th>
<th>Dc</th>
<th>Sl. No. Item</th>
<th>Dc</th>
<th>Sl. No. Item</th>
<th>Dc</th>
<th>Sl. No. Item</th>
<th>Dc</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.00</td>
<td>21</td>
<td>0.05</td>
<td>41</td>
<td>0.00</td>
<td>61</td>
<td>0.00</td>
</tr>
<tr>
<td>2</td>
<td>0.00</td>
<td>22</td>
<td>0.15</td>
<td>42</td>
<td>0.00</td>
<td>62</td>
<td>0.05</td>
</tr>
<tr>
<td>3</td>
<td>0.00</td>
<td>23</td>
<td>0.30</td>
<td>43</td>
<td>0.20</td>
<td>63</td>
<td>0.15</td>
</tr>
<tr>
<td>4</td>
<td>0.00</td>
<td>24</td>
<td>0.25</td>
<td>44</td>
<td>0.30</td>
<td>64</td>
<td>0.05</td>
</tr>
<tr>
<td>5</td>
<td>0.00</td>
<td>25</td>
<td>0.20</td>
<td>45</td>
<td>0.00</td>
<td>65</td>
<td>0.15</td>
</tr>
<tr>
<td>6</td>
<td>0.05</td>
<td>26</td>
<td>0.15</td>
<td>46</td>
<td>0.00</td>
<td>66</td>
<td>0.05</td>
</tr>
<tr>
<td>7</td>
<td>0.15</td>
<td>27</td>
<td>0.30</td>
<td>47</td>
<td>0.05</td>
<td>67</td>
<td>0.30</td>
</tr>
<tr>
<td>8</td>
<td>0.25</td>
<td>28</td>
<td>0.25</td>
<td>48</td>
<td>0.30</td>
<td>68</td>
<td>0.00</td>
</tr>
<tr>
<td>9</td>
<td>0.05</td>
<td>29</td>
<td>0.35</td>
<td>49</td>
<td>0.30</td>
<td>69</td>
<td>0.00</td>
</tr>
<tr>
<td>10</td>
<td>0.10</td>
<td>30</td>
<td>0.00</td>
<td>50</td>
<td>0.35</td>
<td>70</td>
<td>0.00</td>
</tr>
<tr>
<td>11</td>
<td>0.55</td>
<td>31</td>
<td>0.00</td>
<td>51</td>
<td>0.10</td>
<td>71</td>
<td>0.00</td>
</tr>
<tr>
<td>12</td>
<td>0.65</td>
<td>32</td>
<td>0.00</td>
<td>52</td>
<td>0.05</td>
<td>72</td>
<td>0.00</td>
</tr>
<tr>
<td>13</td>
<td>0.00</td>
<td>33</td>
<td>0.00</td>
<td>53</td>
<td>0.25</td>
<td>73</td>
<td>0.00</td>
</tr>
<tr>
<td>14</td>
<td>0.00</td>
<td>34</td>
<td>0.00</td>
<td>54</td>
<td>0.40</td>
<td>74</td>
<td>0.00</td>
</tr>
<tr>
<td>15</td>
<td>0.00</td>
<td>35</td>
<td>0.05</td>
<td>55</td>
<td>0.00</td>
<td>75</td>
<td>0.20</td>
</tr>
<tr>
<td>16</td>
<td>0.00</td>
<td>36</td>
<td>0.00</td>
<td>56</td>
<td>0.00</td>
<td>76</td>
<td>0.50</td>
</tr>
<tr>
<td>17</td>
<td>0.05</td>
<td>37</td>
<td>0.00</td>
<td>57</td>
<td>0.05</td>
<td>77</td>
<td>0.70</td>
</tr>
<tr>
<td>18</td>
<td>0.05</td>
<td>38</td>
<td>0.00</td>
<td>58</td>
<td>0.00</td>
<td>78</td>
<td>0.35</td>
</tr>
<tr>
<td>19</td>
<td>0.20</td>
<td>39</td>
<td>0.00</td>
<td>59</td>
<td>0.10</td>
<td>79</td>
<td>0.60</td>
</tr>
<tr>
<td>20</td>
<td>0.35</td>
<td>40</td>
<td>0.00</td>
<td>60</td>
<td>0.05</td>
<td>80</td>
<td>0.50</td>
</tr>
</tbody>
</table>
Table 2.4 reveals that the values of 'Dc' ranges from 0.00 to 0.70. A detailed account of the distribution of items in various ranges of 'Dc' may be obtained from Table 2.5.

**TABLE - 2.5**

**FREQUENCY DISTRIBUTION AND PERCENTAGE OF THE ITEMS OF CRITERION TEST FOR VARIOUS VALUES OF 'Dc'**

<table>
<thead>
<tr>
<th>Values of 'Dc'</th>
<th>Number of Items</th>
<th>Percentage of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00</td>
<td>34</td>
<td>42.50%</td>
</tr>
<tr>
<td>0.01 - 0.10</td>
<td>16</td>
<td>20.00%</td>
</tr>
<tr>
<td>0.11 - 0.20</td>
<td>9</td>
<td>11.25%</td>
</tr>
<tr>
<td>0.21 - 0.30</td>
<td>10</td>
<td>12.50%</td>
</tr>
<tr>
<td>0.31 - 0.40</td>
<td>5</td>
<td>6.50%</td>
</tr>
<tr>
<td>0.41 - 0.50</td>
<td>2</td>
<td>2.50%</td>
</tr>
<tr>
<td>Above 0.51</td>
<td>4</td>
<td>5.00%</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>80</strong></td>
<td><strong>100.00%</strong></td>
</tr>
</tbody>
</table>

Table 2.5 shows that 95 percent of the total items have value of 'Dc' between 0.00 and 0.50. Only a small fraction of items have value of 'Dc' above 0.51. This clearly indicates that the students were able to respond to most of the items on criterion test after going through the instructional programme. Hence, criterion test was considered satisfactory for measuring the achievement of the students.
(B) SENSITIVITY TO INSTRUCTIONAL EFFECT (s):

Another measure 'Sensitivity to instructional effect(s)' has been developed to analyse the items of criterion test by Gronlund (1973). The index of sensitivity to instructional effect (s) indicates the degree to which an item reflects the intended effects of instruction (i.e., learning gains) occurring between the pre-test and post-test.

The effective items fall between 0.00 and 1.00. The higher positive value of the item is more sensitive to instructional effect (s). Items with zero and negative value do not reflect the intended effects of instruction.

For determining the index of sensitivity to instructional effect (s), a chart was prepared by simply listing the serial number of test items across the top of the chart and pupils' names, down the side of the chart. Then all the correct (+) and incorrect (-) responses were recorded for each student on the pre-test (B) and post-test (A). The number of students correctly attempting each item on pre-test (B) and post-test (A) was, thus, obtained.

Table 2.6 shows the number of students attempting each criterion test - item on pre-test and post-test.
TABLE 2.6

NUMBER OF STUDENTS ATTEMPTING EACH ITEM ON CRITERION TEST
BEFORE AND AFTER INSTRUCTION

<table>
<thead>
<tr>
<th>S.N. Item</th>
<th>B</th>
<th>A</th>
<th>S.N. Item</th>
<th>B</th>
<th>A</th>
<th>S.N. Item</th>
<th>B</th>
<th>A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4</td>
<td>20</td>
<td>31</td>
<td>8</td>
<td>20</td>
<td>61</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>20</td>
<td>32</td>
<td>0</td>
<td>20</td>
<td>62</td>
<td>4</td>
<td>19</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>20</td>
<td>33</td>
<td>0</td>
<td>20</td>
<td>63</td>
<td>1</td>
<td>17</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>20</td>
<td>34</td>
<td>0</td>
<td>20</td>
<td>64</td>
<td>1</td>
<td>19</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>20</td>
<td>35</td>
<td>6</td>
<td>19</td>
<td>65</td>
<td>0</td>
<td>17</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>19</td>
<td>36</td>
<td>5</td>
<td>20</td>
<td>66</td>
<td>4</td>
<td>19</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>17</td>
<td>37</td>
<td>4</td>
<td>20</td>
<td>67</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>8</td>
<td>0</td>
<td>15</td>
<td>38</td>
<td>6</td>
<td>20</td>
<td>68</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
<td>19</td>
<td>39</td>
<td>6</td>
<td>20</td>
<td>69</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
<td>18</td>
<td>40</td>
<td>3</td>
<td>20</td>
<td>70</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>11</td>
<td>0</td>
<td>11</td>
<td>41</td>
<td>4</td>
<td>20</td>
<td>71</td>
<td>2</td>
<td>20</td>
</tr>
<tr>
<td>12</td>
<td>0</td>
<td>13</td>
<td>42</td>
<td>4</td>
<td>20</td>
<td>72</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>13</td>
<td>9</td>
<td>20</td>
<td>43</td>
<td>0</td>
<td>16</td>
<td>73</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>20</td>
<td>44</td>
<td>1</td>
<td>14</td>
<td>74</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>15</td>
<td>0</td>
<td>20</td>
<td>45</td>
<td>4</td>
<td>20</td>
<td>75</td>
<td>1</td>
<td>16</td>
</tr>
<tr>
<td>16</td>
<td>1</td>
<td>20</td>
<td>46</td>
<td>4</td>
<td>20</td>
<td>76</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>17</td>
<td>0</td>
<td>19</td>
<td>47</td>
<td>0</td>
<td>19</td>
<td>77</td>
<td>0</td>
<td>6</td>
</tr>
<tr>
<td>18</td>
<td>0</td>
<td>19</td>
<td>48</td>
<td>0</td>
<td>14</td>
<td>78</td>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>19</td>
<td>0</td>
<td>16</td>
<td>49</td>
<td>0</td>
<td>14</td>
<td>79</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td>20</td>
<td>0</td>
<td>13</td>
<td>50</td>
<td>0</td>
<td>13</td>
<td>80</td>
<td>0</td>
<td>10</td>
</tr>
<tr>
<td>21</td>
<td>0</td>
<td>19</td>
<td>51</td>
<td>1</td>
<td>18</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>0</td>
<td>17</td>
<td>52</td>
<td>0</td>
<td>19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>0</td>
<td>14</td>
<td>53</td>
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<td></td>
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<tr>
<td>24</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>0</td>
<td>16</td>
<td>55</td>
<td>2</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td>0</td>
<td>17</td>
<td>56</td>
<td>1</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>0</td>
<td>14</td>
<td>57</td>
<td>1</td>
<td>19</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>0</td>
<td>15</td>
<td>58</td>
<td>6</td>
<td>20</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>0</td>
<td>13</td>
<td>59</td>
<td>1</td>
<td>18</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>30</td>
<td>7</td>
<td>20</td>
<td>60</td>
<td>3</td>
<td>19</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

N = 20,  B = Pre-test,  A = Post-test

On the basis of Table 2.6, the index of sensitivity to instructional effect(s) was computed by applying the following formula:
\[ S = \frac{R_A - R_B}{T} \]

where:

'S' = the index of sensitivity to instructional effects.

\( R_A \) = the number of pupils who got the item right after instruction.

\( R_B \) = the number of pupils who got the item right before the instruction.

\( T \) = the total number of pupils who got the item both the times.

The values of index of sensitivity to instructional effect(s) so obtained for criterion test items have been presented in Table 2.7.

**TABLE - 2.7**

VALUES OF INDEX OF SENSITIVITY TO INSTRUCTIONAL EFFECT(S) OF CRITERION TEST ITEMS

<table>
<thead>
<tr>
<th>S.N. Item</th>
<th>'S'</th>
<th>S.N. Item</th>
<th>'S'</th>
<th>S.N. Item</th>
<th>'S'</th>
<th>S.N. Item</th>
<th>'S'</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.80</td>
<td>21</td>
<td>0.95</td>
<td>41</td>
<td>0.80</td>
<td>61</td>
<td>0.80</td>
</tr>
<tr>
<td>2</td>
<td>0.95</td>
<td>22</td>
<td>0.85</td>
<td>42</td>
<td>0.80</td>
<td>62</td>
<td>0.75</td>
</tr>
<tr>
<td>3</td>
<td>1.00</td>
<td>23</td>
<td>0.80</td>
<td>43</td>
<td>0.80</td>
<td>63</td>
<td>0.85</td>
</tr>
<tr>
<td>4</td>
<td>0.90</td>
<td>24</td>
<td>0.80</td>
<td>44</td>
<td>0.65</td>
<td>64</td>
<td>0.90</td>
</tr>
<tr>
<td>5</td>
<td>1.00</td>
<td>25</td>
<td>0.80</td>
<td>45</td>
<td>0.80</td>
<td>65</td>
<td>0.85</td>
</tr>
<tr>
<td>6</td>
<td>0.95</td>
<td>26</td>
<td>0.85</td>
<td>46</td>
<td>0.80</td>
<td>66</td>
<td>0.75</td>
</tr>
<tr>
<td>7</td>
<td>0.85</td>
<td>27</td>
<td>0.70</td>
<td>47</td>
<td>0.95</td>
<td>67</td>
<td>0.70</td>
</tr>
<tr>
<td>8</td>
<td>0.75</td>
<td>28</td>
<td>0.75</td>
<td>48</td>
<td>0.70</td>
<td>68</td>
<td>0.80</td>
</tr>
<tr>
<td>9</td>
<td>0.95</td>
<td>29</td>
<td>0.65</td>
<td>49</td>
<td>0.70</td>
<td>69</td>
<td>0.90</td>
</tr>
<tr>
<td>10</td>
<td>0.90</td>
<td>30</td>
<td>0.65</td>
<td>50</td>
<td>0.85</td>
<td>70</td>
<td>0.75</td>
</tr>
<tr>
<td>11</td>
<td>0.55</td>
<td>31</td>
<td>0.60</td>
<td>51</td>
<td>0.85</td>
<td>71</td>
<td>0.90</td>
</tr>
<tr>
<td>12</td>
<td>0.65</td>
<td>32</td>
<td>1.00</td>
<td>52</td>
<td>0.95</td>
<td>72</td>
<td>0.80</td>
</tr>
<tr>
<td>13</td>
<td>0.55</td>
<td>33</td>
<td>1.00</td>
<td>53</td>
<td>0.70</td>
<td>73</td>
<td>1.00</td>
</tr>
<tr>
<td>14</td>
<td>0.95</td>
<td>34</td>
<td>1.00</td>
<td>54</td>
<td>0.60</td>
<td>74</td>
<td>0.95</td>
</tr>
<tr>
<td>15</td>
<td>1.00</td>
<td>35</td>
<td>0.55</td>
<td>55</td>
<td>0.90</td>
<td>75</td>
<td>0.75</td>
</tr>
<tr>
<td>16</td>
<td>0.95</td>
<td>36</td>
<td>0.75</td>
<td>56</td>
<td>0.95</td>
<td>76</td>
<td>0.50</td>
</tr>
<tr>
<td>17</td>
<td>0.95</td>
<td>37</td>
<td>0.80</td>
<td>57</td>
<td>0.95</td>
<td>77</td>
<td>0.35</td>
</tr>
<tr>
<td>18</td>
<td>0.95</td>
<td>38</td>
<td>0.70</td>
<td>58</td>
<td>0.70</td>
<td>78</td>
<td>0.65</td>
</tr>
<tr>
<td>19</td>
<td>0.80</td>
<td>39</td>
<td>0.70</td>
<td>59</td>
<td>0.85</td>
<td>79</td>
<td>0.40</td>
</tr>
<tr>
<td>20</td>
<td>0.65</td>
<td>40</td>
<td>0.65</td>
<td>60</td>
<td>0.80</td>
<td>80</td>
<td>0.50</td>
</tr>
</tbody>
</table>
It is clear from the table 2.7 that the values of 's' varies from 0.35 to 1.00. A more clear picture of the distribution of items for various values of 's' may be obtained from the Table 2.8. This table presents the frequency distribution and percentage of the items for various values of 's'.

**TABLE - 2.8**

**FREQUENCY DISTRIBUTION AND PERCENTAGE OF ITEMS OF CRITERION TEST FOR VARIOUS VALUES OF 'S'**

<table>
<thead>
<tr>
<th>Values of 's'</th>
<th>Number of Items</th>
<th>Percentage of Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Below 0.50</td>
<td>4</td>
<td>5.00%</td>
</tr>
<tr>
<td>0.51 - 0.60</td>
<td>5</td>
<td>6.25%</td>
</tr>
<tr>
<td>0.61 - 0.70</td>
<td>15</td>
<td>18.75%</td>
</tr>
<tr>
<td>0.71 - 0.80</td>
<td>22</td>
<td>27.50%</td>
</tr>
<tr>
<td>Above 0.81</td>
<td>34</td>
<td>42.50%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>80</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Table 2.8 shows that 5 percent of the total test items has value of 's' upto 0.50; 6.25 percent between 0.51 and 0.60; 18.75 percent between 0.61 and 0.70; 27 percent between 0.71 and 0.80; and 42.5 percent above 0.81. It is obvious that most of the items have value of 's' above 0.60. Therefore, it may be concluded that the criterion test was satisfactory in measuring the instructional effects of the programme and the items of the criterion test seemed to be valid.
After having carried out the operation of typical item - analysis for criterion test, the items were again edited and thus final draft of the criterion test was prepared and mimeographed. The structure of the final draft of criterion test is given in Table 2.9.

**Table 2.9**

Structure of the Final Draft of Criterion Test

<table>
<thead>
<tr>
<th>Unit No.</th>
<th>Serial No. of Objectives</th>
<th>Number of Items</th>
<th>Total Number of Items</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>7.5%</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>1</td>
<td>34</td>
<td>42.5%</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>14</td>
<td>9</td>
<td>30</td>
<td>37.5%</td>
</tr>
<tr>
<td></td>
<td>15</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>16</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>17</td>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>18</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>19</td>
<td>2</td>
<td>10</td>
<td>12.5%</td>
</tr>
<tr>
<td></td>
<td>20</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>21</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>22</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>23</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>24</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>25</td>
<td>80</td>
<td>80</td>
<td>100%</td>
</tr>
</tbody>
</table>
It is evident from table 2.9 that the final draft of the criterion test consisted of 60 items. It is also very clear that every objective was duly induced in the final draft of the criterion test and no objective remained without test-item. Thus, the criterion test met the standard what has been termed by Tuckman (1979) 'Criterion of appropriateness.'

RELIABILITY OF CRITERION TEST:

According to Gronlund (1976) criterion tests are not designed to discriminate among individuals, and thus variability need not to be present in the scores and as such the traditional correlational estimates of reliability are inappropriate.

Though there have been various attempts to develop statistical measures for estimating the reliability of criterion tests, a satisfactory solution has not yet been achieved (Hambleton and Novick, 1973). However, to ascertain the reliability of criterion test, the procedure proposed by Swaminathan, Hambleton and Alginia (1974) was followed. This procedure has been discussed in detail by Martuza (1977 pp. 278 - 81).

For determining the reliability, criterion test was again administered the next day on the same sample of 20 students which was used in preliminary tryout. In the light of the results obtained from first post-test and second post-test, a four-fold Table 2.10 was prepared as given below:
TABLE 2.10
FOUR-FOLD TABLE
(Administration-I)

<table>
<thead>
<tr>
<th></th>
<th>Master</th>
<th>Non-master</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master</td>
<td>16</td>
<td>0.0</td>
<td>16</td>
</tr>
<tr>
<td>Non-master</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Total</td>
<td>17</td>
<td>3</td>
<td>20</td>
</tr>
</tbody>
</table>

In Table 2.10, cell 'a' includes the students who were master at both the occasions; cell 'b' includes those who were non-master at first occasion but master at second occasion; cell 'c' includes those students who were master at first occasion but non-master at second occasion; and cell 'd' includes those who were non-master at both the occasions. The criterion of master and non-master was set 85% as suggested by Block (1971). The final draft of the criterion test was of 80 points. Therefore, a student who scored 66 points on criterion test was considered a master and who scored below 66 was regarded as non-master. For the sake of convenience entries of Table 2.10 were converted into proportions by dividing through the total.
number of students (20) in this case. Table 2.11 shows the values in proportions of different categories.

### TABLE - 2.11

VALUES IN PROPORTIONS FOR DIFFERENT CATEGORIES

<table>
<thead>
<tr>
<th></th>
<th>Administration</th>
<th>Master</th>
<th>Non-master</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master</td>
<td>(a)</td>
<td>0.8</td>
<td>0.00</td>
<td>0.8</td>
</tr>
<tr>
<td>Non-master</td>
<td>(c)</td>
<td>0.05</td>
<td>0.15</td>
<td>0.2</td>
</tr>
<tr>
<td>(a+c)</td>
<td>(b+d)</td>
<td></td>
<td></td>
<td>(a+b+c+d)</td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td>0.85</td>
<td>0.15</td>
<td>1</td>
</tr>
</tbody>
</table>

The following formula was used to determine two statistics, Po and K (Kappa):

\[
K = \frac{Po - Pc}{1 - Pc}
\]

Where:

- \( K \) = the degree of agreement uncontaminated
- \( Po \) = the proportion of observed agreements \( (a + d) \)
- \( Pc \) = the proportion of the chance agreements \( (a+b)(c+d)/(b+d) \)

Table 2.12 summarizes the details of computation of reliability of criterion test.

### TABLE - 2.12

DETAILS OF COMPUTATION OF RELIABILITY OF CRITERION TEST

<table>
<thead>
<tr>
<th></th>
<th>Po</th>
<th>Pc</th>
<th>Po - Pc</th>
<th>1 - Pc</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Master</td>
<td>0.95</td>
<td>0.71</td>
<td>0.24</td>
<td>0.29</td>
<td>0.52</td>
</tr>
</tbody>
</table>
It may be observed from Table 2.12 that the values of Po and Pc came out to be 0.95 and 0.71 respectively.

The calculated value of 'K' in the present case was obtained to be 0.82. Since the value of 'K' is always in the interval from 1.00 (reflecting total goal consistency) to some value near -1.00 (reflecting total goal inconsistency), the obtained value of 'K' indicates 82 percent agreement over and above without attributable to chance. Thus, it may be concluded that criterion test seemed to have a high reliability.

VALIDITY OF CRITERION TEST:

During the construction of criterion test, we are concerned primarily with content validity, i.e., to the extent to which test items have adequately sampled the objectives and content of instructional units. In fact, content validity is largely a matter of judgement. The relevance and adequacy of the sample of test tasks for measuring the expected learning outcomes of the instruction is judged.

The criterion test validity was ascertained by the investigator by analysing items with regard to the units-content and instructional objectives of the programme. It was noted that items of the criterion test were distributed over the all units of the programme and over every instructional objective. Moreover, the items of criterion test were prepared in accordance with the table of specifications. Thus test may be assumed to have content validity.
For checking the validity of criterion test, the help of subject matter experts was also solicited. Copies of the list of behavioural objectives and criterion test were given to three subject matter experts. They were asked to give their judgement with regard to the congruence of behavioural objectives and test items respectively. They rated high the congruence between each objective and test item(s).

Another validity procedure suggested by Tuckman (1979) was also applied by examining subsequent performance in short term. Here, the analysis was conducted in terms of 'gain' from pre-test to post-test performance. A group of 20 students of IX class earned a mean score 6.5 on the pre-test. The maximum possible score on the test was 80. On the post-test, this group earned an average score of 69.85, 63.35 (79%) gain over the original average and a net result of 86% out of the maximum possible. This pre-test to post-test gain not only indicated the success of instruction but also supported the validity of criterion test, that the extent to which it reflected proficiency in writing of objectives. Had it not been a measure of such proficiency, it would not have yielded such gain as a result of instruction.

Considering the above mentioned criteria of validity, the criterion test was considered to be of sufficient validity.

A copy of the criterion test and its key have been provided in the Appendices $C_1$ and $C_2$ respectively.
SELECTION OF THE PROGRAMMING MODEL

The format of the programme depends upon the programming model chosen by the programmer. The programming model provides the basic conceptual framework in which individual instructional items are organized.

The selection of an appropriate presentation strategy for a sequence of frames is dependent upon the instructional objectives to be realized, the structures of the behaviours involved, subject matter selected and the characteristics of target population.

Of the available models of programming, the linear model was chosen for the present programme. Reasons for its selection are:

(a) Instructional objectives of the programme involve the constructed type of responses which are amenable to linear model.

(b) The objectives of the programme are such as this is a situation where Skinner's views about errors may possibly be correct.

(c) The structure of the subject matter of the programme is fixed and variations from the conventional patterns are construed as mistakes. The fixed sequence of the content renders it amenable to presentation in small steps.
(d) The subject matter of the programme requires sufficient opportunities for rehearsal of the skills to be developed.

(e) The most crucial point to observe is that it is simple to operate. The learners of the target group never studied through programmed instruction. Hence it is more suitable for the target population.

(f) The target population is homogeneous as far as previous knowledge or entry behaviour is concerned.

(g) The linear programme is comparatively easier to construct than any other model of programming.

In view of the above mentioned reasons, the linear model of programming was deemed fit for the task in hand and was adopted as such.

WRITING OF THE PROGRAMME:

The investigator developed a programme based on linear model profounded by B.F. Skinner (1954). The writing of programme involved three elements:

-- Structuring of the frames,
-- Distribution of the frames; and
-- Sequencing of the frames.

STRUCTURING OF THE FRAMES:

Since the programme is presented in terms of frames, the structuring of the frames becomes the first essential in the programme writing. It is an arduous and time consuming activity
...and demands a tremendous insight in behavioural analysis on the part of the programmer. Taber et al. (1965) define a frame as a "small segment of subject matter which calls forth particular student responses". Depauo (1970) states that not only frame is a unit of subject matter, such as a sentence or a paragraph but also it is constructed to call forth particular responses and eventually specific terminal behaviours.

The structure of a frame, strictly speaking, consists of several parts, which are in some cases separated. The following diagram shows one way in which they may be separated, but there are also other ways:

```
  C ---------- A  
 Correct response  Unit of information
  B  Question
```

Fig. 2.2 Diagram showing one way in which components of a frame may be separated.

As it is evident from the above diagram there are three parts of a frame. One part gives a piece of information which is limited. (i.e. elementary and quantitatively as small as possible). It is called a stimulus. The presentation of this information is followed by a question or an exercise on it, to which the pupil must reply before he can continue to the next
frame. This part is termed 'response'. The third part is known as 'correct response' or 'knowledge of result' that the learner finds to the question he has just been asked. He may thus compare it with the response he has just given and check whether his response is correct or not.

Klaus (1961) has given four essential parts of a frame. They are as follows:

- the stimulus and the stimulus context;
- the cues or prompts necessary to produce the response reliably;
- the response(s) the stimulus evokes; and
- enrichment material which makes the frame more readable and interesting or which reveals previously learned materials to facilitate the student response.

To these four parts of a frame given by Klaus (1961), one more part may be added i.e., 'knowledge of the result'. The stimulus part of a frame and the response which the learner makes to this, constitute an S-R relationship. The crucial element of the frame is to provide stimulus to evoke and guide the student responses and not merely to attempt a content exposition. In structuring of the frames for the present programme greater attention was paid to the establishment, fixation, expansion and linkage of student responses. Each frame was constructed to provide successive approximation in shaping of student
responses into the complex pattern of intended terminal behaviours.

The present programme was divided in four units. The first unit covered the concept of a suffix, its location in a word, its characteristics with regard to meaning and use and its significance in word building; the second unit dealt with the analysis of suffix words into suffixes and rootwords, synthesis of root words and suffixes; third unit consisted of meanings of the suffixes and suffix-words, and forth unit covered the synthesis of one or more different suffixes with one root word and analysis of such words into rootwords and different suffixes. Then each unit of the programme was divided into three main phases which are as under:

_____ Introductory phase;
_____ Teaching phase; and
_____ Testing phase.

Introductory phase of each unit consisted of introductory frames. The frames in this phase involved mainly 'priming' operation to solve the problem at the first instance. A copying frame is an example of 'priming'. In such a frame the stimulus is a written text and the response is reproducing some part of the text (Markle, 1969).

In teaching phase, content structure was presented in terms of expected terminal behaviours specified for each unit.
The frames in this phase consist of 'prompting' operation. The response to be emitted on a particular frame was duly prompted. A prompt is a supplementary stimulus, a hint or a bit of assistance that helps the learner come up with a correct response (Markle, 1969). Since any single frame, acting alone, according to Skinner (1968), is incapable of producing the correct response, various prompts were provided in teaching frames to make the item easier for a student to answer correctly. Both types of prompts—formal and thematic, were used in writing the frames for this phase. Formal prompts provide knowledge about the forms of expected response whereas thematic prompts depend on meaningful associations that make it likely for the student to give the expected response. While formal and thematic prompts have been used simultaneously at times, however, more emphasis has been given to the thematic prompts in the later part of the programme. In order to bring student behaviour under the control of new stimuli, prompts were gradually withdrawn towards the end of this phase. This was done by 'fading' or 'vanishing' the amount of prompts.

Testing phase comprised testing and review frames. These frames were constructed to ascertain the establishment of the behaviour in absence of any kind of prompt. Prompts given in earlier phase, were completely withdrawn here.

In almost all the frames the response part appeared very close to the end of the frame so that the learner might utilize
entire information given in the frame to construct the desired response. This was done keeping in view the suggestion given by Robert Horn (1963). He suggests that the blank should appear as close to the end of the frame as possible so as to spare the student the awareness of flipping his eyes back and forth, skidding around inside frame after frame for relevant material.

In addition to introductory, teaching, testing and review frames, some frames were written which did not call forth student response. Such frames are called 'information frames' Their purpose is to inform the student about the main content of the succeeding frames of the programme.

Thus following the basic mechanism of structuring (i.e., designing) of the frames, the frames were written so as to cover the subject matter contained in the 'analysis of care content' of Hindi vocabulary building.

DISTRIBUTION OF THE FRAMES:

There are three definite phases in a unit of the programme where frames assume a particular form. They are known as introductory, teaching and testing phase. The weightage given to the frames in various phases of each unit is as under:

- Introductory phase: 10% to 15%
- Teaching phase: 65% to 75%
- Testing and review phase: 15% to 20%
SEQUENCING OF THE FRAMES:

The third element in frame writing is sequencing of the frames. Sequencing of the frames comprises "setting out and ordering of the elements into which one has broken down the subject matter, the order thus obtained forms the progression of learning" (Pocstar, 1972).

There are two main approaches to sequencing of the frames:

1. Rule-leg approach; and
2. Sgrul approach.

The programmer adopted a sort of rule-leg approach for sequencing of the frames of the present programme; wherein, first a rule was stated, then it was followed by examples. The following traditional maxims were also utilised while developing sequencing of the frames:

1. Proceed from known to unknown
2. Proceed from simple to complex
3. Proceed from parts to whole.

In fact, the main factor in determining the approach used was practical one: suffixes selected for Hindi vocabulary building are from Sanskrit, and it was hoped that by introducing the rules first the greater student interest in the programme would be maintained.

EDITING OF THE PROGRAMME:

After writing the first rough draft of the programme, it
becomes imperative to go in for an editing of the programme. According to Aspich and Williams (1967), a thorough edit may uncover many programme inadequacies prior to testing. The edit can result in a smoothness that may make the difference between the success and failure of the programme.

Markle (1962) points out that the editorial behaviour, either by the programmer himself or by a colleague, should begin with truth, clarity and facility of expression embodied in the programme. Lysaght and Williams (1963) suggest that editing of the programme has to be done primarily with reference to accuracy and relevance of the material, style, vocabulary and content interest.

Generally, there are three main types of editing which are done with a programme. They are as follows:

1. Editing for composition;
2. Editing for programming techniques; and
3. Editing for technical accuracy.

Editing a programme for composition is the same as editing any other material for composition. The present programme was edited with regard to its grammar, language, spelling; the ability to communicate, aptness of examples and punctuation. Mechanical aspects of the material such as, length of the blanks, uniformity of numbering system were also checked for their adherence to some basic construction rules. Maintenance of the
consistency throughout the programme from the standpoint of what the learner was expected to do was also examined.

Editing for programming technique was done with the help of a colleague of the programmer. Several aspects of the technique editing were applied to the programme as a whole. The continuity of the programme was one of them. The programme was checked to ascertain whether the programme was flowing from item to item or was there an interrelationship between the parts of the programme or was the programme composed of individual unrelated sequences. After probing into such questions, continuity aspect of the programme was improved. The programme was also examined from the point of view of the development of ideas within the programme. Whenever some ideas within the programme did not seem to have logically and methodologically developed, or examples used were not found aptly to develop, the ideas or examples could not appear to be familiar to the target student population, or line of reasoning through the programme did not seem to have been followed by the students according to the material presented, appropriate changes were made in the programme. Another consideration given during a general programme technique edit was concerned to the size of the steps within the programme. The programme was checked for two different types of step sizes: the inter-frame and intra-frame. Programme was also examined for the adherence of rules of construction technique - whether these rules were followed throughout the programme or not, whether sequence of the frames
developed for the programme was according to prescribed practice or not. If any mistake was detected in this respect, it was immediately rectified. In composition edit, the programme was also checked-up in terms of individual frames. In a frame edit, relevancy of the responses, types of responses, response mode, priming, prompting and fading of the prompts were examined.

Technical accuracy edit was done with the help of a subject matter expert to determine whether or not material presented was technical/accurate. Rules, definitions and examples used in the programme were duly checked for their technical accuracy.

The editing of the programme was done in the following sequence as suggested by Espich and Williams (1967):

1. Technical accuracy edit;
2. Programming technique edit;
3. Composition edit.

Thus, initial draft of the programme was made ready for empirical testing. The unit-wise distribution of the frames in the first draft of the programme is shown in Table 2.13.
<table>
<thead>
<tr>
<th>Unit</th>
<th>Content</th>
<th>Total No. of frames</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Concept of a suffix</td>
<td>27</td>
</tr>
<tr>
<td>2.</td>
<td>Analysis of suffix-words into suffixes and root-words; synthesis of root-words and suffixes.</td>
<td>507</td>
</tr>
<tr>
<td>3.</td>
<td>Meaning of suffixes and suffix-words</td>
<td>300</td>
</tr>
<tr>
<td>4.</td>
<td>Synthesis of one or more different suffixes with the single root-word.</td>
<td>30</td>
</tr>
</tbody>
</table>

Grand Total: 864

Table 2.13 shows that unit I contained 27 frames; unit II, 507; unit III, 300; and unit IV, 30. The whole programme contained 864 frames in all.

**EMPIRICAL TESTING OF THE PROGRAMME:**

According to Espich & Williams (1967), the device, or whatever it is, fails to live up to the purpose for which it was designed if the student does not walk away from it possessing those terminal behaviours that the programme was intended to impart. He must learn, and if he doesn't, it is the programmer's responsibility to modify the programme as extensively and as often as necessary to reach the desired goal. In other words, the sole arbiter for indicating the success of a programme is the learner for whom it has been designed (Pandey, 1979).

In order to examine the worth of a programme déverse
types of data are collected by subjecting the programme to empirical testing. Empirical testing is most important and final stage of the programme development. According to Markle (1967), three distinct phases of empirical testing may be identified, viz:

- Laboratory phase (i.e. developmental testing).
- Demonstration phase (i.e. validation testing).
- Extension or Utilization (i.e. field testing).

The laboratory phase of empirical testing takes place during the developmental stage of designing the programme. This phase might be called a "debugging operation". Its main focus is to develop a workable programme.

The second phase of empirical testing is demonstration phase that occurs after the laboratory phase. Its main purpose is to describe the performance characteristics of the programme precisely, obtained under clearly specified conditions.

The third phase of empirical testing is perhaps endless; this extension or utilization phase takes place when programme is used in the field under widely varied conditions and perhaps is adopted to the consumer's needs by the consumer himself. This phase might include (a) comparison of the programme with that resulting from other techniques of instruction, or (b) utilization of the programme in a manner not originally intended or with a population for which the programme was not originally designed.
Only rarely this type of testing is done by the programmer himself.

In the present case, investigator has attempted first two phases of empirical testing of a programme under the headings of developmental and validation testing.

(A) DEVELOPMENTAL TESTING:

Developmental testing, as its name implies, takes place during the development of the programme. The main purpose of this kind of testing is to check how far the first version of the programme is, in fact, suitable for those for whom, it has been written. Hence, in developmental testing, attention of the programmer is focused on the improvement and refinement of the programme.

Brethower (1966) has recently reported that a well conducted developmental testing may lead to a very efficient final product and may result in saving of time and energy during field (or validation) testing. Roebuck (1965) has also shown that observation of a single student may significantly improve a first draft of the programme. He found that a small number of such revised frames reduced error rate and increased acquisition.

Two types of developmental testing are commonly recognized by the programmers, namely, individual testing and small group testing. Both these types of developmental testing were carried out in the present case.
(I) INDIVIDUAL TESTING

In individual testing means only one student is tested at a time. With the help of one student the programmer attempts to uncover as many programme inadequacies as possible and eliminates them from the programme.

After revising and editing the initial draft of the present programme, each frame of the programme was written in separate card with pencil. The correct response was written on the back of each card so that student might not see it before reading and responding the frame. In all 864 cards were prepared. The draft cards were then administered on a sample of 6 subjects individually, keeping in view the number of subjects as suggested by Green (1967). The details of the subjects in respect of sex, age and class is given in Table 2.14.

<table>
<thead>
<tr>
<th>Subject</th>
<th>Sex</th>
<th>Age in years &amp; months</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>13.70</td>
<td>IX</td>
</tr>
<tr>
<td>2</td>
<td>M</td>
<td>13.60</td>
<td>IX</td>
</tr>
<tr>
<td>3</td>
<td>M</td>
<td>14.00</td>
<td>IX</td>
</tr>
<tr>
<td>4</td>
<td>F</td>
<td>13.50</td>
<td>IX</td>
</tr>
<tr>
<td>5</td>
<td>F</td>
<td>13.50</td>
<td>IX</td>
</tr>
<tr>
<td>6</td>
<td>F</td>
<td>13.60</td>
<td>IX</td>
</tr>
</tbody>
</table>
Out of these six subjects, three were selected from Sardar Patel Inter College, Meerut and another three from Knoharlai Kanya High School, Saket Meerut City. All the six subjects, included in the sample of individual testing, were little slower than average as recommended by Espich and Williams (1967, p.113). It was considered that such students could be expected to stumble more often than most of the other students and this way the programmer could get the idea of the stumbling blocks to be removed from the programme. The decision with regard to the selection of students was taken on the basis of class teacher's rating, records of last annual examination and performance in Hindi.

**PROCEDURE FOR INDIVIDUAL TESTING:**

Before, testing on individual basis was done, it was considered worthwhile to put the student in proper frame of mind. For this, the investigator selected one of the six students and prepared him for the administration of the programme. It was impressed upon him that he was going to help the programmer in improving and smoothing out the programme and make it workable and effective by cooperating in learning process as sincerely as possible and pointing out the areas that were slightest bit confusing and difficult, areas in which a particular statement was not consistent with a concept he gained from an earlier part of the programme. He was also told that his frank comments would be given proper consideration.
After these formalities, the draft programme in the form of cards was administered to one of the selected students at a time. The student was asked to read each frame loudly and produce his response orally. Soon after the response was emitted, the student was allowed to see the correct response written on the back of the card. In case, the student gave incorrect response, the programmer always asked him the reason for so replying and recorded all the reasons he gave. The frame was modified immediately and given back to the student to read a loud and respond to it again. This exercise of modification of frame was continued till the student produced the correct response. In this manner entire programme was tailored and adjusted to the needs of the first student. This modified draft / version of the programme was then administered to rest of the students as well, using the procedure adopted in case of first student.

The frames of the draft programme as administered to six students successively were not identical since they were revised each time according to the response given, reactions shown, comments offered and suggestions made regarding frame structure by each student. The programmer observed that amount of the modification in the draft programme went on decreasing over its successive administration to the students. At this stage of testing, post-test was not given since the difficult frames could invalidate all the results.
A careful perusal of the record of observations made during individual testing revealed that wrong responses were the results of one or more of the following factors:

- Language difficulty.
- Types and amounts of prompts.
- Types of response.
- Sequencing of frame.
- Difficult rules.
- Difficult examples.
- Insufficient practice.
- Density of the content.

In the light of above mentioned observations, frames were revised by simplifying vocabulary and sentences, using appropriate types and amount of prompts, changing the type of response, modifying sequence of frames, reducing the amount of information in particular frame, removing unfamiliar examples, simplifying rule and increasing the amount of practice.

As a result of the individual testing, 32 frames were added to the programme. In unit I, 1 frame; in unit II, 16 frames; in unit III, 11 frames; and in unit IV, 4 frames were added. In unit II, 10 frames were found redundant and consequently they were dropped. Table 2.15 shows unit-wise distribution of frames in the modified draft of the programme.
TABLE- 2.15

UNITWISE DISTRIBUTION OF FRAMES AFTER INDIVIDUAL TESTING

<table>
<thead>
<tr>
<th>Unit No.</th>
<th>Content</th>
<th>Total No. of Frames</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Concept of a suffix</td>
<td>28</td>
</tr>
<tr>
<td>II</td>
<td>Analysis of suffix words into suffixes &amp; rootwords; synthesis of root-words and suffixes.</td>
<td>513</td>
</tr>
<tr>
<td>III</td>
<td>Meaning of suffixes and suffix-words</td>
<td>311</td>
</tr>
<tr>
<td>IV</td>
<td>Synthesis of one or more different suffix suffixes with the single rootword.</td>
<td>34</td>
</tr>
</tbody>
</table>

Grand Total: 686

(II) SMALL GROUP TESTING:

According to Spich and Williams (1967), testing on an individual basis is merely to ensure that a student can understand what he is reading and perform those tasks required of him as he goes through the programme. At this point, the programmer does not know whether or not programme works. Therefore, programme is tried out on a small group of students to determine how much of the material they learn.

After making a revision and modification of the first draft of the programme on the basis of individual testing, the programme was mimeographed in a definite format. Instructions for reading the programme were also prepared. Then this modified
draft was administered on a sample of 20 students randomly selected from two schools of Meerut City, namely Sardar Patel Inter College and Kanohar Lal Kanya High School. The details of the subjects in respect of age, sex and class are given in Table 2.16.

**Table 2.16**

**Details of Subjects for Small Group Testing**

<table>
<thead>
<tr>
<th>Subject</th>
<th>Sex</th>
<th>Mean age</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>M</td>
<td>13.70</td>
<td>IX</td>
</tr>
<tr>
<td>10</td>
<td>F</td>
<td>13.80</td>
<td>IX</td>
</tr>
<tr>
<td><strong>Total: 20</strong></td>
<td><strong>M&amp;F</strong></td>
<td><strong>13.65</strong></td>
<td><strong>IX</strong></td>
</tr>
</tbody>
</table>

Before the administration of the programme the investigator contacted each selected student individually and fixed the time and the place for the actual administration. All the 20 selected students were collected at one fixed place in the morning hours of their school time. It was impressed upon the students that they are taking the draft of a programme on 'Hindi vocabulary building', one that is still in developmental stage. The students were told that they are not being tested out but actually, they are helping the programmer to test the programme. They were encouraged to give the programme a fair trial and to try to learn the material.
After these introductory remarks, the criterion test was administered as pretest on the students to determine the extent of their knowledge in the area concerned. Then students were instructed in the mechanics of taking the programme. They were also asked to mark the difficult areas or frames in some manner as they worked their way through, so that the programmer, later on, could discuss these points with them. Then the students were distributed copies of the programme and asked to go through the material. Once the students started the programme they were not given any kind of help or clarification of the material. The investigator noted the starting and finishing time of each student since he was interested in knowing how long it takes an average student to finish the programme. The mean time taken by the students for the programme was found to be 11 hours 30 minutes. After completion of the programme, criterion test was administered on the students. Before administering the test the students were ensured that the result of this test were not going to affect their annual examination in any way and the only purpose of this test is how much material they have learnt through the self-instructional material. After completing the test, the copies of the programme and test were collected back from the students and there was general discussion between the students and the investigator. In discussion the students were asked to give their comments about the programme in order to determine what programme inadequacies caused difficulties to them.
STATISTICAL ANALYSIS AND REVISION OF THE PROGRAMME:

On the basis of the data obtained at this stage of testing, the programme was evaluated against two criteria, i.e., internal and external criteria. Internal criteria included 'Error Rate', 'Programme Density' and external criterion comprised 'Gain Ratio'. Description of these criteria is given as under:

ERROR RATE:

According to Markle (1969), an error is a response not acceptable to the programmer. Errors may arise due to the following reasons:

- Ambiguity in verbal construction of the frames.
- The amount of information given in the frames may have been too much.
- The response expected may be too difficult for the learner.
- The response may be irrelevant.
- Prompts or cues have been withdrawn too quickly instead of being 'faded' at a rate consistent with difficulty involved in a particular section of the subject matter (Patricia, 1969).

The percentage of incorrect or not acceptable responses on a frame is considered as an error rate of the individual frame. Similarly the percentage of incorrect responses in a
unit (a set of frames) of the programme or in the total programme is considered as an error rate of the unit of the programme or the total programme.

On a frame there may be one or more responses. When each frame requires one response only, the error rate is calculated by counting the errors made by the individuals on all the frames and the total number of errors is divided by total number of frames multiplied by the number of individuals taking the programme and this obtained ratio is multiplied by 100 so as to give the percentage of error rate. Summarizing in the form of formula (1):

\[
\text{Error Rate in percentage} = \frac{\text{Total number of errors}}{\text{Total no. of frames} \times \text{No. of individuals}} \times 100
\]

But when frames require more than one responses, then for calculation of error rate, the total number of errors disclosed on the responses is divided by the total number of responses in the frames multiplied by the number of individuals taking the programme and obtained ratio is multiplied by 100 so as to give a percentage of error rate. Summarizing in the form of formula (2):

\[
\text{Error Rate in percentage} = \frac{\text{Total no. of Errors} \times 100}{\text{Available Responses in frames} \times \text{No of individuals available}}
\]

(Pandey, 1979, p.235)
In the present programme, there were more than one responses in most of the frames. Therefore, above mentioned formula (2) of the error rate was adopted to calculate the error rate of the programme. The error rate thus computed for the entire programme and for various units, after small group testing, have been summarized in Table 2.17.

**TABLE - 2.17**

**ERROR RATE OF THE PROGRAMME AS A WHOLE AND UNIT-WISE**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Total No. of frames</th>
<th>Total No. of responses</th>
<th>Total No. of errors</th>
<th>No. of Students</th>
<th>Error Rate in percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>28</td>
<td>28</td>
<td>30</td>
<td>20</td>
<td>5.35</td>
</tr>
<tr>
<td>II</td>
<td>513</td>
<td>930</td>
<td>230</td>
<td>20</td>
<td>6.02</td>
</tr>
<tr>
<td>III</td>
<td>311</td>
<td>376</td>
<td>230</td>
<td>20</td>
<td>3.05</td>
</tr>
<tr>
<td>IV</td>
<td>34</td>
<td>66</td>
<td>53</td>
<td>20</td>
<td>4.01</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>596</strong></td>
<td><strong>1400</strong></td>
<td><strong>1433</strong></td>
<td>20</td>
<td>5.11</td>
</tr>
</tbody>
</table>

Different standards for acceptable error rate have been suggested by different programmers. Skinner allows 5 percent error rate which are attributed to slip of various kinds (Kocziar, 1972). Patricia (1969) also recommends 5 percent error rate. But Dececco and Crawford (1977, p.380) and Espick and William (1967, p.124) are of the opinion that error rate up to the extent of 10 percent may be accepted. Parry (1963), however, is more liberal and suggests that in certain situations the error
rate even more than 10 percent may be tolerated. The investigator adhered to more stringent level of error rate, viz. 5 percent for the purpose of revision of the frames of the present programme as suggested by Skinner and Patricia.

Table 2.17 shows that error rates on unit III and IV are 3.05 and 4.0 respectively which are in admissible range of error rate. Only in case of unit I and unit II, the error rate is slightly higher than 5 percent.

The error rate of the whole programme was found to be 5.11, which is slightly higher than acceptable error rate.

PROGRAMME DENSITY:

It has always been possible to measure the difficulty of the programme through conventional item analysis which is dependent upon the performance of students. However, one can not measure the difficulty level of an item without recourse to measurement of the behaviour that the item calls forth. This behaviour is subject to contamination by variables not under control of the programmer. Therefore, Green (1962) suggests that ideally an independent measure should be used.

According to Green (1962) the density of the programme is an independent measure of difficulty of the programme. The density function is an indirect measure of the rate at which material is presented.

Two types of density have been mentioned by Green. First
is called independent density. This is the density of a part of the programme. It is to independent density that error rate is significantly related. The second type of density is called cumulative density. The cumulative density takes into account the prior appearance of specific terms on preceding parts of the programme.

Most of the programmers have used the type token ratio (T.T.R) as the measure of the density of a programme. Type token ratio is defined as "number of different responses divided by the total number of responses". To calculate the density of the programme, first, programmer counts the total number of responses in the programme. Suppose two responses are called for in a particular frame, the number of responses in that frame is said to be two. This way, the total number of responses for all the frames of the programme is counted. Then the number of different responses is ascertained. If a particular response is repeated five times, these would be considered as one response only. Thus, all the non-repetitive responses are noted. This number is then divided by the total number of responses required of the student.

A programme would have a density of 1.00 if every response required by the programme were different and a programme would have minimal density if every response that is required of the student consisted of the same word. Density of the programme ranges from zero to one.
In the present case, the investigator has used the T.T.R. as the measure of density of the programme. The following formula was applied to compute T.T.R. values of the programme:

\[
T.T.R. = \frac{\text{No. of different responses}}{\text{Total No. of responses required}}
\]

The obtained values of T.T.R. for various units and the whole programme have been summarised in Table 2.18.

### TABLE 2.18

<table>
<thead>
<tr>
<th>Unit</th>
<th>Total No. of frames</th>
<th>Total no. of responses required</th>
<th>Total no. of different responses required</th>
<th>T.T.R.</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>28</td>
<td>28</td>
<td>14</td>
<td>0.50</td>
</tr>
<tr>
<td>II</td>
<td>513</td>
<td>930</td>
<td>544</td>
<td>0.58</td>
</tr>
<tr>
<td>III</td>
<td>311</td>
<td>376</td>
<td>119</td>
<td>0.31</td>
</tr>
<tr>
<td>IV</td>
<td>34</td>
<td>66</td>
<td>62</td>
<td>0.94</td>
</tr>
<tr>
<td>Totals</td>
<td>886</td>
<td>1400</td>
<td>739</td>
<td>0.52</td>
</tr>
</tbody>
</table>

Table 2.18 indicates that T.T.R. values on different units of the programme ranged from 0.31 to 0.94. The T.T.R. values in case of Unit II and Unit IV are somewhat higher.

It may also be observed from the Table 2.18 that T.T.R. of the entire programme was found to be 0.52, which indicates that the programme as a whole appeared to be of moderate difficulty. It may also be noted on the basis of T.T.R. that
a student may learn 52 new responses after making 100 responses.

GAIN RATIO:

One of the basic premises of programmed instruction is that a programme is designed with specific purpose. In order to determine when these objectives have been met, several measurement devices have been used.

Scores on the criterion test are usually taken to provide the most powerful evidence of a programme's effectiveness. If 90% of the learners score 90% or more on the final test, then the programme is said to have worked. James Hartley (1972) points out that unfortunately such a result may be the product of several undesirable factors, for example:

- test might be invalid and unreliable;
- the learners might have known 80% of the material before they began, and indeed they might have spent for longer working on the programme than was commensurate with the amount they learned.

Therefore, he suggests that in order to assess the effectiveness of programmed instruction, it is important to relate test scores obtained after using the programme (the post-test scores) to the learner's initial level of knowledge and skills determined by the pretest.
McGuigon and Peters (1965) reported on investigation of the suitability of different measures of pupil achievement for evaluating programmed materials. They found that the best measure of a programme's efficiency is the ratio between amount learned and the amount that could possibly be learned. This was termed "gain ratio", and an arbitrary value of 0.50 was set as a criterion by which good programmes were distinguished from those 'unsuitable for publication'. The range of this gain ratio is from 0 to 1. This concept has been widely used and extended in the field of programmed instruction (see Blake, 1966; Davies, 1969).

In the present case, the programmer followed the procedure of 'gain ratio' to find out the work ability of the programme. This gain ratio is found by dividing the mean gain between the pretest and posttest scores by the mean possible gain (defined as the difference between the mean pretest scores and full marks on the post-test), test being the same or parallel. Summarising in the form of formula:

\[
\text{Gain Ratio} = \frac{m_2 - m_1}{T - m_1}
\]

where:

- \( m_1 \) = Mean of pretest score
- \( m_2 \) = Mean of post-test score
- \( T \) = Total marks.
The mean performance of the group of 20 students on the pretest was found to be 6.5 and the average performance of the same group on post-test was obtained to be 69.85. The total marks for the criteria were 50, after putting these values in the formula and computing, the value of gain ratio came out to be 0.861. The results have been summarized in the Table 2.19 that follows:

**TABLE - 2.19**

<table>
<thead>
<tr>
<th>N</th>
<th>M1</th>
<th>M2</th>
<th>Maximum possible gain</th>
<th>Actual gain</th>
<th>Gain Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>6.5</td>
<td>69.85</td>
<td>73.50</td>
<td>63.35</td>
<td>0.861</td>
</tr>
</tbody>
</table>

Table 2.19 clearly shows that the obtained gain ratio is 0.861, which is more than the prescribed value suggested by McGuihon and Peters. It further indicates that, on the average, each student’s performance (from pre-test to post-test) increased 86% of the maximum possible as measured by the criterion test. It may, therefore, be asserted that the programme has a satisfactory gain ratio which proves its validity.

**PREPARATION OF THE FINAL DRAFT OF THE PROGRAMME:**

On the basis of error rate, programme density, gain ratio and observations made by the students, the programme was revised and modified. Consequent upon the revision, in all 13 frames
were added to various units of the programme. In unit I, 4 frames; in unit II, 8 frames; and in unit IV, 1 frame. In unit III no frame was added. In the revision process of the programme more emphasis was given on rewording or restructuring of the frames for maximum clarity and impact rather than adding new frames, keeping in view the suggestion made by Bruce (1968).

The final draft of the programme contained 899 frames in all. This draft was edited once more in respect of accuracy of the content, programming techniques and composition. The fully edited programme was subsequently printed for validation testing. A copy of the final draft of the programme is given in the appendix 'A1'.

Table 2.20 shows the unitwise distribution of the frames in final draft of the programme.

| TABLE - 2.20 |

UNITWISE DISTRIBUTION OF FRAMES AFTER SMALL GROUP TESTING

<table>
<thead>
<tr>
<th>Units</th>
<th>Content Description</th>
<th>Total No. of frames</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit-1</td>
<td>Concept of a suffix</td>
<td>32</td>
</tr>
<tr>
<td>Unit-2</td>
<td>Analysis of suffix-words into suffixes and Root-words; Synthesis of Rootwords and suffixes.</td>
<td>521</td>
</tr>
<tr>
<td>Unit-3</td>
<td>Meaning of Suffixes and Suffix-words</td>
<td>311</td>
</tr>
<tr>
<td>Unit-4</td>
<td>Synthesis of one or more different suffixes with the single rootword.</td>
<td>35</td>
</tr>
<tr>
<td></td>
<td>Grand Total :</td>
<td>899</td>
</tr>
</tbody>
</table>
It is evident from Table 2.20 that unit I contained 32 frames; unit II, 521 frames; unit III, 311 frames; and unit IV, 35 frames. In all, the entire programme contained 899 frames.

(b) VALIDATION TESTING:

Validation testing is the final phase in the programme development. After processing through developmental testing, if a programme appears to be satisfactory and nears the final form, a validation test is given to gather the data on the performance characteristics of the programme. According to Markle (1967, p.137) here the programmer in an attempt to answer the question who learns what under what conditions in how much time, demonstrates with greater precision that here does, indeed exist a particular set of sample who was shown to perform specified level on a particular set of test questions after exposure to the specified set of material under a desirable set of learning conditions.

Validation testing of the programme was carried out on the group of 50 representative students of target population. These students were selected randomly from two schools of Meerut City, namely, Sardar Patel Inter College and Kanohar Lal Kanya High School, Saket. It may be mentioned here that the students who were chosen for individual testing as well as small group testing were not included in this sample of students. The structure of the sample in respect of sex, age and class is given in Table 2.21 that follows:
TABLE - 2.21
STRUCTURE OF THE SAMPLE IN VALIDATION TESTING

<table>
<thead>
<tr>
<th>No. of Students</th>
<th>Sex</th>
<th>Mean Age in years</th>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>25</td>
<td>M</td>
<td>13.7</td>
<td>IX</td>
</tr>
<tr>
<td>25</td>
<td>F</td>
<td>13.5</td>
<td>IX</td>
</tr>
<tr>
<td>TOTAL 50</td>
<td>M &amp; F</td>
<td>13.6</td>
<td>IX</td>
</tr>
</tbody>
</table>

Table 2.21 shows that both boys and girls formed the sample and both sex were fairly represented.

PROCEDURE OF VALIDATION TESTING:

After selecting the sample, investigator explained the purpose of the programme as well as the procedure for taking the programme to both the groups. This seemed to be conducive in creating normal conditions for programme administration. The investigator availed of the assistance of two research scholars in administering the programme to the sample. These research scholars were duly trained for this purpose.

Before taking the programme, both the groups of students were administered the criterion test as pre-test to find out their initial level of learning in respect of Hindi vocabulary building as incorporated in the programme. No time limit was fixed for pre-testing. Students took a mean time of 40 minutes
to complete the criterion test. Then each student was given one printed copy of the programme along with a copy of answer-sheet and one Thick Card sheet to cover the correct answer while reading a frame. The programme was completed in six days. The average time taken by all the subjects was found to be 11 hours 50 minutes. After all the students had completed the programme, the criterion test was administered as post-test to determine the achievement of the students. A self prepared checklist was administered after post-test to know the reactions of the students towards the various aspects of the given programme. A copy of the check list has been provided in the appendix D.

Copies of the programme, answer-sheets, criterion test and check-list were collected from the students. Students' responses were scored and thus data obtained were analyzed.

STATISTICAL ANALYSIS:

On the basis of the data obtained at this phase of testing, the programme was evaluated against two criteria, i.e., internal criteria and external criteria. Internal criteria included 'Error Rate', 'Programme Density' and 'Sequence Progression'. External criteria encompassed 'Gain Ratio' and 'Reactions of the students towards the programme'.

ERROR RATE:

The error rate of various units and the entire programme was calculated by adopting the same procedure as in the case of
small group testing of the programme. Table 2.22 shows the error rate in respect of each unit and the total programme.

**TABLE 2.22**

<table>
<thead>
<tr>
<th>Unit</th>
<th>Total No. of frames</th>
<th>Total No. of responses in frames</th>
<th>Total No. of errors</th>
<th>Total No. of students</th>
<th>Error Rate (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>32</td>
<td>33</td>
<td>36</td>
<td>50</td>
<td>2.18</td>
</tr>
<tr>
<td>II</td>
<td>521</td>
<td>951</td>
<td>2114</td>
<td>50</td>
<td>4.44</td>
</tr>
<tr>
<td>III</td>
<td>311</td>
<td>376</td>
<td>390</td>
<td>50</td>
<td>2.07</td>
</tr>
<tr>
<td>IV</td>
<td>35</td>
<td>69</td>
<td>116</td>
<td>50</td>
<td>3.36</td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL:</strong> 899</td>
<td><strong>1429</strong></td>
<td><strong>2656</strong></td>
<td><strong>50</strong></td>
<td><strong>3.78</strong></td>
</tr>
</tbody>
</table>

Table 2.22 reveals that the error rate for all the units was below 5 percent. It ranged from 2.07 to 4.44. The error rate of the entire programme was found to be 3.78 percent which is also below the acceptable value of 5 percent error rate. Thus the programme appeared to be effective on the basis of error rate.

**PROGRAMME DENSITY**

The concept of programme density has been discussed in small group testing. The type token ration (T.T.R) for different units of the programme and the total programme was calculated by adopting the same procedure as in the case of small group testing.
of the programme. The values of TTR as obtained for different units and the entire programme are reported in Table 2.23.

TABLE - 2.23
VALUES OF T.T.R. IN RESPECT OF VARIOUS UNITS AND THE ENTIRE PROGRAMME IN VALIDATION TESTING

<table>
<thead>
<tr>
<th>Unit</th>
<th>Total no. of frames</th>
<th>Total no. of responses</th>
<th>Total no. of different responses</th>
<th>T.T.R.</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>32</td>
<td>33</td>
<td>15</td>
<td>0.45</td>
</tr>
<tr>
<td>II</td>
<td>521</td>
<td>951</td>
<td>545</td>
<td>0.57</td>
</tr>
<tr>
<td>III</td>
<td>311</td>
<td>376</td>
<td>119</td>
<td>0.31</td>
</tr>
<tr>
<td>IV</td>
<td>35</td>
<td>69</td>
<td>62</td>
<td>0.69</td>
</tr>
<tr>
<td>TOTAL</td>
<td>899</td>
<td>1429</td>
<td>741</td>
<td>0.51</td>
</tr>
</tbody>
</table>

Table 2.23 shows that the value of T.T.R. for various units ranged from 0.31 to 0.89. The value of T.T.R. for unit I is 0.45; unit II, 0.57; unit III, 0.31; unit IV, 0.89. In case of unit I and unit III, the values are below 0.5, hence it was inferred that these units were of moderate difficulty level. In the case of unit II and unit IV, the values of T.T.R. are above 0.5 which seem quite high. But the reason of this was that different words were taken as examples for teaching a single concept in these units.

It may also be noted from the Table 2.23 that the value of T.T.R. of the entire programme was found to be 0.51, which
indicates that programme was of moderate difficulty. On the basis of this T.T.R. value, it may be inferred that on the average 51 different responses were required of the student while emitting 100 responses or student may learn 51 new responses after every 100 responses in the programme.

SEQUENCE PROGRESSION :

Sequence progression is one of the important essential criteria to be used to test the authenticity of the programme. Skinner (1972) emphasizes that the steps in a programme should not only be of the proper size but be arranged in an effective sequence. Klaus (1962) is also of the opinion that in preparing a programme, the writer can greatly enhance its efficiency by thoroughly determining beforehand what the sequence of topics will be. Lumsdaine (1966) points out that sequencing is not just a priori intellectual analysis of the subject matter; it must be student oriented and just to the extent of trying to guess what the students difficulties will be but to the extent of finding out what these difficulties are.

It has been invariably observed that the programmer develops a sequence of frames within each unit (a segment) and of units (segments) within the programme which he considers logical and thinks that so designed sequence would prove to be effective for the learners of target population; but when programme is subjected to empirical testing, it may reveal many
inadequacies and gaps in the instructional sequence. Hence a sequence based on a priori intellectual or logical analysis of the subject matter needs to be carefully examined in terms of student responses on post-test (Criterion test) to ascertain its logical progression in real sense.

In order to analyze the sequence progression, the criterion test items were arranged logically in consonance with the frame sequence in each unit of the programme. This arrangement of criterion test items has been shown in Table 2.24.

**TABLE - 2.24**

**UNITWISE ARRANGEMENT OF ITEMS OF THE CRITERION-TEST FOR SEQUENCE PROGRESSION**

<table>
<thead>
<tr>
<th>Units</th>
<th>Test Items</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit-1</td>
<td>73, 1, 2, 3, 4, 13</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>Unit-2</td>
<td>74, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 56, 59, 60, 61</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 55, 56, 57</td>
<td></td>
</tr>
<tr>
<td>Unit-3</td>
<td>9, 10, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 80, 5, 6, 7, 8, 45, 46, 47</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>46, 49, 50, 51, 52, 53, 54</td>
<td></td>
</tr>
<tr>
<td>Unit-4</td>
<td>87, 75, 28, 76, 29, 78, 77, 11, 12, 79</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>Grand Total : 80</td>
<td></td>
</tr>
</tbody>
</table>
After arranging the items of criterion test in logical order, total scores of the students on criterion test after instruction were organized in the rank order from high to low. Then 11 students out of 50 were selected by weeding out randomly one student from each of the two pairs of students who got repetitive scores. The scores of these 11 students are given in Table 2.25.

**TABLE - 2.25**

<table>
<thead>
<tr>
<th>S.No. of Students</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>3</th>
<th>5</th>
<th>6</th>
<th>6</th>
<th>9</th>
<th>10</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Score</td>
<td>77</td>
<td>76</td>
<td>75</td>
<td>74</td>
<td>73</td>
<td>72</td>
<td>71</td>
<td>70</td>
<td>68</td>
<td>67</td>
</tr>
</tbody>
</table>

In order to examine sequence progression of the programme, a two dimensional matrix i.e., scalogram was prepared by plotting all the correct and incorrect responses of each of the 11 students. A tick (✓) mark was used to show a correct response and a cross (X) mark was used to show an incorrect response. The total scores of these students were organized vertically and test-items horizontally as shown in Figure 2.3.

It is clear from the scalogram that in each unit of the programme the occurrence of correct responses decreases as the programme moves from lower level to the higher level of learning.
**Fig. 2-3**

**SEQUENCE PROGRESSION ANALYSIS**

*(SCALOGRAM)*

<table>
<thead>
<tr>
<th>UNIT</th>
<th>UNIT-I</th>
<th>UNIT-II</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>77</td>
<td>74</td>
</tr>
<tr>
<td>2</td>
<td>74</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>73</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>74</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>73</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>72</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>71</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>70</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>68</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>67</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>66</td>
<td></td>
</tr>
</tbody>
</table>

**INDEX:** ✓ = RIGHT RESPONSE  
✗ = WRONG RESPONSE
<table>
<thead>
<tr>
<th>UNIT</th>
<th>UNIT - III</th>
<th>UNIT - IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>SN.</td>
<td>SCORE</td>
<td>9</td>
</tr>
<tr>
<td>1</td>
<td>77</td>
<td>✓</td>
</tr>
<tr>
<td>2</td>
<td>76</td>
<td>✓</td>
</tr>
<tr>
<td>3</td>
<td>75</td>
<td>✓</td>
</tr>
<tr>
<td>4</td>
<td>74</td>
<td>✓</td>
</tr>
<tr>
<td>5</td>
<td>73</td>
<td>✓</td>
</tr>
<tr>
<td>6</td>
<td>72</td>
<td>✓</td>
</tr>
<tr>
<td>7</td>
<td>71</td>
<td>✓</td>
</tr>
<tr>
<td>8</td>
<td>70</td>
<td>✓</td>
</tr>
<tr>
<td>9</td>
<td>68</td>
<td>✓</td>
</tr>
<tr>
<td>10</td>
<td>67</td>
<td>✓</td>
</tr>
<tr>
<td>11</td>
<td>66</td>
<td>✓</td>
</tr>
</tbody>
</table>
material. It means that the students who got higher score on Unit-I, also got higher score on the Unit II, III and IV respectively. This trend shows a positive transfer of learning.

It is also evident from the scalogram that the errors tend to cluster toward high level of learning in case of low achievers.

This scalogram further reveals that there is no student who attempted all the items related with last unit correctly and all the items related with first-unit incorrectly.

On the basis of these observations it may be concluded that the sequence of instructional programme seems to be logical in terms of the rationale accepted for the programme.

**GAIN RATION**

In order to evaluate the effectiveness of the programme, 'gain ratio' was computed in the same manner as with reference to small group testing.

The mean performance of the sample group of 50 students on pre-test was found to be 7.28 and the mean performance of the same group of the students on post-test was obtained as 71.96. After computation, the gain ratio came out to be 0.88. The details of its computation have been summarized in Table 2.26.

**Table 2.26**

<table>
<thead>
<tr>
<th>N</th>
<th>M1</th>
<th>M2</th>
<th>Maximum</th>
<th>Actual possible gain</th>
<th>Gain</th>
<th>Gain Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>50</td>
<td>7.28</td>
<td>71.96</td>
<td>72.72</td>
<td>64.68</td>
<td>0.88</td>
<td></td>
</tr>
</tbody>
</table>
Table 2.26 shows that obtained value of gain ratio is quite higher than the prescribed value of gain ratio by Mc Guigon and Peter's (1965) for considering a programme as satisfactory. This obtained value of gain ratio further indicates that on the average, each student's performance (from pre-test to post-test) increased 65% of the maximum possible. Hence it may be concluded that the present programme appeared to be effective and was worth publishing.

STUDENTS' REACTIONS:

Another external criterion which is often used by the programmers in evaluating the effectiveness of the programmes is to assess the students' reactions towards the programme. Several programmers have suggested construction of properly validated attitude scale for this purpose (Neidt and Sjogren, 1968; and Ellams, 1969). Most of the investigators, however, have constructed themselves a kind of opinionnaire or attitude scale or questionnaire or checklist for assessing the reactions of the learners towards the programme. In the present case, the investigator himself also constructed a checklist to know the reactions of the students towards the various aspects of the programme. The checklist consisted of 13 different statements. A copy of the same is given in Appendix-D.

On the completion of the programme, students were administered the checklist. Obtained data were tabulated by
counting the frequencies of the responses of the students for each statement. The totals of the frequencies for each category of the statement were converted into percentage. The results have been summarized in Table 2.27.

**TABLE 2.27**

PERCENTAGE OF THE RESPONSES OF STUDENTS FOR DIFFERENT CATEGORIES OF EACH STATEMENT.

<table>
<thead>
<tr>
<th>Statement Number</th>
<th>Agree</th>
<th>Disagree</th>
<th>Undecided</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>90%</td>
<td>6%</td>
<td>4%</td>
</tr>
<tr>
<td>2</td>
<td>88%</td>
<td>4%</td>
<td>6%</td>
</tr>
<tr>
<td>3</td>
<td>92%</td>
<td>4%</td>
<td>4%</td>
</tr>
<tr>
<td>4</td>
<td>84%</td>
<td>8%</td>
<td>8%</td>
</tr>
<tr>
<td>5</td>
<td>88%</td>
<td>4%</td>
<td>4%</td>
</tr>
<tr>
<td>6</td>
<td>96%</td>
<td>2%</td>
<td>2%</td>
</tr>
<tr>
<td>7</td>
<td>94%</td>
<td>2%</td>
<td>4%</td>
</tr>
<tr>
<td>8</td>
<td>92%</td>
<td>6%</td>
<td>2%</td>
</tr>
<tr>
<td>9</td>
<td>90%</td>
<td>6%</td>
<td>4%</td>
</tr>
<tr>
<td>10</td>
<td>90%</td>
<td>4%</td>
<td>6%</td>
</tr>
<tr>
<td>11</td>
<td>76%</td>
<td>8%</td>
<td>16%</td>
</tr>
<tr>
<td>12</td>
<td>80%</td>
<td>6%</td>
<td>12%</td>
</tr>
<tr>
<td>13</td>
<td>88%</td>
<td>4%</td>
<td>8%</td>
</tr>
</tbody>
</table>

The results of Table 2.27 indicate that more than 84 percent of the students were of the opinion that language of this book was simple and easy to understand, rules and examples given in this text were clear. About 96 percent of the students
expressed that presentation of the content in small steps in this book helped them in learning of the content. More than 90 percent of the students felt that a frame was to be read carefully to complete the frame and a desire arose to read the next frame after filling in the blank and testing the response of the frame. About 90 percent of the students were of the opinion that the book was useful from the point of view of understanding the subject matter and learning of difficult content was also easier through this text than that of classroom teaching. About 76 percent of the students expressed that learning through programmed text took less time than that of classroom teaching. Furthermore, more than 80 percent of the students were of the opinion that such books should be available in other subjects, and they would enjoy reading through such type of books.

Keeping in view, the above mentioned observations it may be stated that the general tone of the comments of the students was overwhelmingly favourable towards the various aspects of the present programme.

On the basis of the results of both criteria—internal and external, it may be inferred that the programme is valid and may be used to conduct the experimental study. But to study the effect of confirmation of results on the performance of the learners, the investigator also needed another version of the programme consisting delayed confirmation of results.
Therefore, it was considered expedient to prepare a draft of the said programme from the validated linear programme on Hindi vocabulary building, by arranging correct responses for a set of five frames. Both versions of the programmed instructional material have been provided in Appendices A₁ and A₂ respectively.

In the following chapter methodology, design of the study, sampling, tools, experimentation data collection and statistical technique have been discussed.