Chapter IV

METHODOLOGY

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Methodology is an important aspect of any kind of research work. It is the sequence of proper modes and orders of procedures. Methods of research according to Good, Barr and Scates (1941, p. 207) "may be classified from many point of view; the field to which applied: Education, History, Philosophy, psychology, Biology etc; purpose: description, prediction, determination of causes, determination status etc; place where it is conducted: in the field or in the laboratory; application: pure research or applied research; data gathering devices employed: tests, rating scale, questionnaire etc; nature of data collected: objective, subjective, quantitative, qualitative etc; symbols employed in recording, describing or treating results: mathematical symbols or language symbols; forms of thinking: deductive, inductive etc; control of factors: controlled and uncontrolled, experimentation; methods employed in establishing causal relationships: agreement, difference, residues and concomitant variation".

There are various methods and procedures adopted by research workers to gather facts for their study through various sources. Of which the generally accepted three methods in educational research are historical method, survey method and experimental method.

Though there are different methods and procedures, the method adopted for a particular study should always be suited to the purpose and approach of the study. In other words the nature of the problem and the kind of data required for its solution determine the method to be adopted for the study.

**RESEARCH DESIGN OF THE PRESENT INVESTIGATION**

The present investigation made use of survey method for assessing and critically evaluating the programmes of early childhood education.
centres of Kerala. The survey, according to Best and Kahn (1995), involves a clearly defined problem and definite objectives. It requires expert and imaginative planning, careful analysis and interpretation of the data gathered, and logical and skillful reporting of the findings.

The survey method collects data from relatively large number of cases at a particular time. It is concerned with the generalized statistics that result when data are abstracted from a number of individual cases.

It may be mentioned in this context that survey method falls under the broad category of descriptive research, which is primarily concerned with conditions or relationships that exist, opinions that are held, processes that are going on, effects that are evident, or trends that are developing. It is primarily concerned with the present, although it often considers past events and influences as they relate to the current conditions. The method of descriptive research is particularly appropriate in the educational context where evaluation of various programmes conducted in the educational setting is warranted.

The term “evaluation” as used in the present investigation implies the process used to determine what has happened or what is happening in the early childhood education (ECE) centres in Kerala during the course of the present study. In other words it involves a critical study of the programmes conducted by the ECE centres for the all-round development of the individual child. The major purpose of this kind of evaluation is to see whether a particular programme is working, whether an institution is successful according to the goals set for it, or if the original intent is being successfully carried out. As Best & Kahn (1995) observe, to assessment, evaluation adds the ingredient of value judgment of the social utility, desirability or effectiveness of a process, product or a programme, and it
sometimes includes a recommendation for some course of action. In the present study educational programmes of ECE centres are examined critically to determine their success in meeting accepted objectives, with recommendations for constructive action.

PROCEDURE FOR SELECTING THE SAMPLE

For the selection of an adequate sample for the present investigation multi stage sampling was employed. As the first step, district wise categorization of the sample was considered.

The State of Kerala, where the present study was conducted consists of 14 revenue districts: Thiruvananthapuram, Kollam, Alappuzha, Pathanamthitta, Kottayam, Idukki, Eranakulam, Thrissur, Palakkad, Malappuram, Kozhikode, Wayanad, Kannur and Kasargode. Of these, 6 districts viz., Thiruvananthapuram, Pathanamthitta, Kottayam, Idukki, Kozhikode and Kasargode were selected to represent all the districts in the state. It may be mentioned in this context that factors such as various categories of ECE centres, number of ECE centres in each district, locality of the districts, educational standards maintained by the districts, percentage of literacy, and nature of management of educational institutions were considered for selecting these districts from where the sample of ECE centres were selected for the study.

The various categories of ECE centres in Kerala include Anganwadies, Balwadies, Government nursery schools, Pre primary classes in normal schools run by its Parent Teacher Associations (PTAs), Nursery schools run by Scheduled Caste development department and Kindergarten/Nursery schools run by Tribal development department. Besides these pre primary institutions run by private commercial agencies,
on which the State Government do not have any control, are also functioning in the State. The statistics regarding the ECE centres come under each of these categories has already been given in Table 1, Chapter I.

In the present study ECE centres run by or controlled by the State Government were only considered. Nursery schools run by Scheduled Caste development department and Kindergarten/Nursery schools run by Scheduled Tribe development department were not included since the programmes conducted by these schools were more or less the same and similar to those of Government nursery schools and Anganwadies.

From the six districts selected in the sample 348 institutions (ECE centres) were finally selected randomly for the purpose of the present study, using the method of random sampling technique. The relevant details are given in Table 4.

Table 4
Details regarding ECE centres selected in the sample

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Category of ECE Centre</th>
<th>No. of ECE centres selected in the sample</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Anganwadies</td>
<td>232</td>
</tr>
<tr>
<td>2.</td>
<td>Balwadies</td>
<td>47</td>
</tr>
<tr>
<td>3.</td>
<td>Government nursery schools</td>
<td>33</td>
</tr>
<tr>
<td>4.</td>
<td>Preprimary classes in Govt. schools run by Parent Teacher Associations</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>348</td>
</tr>
</tbody>
</table>

TOOLS AND TECHNIQUES USED FOR THE STUDY

The researcher has to select the appropriate tools based on the nature of the data to be collected. In the present study data regarding
certain existing practices of ECE centres were to be collected. For this questionnaire was the most suitable one because "it is widely used in educational research to obtain information about certain conditions and practices and inquire into opinions and abilities for selecting the required details from the individual or group" (Koul, 1999). Hence questionnaire was used for the present investigation.

CONSTRUCTION AND STANDARDIZATION OF THE PRESENT QUESTIONNAIRE

Preparation of Draft Questionnaire

Keeping in mind the programmes of ECE centres as specified in the hypothetical model (Chapter III), to collect the relevant data, a draft questionnaire was prepared first (Appendix A). It consisted of questions to collect information regarding programmes conducted at the centres for the five aspects developments mentioned in Chapter III, viz.,

A. Socio-emotional development;
B. Physical and motor development;
C. Language development;
D. Cognitive development; and
E. Development of Creative expression and aesthetic appreciation of the child.

With a view to collect the maximum relevant information about the programmes conducted at the ECE centres each of the five aspects of developments mentioned above were sub divided into different components. (Details regarding the sub division are presented Chapter III.)
Corresponding to each of these components, seven to ten plays/activities suitable for its development was included in the draft questionnaire. The purpose of including these activities in the questionnaire was to ask the respondents whether they are conducting, them at their centres or not. Besides these activities, questions to collect details regarding certain other factors such as location of the institutions, parent's meetings, home visits, facilities of the centres, and planning of the teachers were also included in it.

The draft questionnaire was subjected to revisions and modifications with the help of experts in the field of ECE. The experts included teachers of ECE centres, teacher trainers, headmasters of Pre primary teacher training institutes, supervisors and project officers of Anganwadies, peoples concerned with ECE in the District Primary Education Programme (DPEP), faculty members in the District Institute of Education and Training (DIET) and persons of ECE in the State Council of Educational Research and Training (SCERT). According to the suggestions of these experts certain play activities were deleted from the draft and a few new activities/plays were added to it.

**Pilot Study**

Using the modified questionnaire, a pilot study was conducted in four ECE centres in the districts of Idukki and Kottayam. Based on the experience of the pilot study some more modifications were made in the draft questionnaire, and thus the final one was constructed (Appendix B).

It is evident from a comparison of the draft and the final questionnaire that adequate modification was made by way of addition, revision, and deletion of items in the draft. It may also mention here that
the final questionnaire was edited on the basis of the nature of items included in it.

**Description of items in the Questionnaire**

The questionnaire consisted of three parts viz., Part A, Part B, and Part C. The questions under Part A were used for obtaining general information about the ECE centre and the programmes conducted by it as well as relevant informations used for evaluation of the programme meant for the various aspects of development of children.

Part A included questions to know the name of institution, category under which it comes, number of children and teachers, and items to collect the details regarding teachers planning, parents meetings and availability of play materials and play space. Some of the questions in Part A were used for ascertaining the reliability of responses of the respondents by noting the internal consistency with relevant questions under Part B or C. The question related to planning (Q. 5(A)), for example, gives an adequate picture regarding the type of planning conducted at the centre for the successful functioning of the programmes. Thus, though, only a few of the questions under Part A were used for actual analysis, all the questions under Part A were useful in one-way or the other.

Part B and Part C were meant for collecting data regarding the programmes conducted at the centres for the five developments mentioned above under construction and standardisation of the present questionnaire.
In Part B, the first seven questions (Q.1 to 7) were included to know whether sufficient number of plays/activities suitable for the development of a component "adjusting the child to the ECE centre" were or not conducted at the centres. The purpose of the next four questions (Q.8 to 11) was the collection of such informations with respect to another component, the "development of the self-concept of the child". In order to know the details regarding plays/activities conducted at the centres for the "development of personal cleanliness of the child" four items (Q.12 to 15) were included in the questionnaire. Questions 16 and 17 were meant to know the number of activities adopted at the centres for the "development of good personal habit of the child". Next three items (Q.18 to 20) were included in the questionnaire to get details regarding the sufficiency of activities conducted at the centres for the "development of leadership quality in children". To collect the number of plays/activities conducted at the ECE centres for the "development of the ability to control the emotions of the child". Questions 21 and 22 were included in the questionnaire.

In order to collect details regarding the plays/activities conducted at the centres for the "physical, gross motor and fine motor development" of the child Questions 23 to 29, 30 to 36 and 37 were included in the questionnaire. The purpose of next five questions (Q.38 to 42) was to get the number plays/activities adopted at the centres for the "development of sound discrimination" of the child. Question 43 was meant to know about the activities conducted for the "development of sound discrimination of the child". Last two items (Q.44 and 45) were asked to know about the plays/activities conducted at the centres for the "development of the sense of smell" and "taste" respectively.

Questions on 22 plays/activities were included in Part C. The purposes of all these questions too were to know the number of suitable
activities adopted at the ECE centres for obtaining various developments in the child. All the 22 plays/activities given in this part were suitable for more than one development. The purpose of each of these items is, therefore, not explained here.

The importance and benefits of each of the plays/activities included in both parts B and C have already been discussed in Chapter III under the "description of suggested activities".

Open-ended questions

It may be mentioned here that enough space was provided in the questionnaire to add new plays/activities conducted at her/his ECE centre, which were not included in the questionnaire. For this two measures were taken:

i. At the end of Part (C) of the questionnaire one open-ended question was included (Q. 23 (C)).

ii. For questions from 43 to 45 in Part (B) space was provided for mentioning similar plays/activities related to the specific development, which were conducted at their ECE centre.

Further, corresponding to every play/activity mentioned in Part (C) only a few, commonly attainable, developments was indicated in the questionnaire. If at an ECE centre any of the play/activity was adopted for obtaining developments not mentioned in the questionnaire, to indicate those developments space was provided at the end of every item in Part (C).
Procedure Used for Administering the Questionnaire

In the present study data were collected from 348 ECE centres, using a questionnaire. In all the centres the tool was administered individually, as it provides “an opportunity to establish rapport with the respondents and to explain the meaning of the questions to respondents that may not be clear to them” (Koul, 1999). Because of this procedure sufficient occasions were obtained for asking the respondents further details regarding their responses to ensure its accuracy.

For collecting the data from some of the Anganwadies, opportunities were got to administer the questionnaire to groups of respondents when they came at the office for attending their official sectoral meetings. The help of teachers from District Institute of Education and Triaging (DIET) of the concerned district were also obtained for collecting the data.

The Accuracy of the Data Given by the Respondents

To ensure the accuracy of the information given by the respondents the following three measures were adopted while the questionnaires were filled up:

(i) Asking details about the plays/activities

When a respondent mentions that a play/activity was conducted at the centre for a particular development, she/he was requested to explain how this play/activity was conducted for achieving that particular objective. For example, if a respondent mentioned that “story telling” was used at the centre for the “development of good personal habits” in children, she/he
was asked to say which story was used for this particular purpose. If she
did not give a satisfactory answer, her reply that story telling was used for
the "development of good personal habits" was not considered.

(ii) Cross checking of the responses

In order to establish the reliability of answers given by the
respondents cross checking of their responses was also made use of. For
example if a respondent mentioned that ball throwing was conducted at
their centre for the "gross motor development" of children and as response
to another question she indicated that balls were not available at the
centre her response to that particular item was not considered.

As another example, if a respondent indicated that indoor games
were conducted for "gross motor development" of children and as reply
to another question she indicated that the indoor space is very tiny, her
response to that item was not considered.

(iii) Examination of relevant records

Whenever it was possible, examination of relevant records were
also made use of for ensuring the accuracy of the replies given by the
respondents. For example, if a respondent mentioned that she properly
maintains the growth chart of children for assessing their physical
development, she/he was requested to show it. Then by observing the
records the reliability of her response was determined. Even if she did not
produce the record, her response to that particular item was not
considered. As another example, if a teacher replied that she conducts
parents meetings once in every month, she was asked to show the records related to it such as the minutes book and attendance register.

VALIDITY AND RELIABILITY OF THE QUESTIONNAIRE

With a view to establish the validity (a questionnaire is valid if it measures what it intends to measure) and reliability (a questionnaire is reliable, if there is consistency in measurement), adequate care has been taken while developing and selecting each question. Further, experts were asked to evaluate the questions to check its validity. All the three experts unanimously confirmed the validity of the questionnaire. To make sure of the reliability, the questionnaire was administered twice on ten ECE teachers. The investigator along with the experts, compared the responses obtained on the two occasions, and confirmed that there is consistency in the responses.

The details given above may provide information to indicate that the present questionnaire is a valid and reliable tool for assessing the programmes of ECE centres in Kerala.

METHODS OF ANALYSIS OF THE QUESTIONNAIRE

(1) The Degree of Sufficiency of Programmes for Each Component

The criterion fixed for assessing the degree of sufficiency of programmes was the number of suitable plays/activities conducted at the centre for achieving the development of each component. Usually several plays/activities may be available for the development of each component. (A description of suggested suitable plays/activities are included in Chapter III). But the minimum or maximum number of plays/activities to
be performed for achieving the objective is not specified in any of the literature related to this area. Hence the investigator formulated the following procedure for the purpose.

Thirty-five educationists/experienced personnel in the field of ECE were contacted frequently and they were asked to suggest the optimum number of plays/activities to be carried out for the development of each of the components used in the present investigation. The mean and standard deviation of the numbers they suggested were calculated and two numbers, viz., mean plus one standard deviation (M+1.S.D) and mean minus one standard deviation (M-1.S.D) were found out. These values were rounded off to the nearest integer. Thus two numbers, viz., 5 and 2 were obtained. This means that if 5 or more suitable plays/activities were conducted for the development of a particular component, then the sufficiency of the number of programmes of that particular component could be evaluated as “plenty”. If 2 or less programmes were conducted it may be treated as “deficient”. The degree of sufficiency may be designated as “adequate” if 3 or 4 suitable plays/activities were carried out for the purpose mentioned above.

The same treatment was followed for all the components. That is, the number of play activities to be conducted for assessing as “plenty”, was the same for all components; for assessing as adequate was the same for all components; and for assessing as “deficient” was the same for all components.

For convenience, a table is presented as noted below:
Table 6

Frequency of suitable plays/activities and its verbal evaluation or interpretation

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>No. of suitable plays/activities</th>
<th>Verbal Evaluation/interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5 or more</td>
<td>Plenty</td>
</tr>
<tr>
<td>2</td>
<td>3 or 4</td>
<td>Adequate</td>
</tr>
<tr>
<td>3</td>
<td>2 or less</td>
<td>Deficient</td>
</tr>
</tbody>
</table>

It may be mentioned here that the above criterion was fixed after giving detailed information regarding all the different developmental areas of the child, to all the experts in order to suggest the optimum number of activities necessary for the development of the concerned component. The experience of the investigator, as a resource person to conduct orientation programmes for pre school teachers, could make use of the purpose of the formulation of the criteria presented in table 5.

(2) Criteria for Assessing the Success of Programmes Based on Each Aspect of Development

In order to assess the extent of success of various programmes based on each aspect of development, the degree of sufficiency of programmes of each of its components was taken into account. That is, if an aspect of development has ‘n’ components, the success of programmes of that aspect of development was determined by considering the degree of sufficiency of programmes of those ‘n’ components. Based on this, the extent of success of the programmes of each of the development was assessed as “highly successful” (H.S),
"moderately successful (M.S)" and "not successful (N.S)". As the number of components contained varies in different aspects of development there was variation in assessing the verbal evaluation of programmes also. The details are following:

A. Socio-emotional development

The socio-emotional development as mentioned in Chapter III was subdivided into seven components. The success of programmes of this aspect of development was assessed as “highly successful" (H.S), if the programmes of at least five of its components were treated as “plenty" and the remaining components, if any, were treated as “adequate". That is, in the following three situations it was termed as “highly successful" (H.S).

a. Programmes of five components were treated as “plenty" and two as "adequate”.
b. Programmes of six components were treated as “plenty" and one as "adequate”.
c. Programmes of all the seven components were treated as "plenty".

For convenience, the different possibilities of the programmes of the socio-emotional development to be designated as “H.S" was represented in the form (P,A) where P denotes the number of components termed as "plenty" and A the number of components termed as "adequate". Accordingly, the programmes of the socio-emotional development was termed as “H.S" for (5, 2), (6, 1) and (7, 0).

The success of programmes of this area was assessed as "moderately successful" (M.S) if all its components were termed as at least “adequate” with maximum four components termed as "plenty". As
done just above, the different possibilities for the programmes of socio-emotional development to be termed as "M.S" was represented by (4, 3), (3, 4), (2, 5), (1, 6) and (0, 7).

The programmes of this area of development was designated as "not successful" (N.S) if the programmes of any one or more of the components was assessed as "deficient". It may be mentioned here that even if all the remaining components were treated as "plenty" or "adequate", the presence of a single component designated as "deficient" with respect to the programmes, would be enough for treating the programmes of an aspect of development as "not successful" (N.S). This highlights the significance of each of the seven components considered for the present study.

B. Physical and motor development

The aspect of physical and motor development was split into three components as mentioned in chapter III. The success of programmes of this area was termed as "H.S" if at least two of the components were treated as "plenty" and the remaining one, if there was, designated as "adequate". The different possibilities as per the procedure adopted in the previous case were (2, 1) and (3, 0).

It was ascertained as "M.S" if all its components were treated as at least "adequate" with maximum one component as "plenty". The different possibilities for the programmes of physical and motor development to be designated as "M.S" were: (1, 2); and (0, 3).

The success of programmes of this area was designated as "N.S" if any one or more of the components was termed as "deficient".
C. Language development

The language development was sub-divided into six components as mentioned earlier in this chapter. The success of programmes of this aspect of development was assessed as “H.S” if at least four of the six components were treated as “plenty” and the remaining components, if any, were treated as “adequate”. As mentioned in the previous cases, the different possibilities for the programmes of this area to be termed as “H.S” were: (4, 2); (5, 1); and (6, 0).

The success programmes of this aspect were designated as “M.S” if all its components were treated as at least “adequate” with maximum three components treated as “plenty”. Its different possibilities were (3, 3); (2, 4); (1,5) and (0,6).

If any one or more of the six components was treated as “deficient”, the success programmes of the area of language development as done in the previous cases, were assessed as “N.S”.

D. Cognitive development

The cognitive development was sub-divided into seven components as mentioned in chapter III. The success of programmes of this aspect of development was termed as “H.S” if at least five of the seven components were treated as “plenty” and the remaining, if any, were treated as “adequate”. The different possibilities were: (5, 2); (6, 1); and (7, 0).

The success of programmes of cognitive development was assessed as “M.S” if all its components were treated as at least
"adequate" with maximum four components termed as "plenty". The different possibilities were: (4, 3); (3, 4); (2, 5); (6, 1) and (0, 7).

If the programmes of any one or more of the seven components were termed as "deficient", the success of programmes of the area of cognitive development was designated as "N.S".

E. Development of Creative Expression and Aesthetic Appreciation

The area of creative expression and aesthetic appreciation was subdivided into three components as mentioned in chapter III. The success of programmes of this area of development was termed as "H.S", if the programmes of at least two of the three components were treated as "plenty" and the remaining one, if there was, treated as "adequate". Its different possibilities were: (2, 1); and (3, 0).

The success of programmes of this area was termed as "M.S" if all its components were designated as at least "adequate" with maximum one "plenty". The different possibilities were: (1, 2); and (0, 3).

If the programmes of any one or more of the components were treated as "deficient", the success of programmes of the area of creative expression and aesthetic appreciation was assessed as "N.S".

(3). Classification of ECE centres as “Excellent”, “Good” or “Poor”

The ECE centres included in the sample were classified as "excellent", "good" or "poor" based on the assessment of the programmes conducted at the centre for the development of the five aspects considered in the study viz.,
A. Socio-emotional development;
B. Physical and motor development;
C. Language development;
D. Cognitive development; and
E. Development of creative expression and aesthetic appreciation. Its details are followed.

a) “Excellent” ECE Centres

An ECE centre was designated as “excellent” if and only if it comes under any of the following categories with respect to the success of programmes for the five aspects of development:

(i) All the five aspects were assessed as “H.S”;
(ii) Four of the aspects were assessed as “H.S” and the remaining one aspect was assessed as “M.S”;
(iii) Three of the aspects were assessed as “H.S” and the remaining two aspects were assessed as “M.S”.

The details are given in Table 6.

Table 6
Different possibilities of an ECE centre to be designated as “excellent”

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Number of development aspect assessed as:</th>
<th>Total number of aspects assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Highly Successful</td>
<td>Moderately Successful</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>
b) "Good" ECE Centres

An ECE centre was designated as "good" if and only if it comes under any one of the following categories with respect to the success of programmes for the five aspects of development:

(i) Two of the five aspects were assessed as "H.S" and the remaining three aspects were assessed as "M.S".
(ii) One of the five aspects was assessed as "H.S" and the remaining four aspects were assessed as "M.S".
(iii) All the five areas were assessed as "M.S".

The details are given in Table 7.

Table 7

Different possibilities of an ECE centre to be designated as "good"

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Number of development aspects assessed as:</th>
<th>Total number of aspects assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Highly Successful</td>
<td>Moderately Successful</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>5</td>
</tr>
</tbody>
</table>


c) "Poor" ECE Centres

All the ECE centres which were not eligible to be designated as either "excellent" or "good" were designated as "poor". The details are given in Table 8.
Table 8
Different possibilities of an ECE centre to be designated as "poor"

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Number of development aspects assessed as:</th>
<th>Total number of areas assessed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Highly Successful</td>
<td>Moderately Successful</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>0</td>
</tr>
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</tr>
<tr>
<td>15</td>
<td>0</td>
<td>4</td>
</tr>
</tbody>
</table>

(4) Statistical Techniques Used for Analysis

Analysis of Questionnaire on "Programmes of Early Childhood Education Centres" was done after categorizing the responses in various ways. Percentage analysis was done for this purpose.

The main statistical technique used in the present study was the test of significance between percentages $P_1$ and $P_2$. The formula used for it was:
CR = \frac{(P_1 - P_2) - 0}{\sigma_{P_1 - P_2}} \quad \text{where}

CR \text{ is the Critical Ratio;}

\sigma_{P_1 - P_2} = \sqrt{PQ \left( \frac{1}{N_1} + \frac{1}{N_2} \right)}

N_1 \text{ and } N_2 \text{ are the size of the two samples,}

P = \frac{N_1 P_1 + N_2 P_2}{N_1 + N_2}, \quad \text{and}

Q = (1 - P)

(Garrett, 1981).

If the CR exceeds 2.58, the difference is significant at 0.01 level. If the CR exceeds 1.96 the difference is significant at 0.05 level. If the CR is less than 1.96, the difference is not significant statistically.