**Research Instruments**

Research Instruments are tools or techniques used for data collection in a research. Nworgu (2006) identifies the following as techniques and instruments that can be used to collect primary data in research:

1. Observation
2. Questionnaire
3. Interview
4. Measuring Scales

1.) Observation

A researcher may observe people, events, situations or objects and collect the information he/she needs to solve a research problem. If the researcher is to observe human behavior, he/she will do so in the natural setting, that is, in a situation where the behaviour to be observed is shown.

Types of Observation

1. Participant Observation
2. Non-Participant Observation

a.) Participant Observation

The observer could be a member of the group he/she wants to observe or he/she may join the group because he/she wants to collect certain information related to a research study.

b.) Non-Participant Observation

The observer is neither a member of the group nor a participant in the setting he/she wants to observe. The observer only observes the behaviour of the people in a group or in a situation.

**Questionnaire**

This is widely used by researchers in Education to obtain information on different types of studies.

Types

1. Structured or Fixed Response
2. Unstructured or Open-End

a.) Structured or Fixed Response

It contains questions or items that cover all research objectives (or research questions and/or hypotheses) and the response options which participants are expected to pick from for each question or item in the questionnaire. In some cases, the researcher can anticipate all possible responses that can be given by the participants (that is, those who will fill the questionnaire). For example, if you need information on teachers’ qualifications in senior secondary schools in a local government area, we all know that the minimum qualification for teaching in those schools should be a first degree or Higher National Diploma, while the highest qualification a teacher in a senior secondary school can have is PhD. So, the response options for an item on Qualification of Respondent will be:

HND

B Sc./B. A

B. Sc. Ed/B. A. Ed/B. Ed

M. Ed

M. Sc./M.A

PhD

In other cases, it is not possible to determine the responses that participants in the study will give. For example, if you want to obtain information on sources of funds in private secondary schools, participants may list different sources since those schools charge different fees. You can conduct a pilot study which can suggest the options to be included. Some researchers may create enough space in the questionnaire and put an option: Others (please specify).

b.) Open-End or Unstructured Questionnaire

With this type, the researcher does not provide response options for the items or questions in the questionnaire. Participants are required to give their responses as they like and they are free to use their own words. You can use unstructured questionnaire if you cannot determine beforehand the responses that the participants in your study will give. With this type of questionnaire, participants can give information that you did not think of and such information can help you understand the research problem better.

Questionnaire Construction

When constructing a questionnaire, take note of the following:

1.) The characteristics of the sample that you have selected: level of education, age, class, etc. so that suitable language and illustrations can be used to prepare the questionnaire.

2.) Review relevant literature and determine the variables involved (as shown in the research questions or hypotheses) and prepare the questions or items that will help you collect data that will be used to answer research questions or test research hypotheses.

3.) Choose either structured or unstructured type of questionnaire. The questionnaire should not be too long so that participants will be willing to complete it.

4.) Choose the response mode: This depends on the type of data you require: is it nominal, ordinal, interval or ratio data you need? Take note of the research questions you want to answer or the hypotheses you want to test before you collect any data. Bear in mind that the data you collected will determine the statistical tool you will use for data analysis. When you want to choose response mode, consider the ability of the participants to respond easily to the questions/items and the time that will be needed to complete the questionnaire.

5.) Write the questions or items in clear language.

Writing Questionnaire Items or Questions

According to Nwankwo (1983), you must ensure that the items:

1. are related to the research problem, that is, they will help you to collect the data needed to answer your research questions or test your research hypotheses.
2. are the relevant ones you need - open-end or structured. You also need to consider the statistical tool you will use for data analysis before you choose the format.
3. are clear. They should be written in clear language. A question or an item should contain one idea. For example, an item such as: Teachers in my school are regular and punctual in school will not yield accurate data. Is it punctuality or regularity of teachers in school that is being measured? You also need to avoid using ambiguous words. For example, if you have an item: My principal treats all students fairly when he/she applies school rules, participants will find it difficult to know what you mean by fair treatment. Instead, the item may read: My principal does not consider any student his/her friend or enemy when he/she applies school rules.
4. do not suggest how they should be responded to. For example, the following question suggests how it should be answered: In view of the fact that corporal punishment can harm students physically, do you support its use to maintain discipline in schools? Data collected from suggestive questions/items will not be valid.
5. do not ask for knowledge and information that the participant does not have when he/she is responding to the items. For example, an item in a questionnaire prepared to collect data on Universal Basic Education (UBE) should find out if those who will respond to it (that is, the questionnaire) know what UBE stands for before asking them to respond to other items on it (that is, UBE).

6.) do not seek sensitive information from participants.

**Pilot Testing and Administration of Questionnaire**

After you have prepared your questionnaire, you need to validate it. Validity is the first psychometric property an instrument must possess. The questionnaire can be validated by your supervisor, and experts in your field of study and in Test and Measurement. The suggestions they make will be used to improve the quality of the instrument.

Thereafter, you have to conduct a pilot study to test it. You can use a small sample which is similar to the one to be used for the main study. For example, if the main study will be conducted in Somolu Local Government Area and public secondary school principals in the LGA will be asked to fill the questionnaire, you can give it to public secondary school principals in Lagos Mainland Local Government Area to fill in the pilot study. The feedback you get from the pilot study can help you to reframe some of the items/questions or determine if some of the suggestions provided above on how to write questionnaire items are not complied with (especially serial numbers 3, 4, 5 and 6).

During the pilot study, you also need to test for the reliability of the instrument, which is the second psychometric property an instrument must possess.

The valid and reliable questionnaire is then administered to the participants in the main study.

**Interview**

The interviewer (the researcher) requires good communication skills to make use of this method of data collection; he must know how to ask correct questions; and how to get the interviewees (participants) to give the required information. Interview can be conducted face-to-face or by telephone.

When you want to use the method, you have to be friendly with the participants. Assure them about the confidentiality of the information they are going to supply to you and that the information will be used for the research only.

Interview Structure

Nwankwo (1983) identifies the following format:

1.) Unstructured Interview

The interviewee is free to express him/herself the way he likes, using his/her own words. The researcher does not impose any structure on the participant.

2.) Semi-Structured Interview

Some structured questions are prepared by the researcher, but he/she can ask other questions not listed to clarify responses given further. However, the researcher should know relevant questions to ask when it is necessary for the interviewee to clarify some responses.

3.) Structured Interview

The researcher will prepare a list of questions to be asked. He/she only allows the interviewee to expatiate on the responses briefly because specific information is required. This is necessary when specific information is required from all the participants.

Telephone Interview

You may need to check the website of an organization, a school or Ministry of Education to obtain telephone numbers of people to be interviewed in your study. Some people may not be willing to give you their personal phone numbers. Therefore, you may need to obtain the official phone numbers and the interview will have to be conducted during official hours.

You need to consider how good the telephone network is before you decide to conduct telephone interview. It will be cheaper to use telephone interview if the participants in your study live in far places (for example, you are in Lagos and participants your study are in Abuja) and they have given their consent to be so interviewed. Since the interview is conducted on phone, your influence on the participant will be reduced.

**Measuring Scale**

When you, as a researcher, use a measuring scale, it enables you to assign numbers, for example, to opinions, beliefs, attitudes, etc. of people in a systematic way. Those numbers, for example, indicate the extent to which a person possesses the characteristic that the Scale tries to measure.

Likert-type or Summated Rating Scale.

Students of educational management use Likert-type Rating Scale to collect data.

When you want to prepare this scale, you have to develop a list of statements on the variables you want to measure and a set of graduated response options. Any participant in the study will read each statement and pick a response option which corresponds with his opinion on that statement. During data analysis, those response options are given numerical values. The responses for all the statements are added (summed) up to obtain a participant’s total score for the variable that you are measuring. That is why it is called summated rating scale.

The wording of each statement will determine the value to be given to the response option ticked by the participant. For example, let us assume that Strongly Agree (SA), Agree (A), Disagree (D), and Strongly Disagree (SD) are the response options in a Summated Rating Scale. SA, A, D and SD will be scored 4, 3, 2 and 1 respectively if the statements are positively worded (for example, Teachers in my school are always regular in class). If the statements are negatively worded (for example, Teachers in my school are not regular in class), the scoring will be reversed. When you use SA, A, D, and SD as response options, Neutral or Undecided may or may not be included. When you do not include it (Neutral or Undecided) as a response option, you are asking a participant to express an opinion on a statement on which he/she does not have an opinion. If it is included and a participant ticks it as a response option on a statement, it should not be scored or given any numerical value.

If Neutral or Undecided response option is not included in a measuring scale, that is, when the scale has four response options (for example, SA, A, D and SD) that scale is called a modified Likert-type Rating scale. In that case, you are asking all the participants to pick a response option for each of the statements.

If you want to include ‘Neutral or Undecided’ response option, let it be at the beginning or the end of the response options (that is: U, SA, A, D, SD or SA, A, D, SD, U). It should not be a midpoint between the two extreme response options, that is, it is not correct to arrange the response options like this: SA, A, U, D, SD. When you are scoring the responses when you use this format: U, SA, A, D, SD or SA, A, D, SD, U, ‘Undecided’ option should be given zero value (0) because a participant who ticked ‘Undecided’ option has no opinion to give on what you are measuring.

**Validity and Reliability of Instruments**

Validity is the extent at which an instrument measures what it claims to measure. An instrument (for example, a questionnaire) or a test (for example, a maths test) that measures what it says it measures is said to be valid.

Four types of validity can be identified (Van Dalen, 1979):

1.) Content Validity

According to Van Dalen (1979), it is also called logical, sampling or curricular validity. When you want to determine content validity of your instrument (for example, a questionnaire), you will examine the content of the area that the questionnaire is to assess by reviewing literature on the area. You will then develop the questionnaire to measure the various aspects of that content. As a student, you will then give the questionnaire to your supervisor (and other experts in your field of study, if you like) who will then determine the extent to which the questionnaire measures the content for which it has been designed. Your supervisor (and other experts, if you like) will also assess if each item in the questionnaire is relevant to the research problem you are investigating or not. When we talk about relevance to the research problem here, you must remember that the questionnaire items must help you collect data to answer research questions or test research hypotheses, which show the problem you are investigating. Your supervisor (and other experts) will also determine if those who will complete the questionnaire (that is, the participants in your study) will understand each of those items.

Face validity is an aspect of content validity. It is saying that “on the face of it”, the instrument (e.g. questionnaire) measures what it says it measures.

2.) Predictive Validity

As a researcher, you may want to use a test to predict a future outcome, which may be success in school or on a job. If the test you have prepared is able to make exact prediction of the future outcome for which you have prepared it, then it is said to have predictive validity.

There are three steps involved in determining predictive validity:

1. Prepare and administer the test.
2. Wait until the future outcome (e.g. performance in school) predicted by the test has happened.
3. Find the relationship between the test scores and actual performance (future outcome) that the test has been designed to forecast. (Remember that you have to use a correlation statistic that is relevant to the data you collected.)

The higher the correlation co-efficient you got, the more accurate the test would be as a predictor of the future outcome. The problem with predictive validity is that it might be difficult to determine the yardsticks to use to measure a future outcome such as success in a vocation, for instance, teacher effectiveness.

3.) Concurrent Validity

The procedure for determining concurrent validity is similar to that of ascertaining predictive validity. The difference is that the future outcome that is predicted is measured almost the same time when the predictor test is administered. For example, instead of waiting for some time to determine whether a vocational interest test can forecast success in a particular occupation, a researcher may decide to correlate the scores obtained on the test by people who can be regarded as successful in a particular occupation with the scores of people who are successful in other occupations to find out if the test differentiates the groups.

Another way of determining concurrent validity is to relate performance on a test with performance on another well-known test (if a well-known test exists). For instance, if you have developed a test to measure intelligence of people, you may validate your test concurrently by comparing performance of people on it with their performance on the well-known one.

It can also be determined by comparing performance on a test with performance obtained by using another method, for example, assessment by human judges (Tuckman, 1999). For instance, results of a test which will measure the degree to which people exhibit neurotic disorder could be compared with the results of an assessment conducted by some clinical psychologists who did not know the results of the test. Any correlation between the test scores and the results of judges’ assessment will mean that the test has concurrent validity.

4.) Construct Validity

A construct is said to be a characteristic that is hypothesized to explain an aspect of human behaviour such as anxiety, intelligence, motivation, introversion, extroversion, etc. We cannot see constructs, we cannot touch them or hear them. We can only imply them from test scores or observe them through aggressive acts (e.g. hostility), persistence with which a task is done, for example, motivation, etc. (Best, 1981).

When you want to determine construct validity of a test, for example intelligence test, the first thing to do is to define the construct. That is, the construct is explained in terms of some behavior. For example, an intelligent person may be defined as someone who will score high marks in all courses he registered for. You will then determine whether that intelligence test that you have prepared measures the construct (that is, intelligence), by finding out if those who scored high marks on the intelligence test exhibit the expected behaviour (that is, they scored high marks in all courses they registered for). Construct validation is not limited to the assessment of the test alone, but also an evaluation of the theory on which the test is based.

Reliability

An instrument (e.g. a questionnaire) is reliable when it measures consistently what it says it measures. Four methods can be used to investigate the reliability of an instrument.

1.) Test- retest Method

If you want to use this method, you will need to administer the instrument (e.g. a questionnaire) you have prepared on two occasions to the same group of people under the same conditions. You will then correlate the two sets of scores you obtained on those two occasions to determine the reliability of the instrument. Remember that you will use correlation statistic that is relevant to the data you collected. Only one form of the instrument is required. The interval between the two occasions when the instrument will be administered is usually two to three weeks. That is a period that is long enough to ensure that the people would have forgotten how they completed the instrument on the first occasion. That period of two to three weeks is also not too long for them to gain experiences that would change the way they will complete the instrument on the second occasion.

2.) Alternate Form Reliability

Two forms of an instrument (e.g. a questionnaire) are prepared, for example Form A and Form B. Form A and Form B will be similar in every way except that the items are not exactly the same. They are only alike in content and level of difficulty. The two forms are administered to the same people involved in the pilot study, and the scores obtained from the two forms of the instrument that were administered will be correlated (using relevant correlation statistic) to establish the degree of relationship between them. The correlation coefficient obtained will show the degree of the relationship between the two sets of scores.

This method removes the recall effects that may occur when the same instrument is administered on two occasions when we use test-retest method. The major problem of the alternate form reliability is the difficulty of preparing two forms of an instrument that are exactly equivalent.

3.) Split-Half Reliability

This one also demands only one form and one administration of an instrument. The instrument is divided into two halves. For example, odd-numbered items may represent one half, while even-numbered items may represent the second half. You will then obtain scores on each half of the instrument for each participant involved in your pilot study. After that, you will correlate the two sets of scores by using appropriate correlation statistic.

The correlation co-efficient (r) you obtained between the two halves represents the reliability of half of the instrument and will underestimate the reliability of the whole instrument. You can use Spearman-Brown Prophecy Formula to adjust the correlation co-efficient you got to compute the estimate of the reliability of the whole instrument.

Spearman-Brown Prophecy Formula =

2 x Correlation Co-efficient (r) between two halves of the instrument

­­­­­­­­­­­1 + Correlation coefficient between two halves of the instrument

Example: Assume that the correlation coefficient (r) obtained from the two halves of an instrument was 0.8.

Then, the estimate of the reliability = 2 x 0.8 = 1.60 = 0.89.

1 + 0.8 1.80

The problem with the Spearman-Brown Prophecy Formula is that it tends to give a higher estimate of reliability than what will be obtained when the test re-test or alternate-form method is used (Van Dalen, 1979).

4.) Kuder-Richardson Reliability

Kuder and Richardson developed Formulas 20 and 21 that can be used to estimate the internal consistency of a test without dividing it into halves. This method “determines how answers to each item on the test relate to answers on each other item and to the test as a whole” (Van Dalen, 1979, p.140).

Kuder-Richardson Formula 21 (*KR*21) is easier to compute than *KR*20. Formula 21 also requires less time than any other technique of determining reliability. To compute KR21, one will need the test mean (M), the variance (σ2), and the number of items that the test has (N).

r *KR*21 = N(σ2)– M (N- M)

(N – 1) σ2

Example: An 80-item test has a mean score of 40 and a standard deviation of 20. Calculate the reliability estimate (r).

Therefore:

N = 80

M = 40

Variance (Standard deviation squared) σ2 = 400

r *KR*21  = 80(400) – 40(80 - 40) = 32000 – 40 (80 - 40)

(80 - 1)400 (79)400

r *KR*21  = 32000 – 1600 = 30400 = 0.96

79 x 400 31600

The values of r *KR*21 are slightly less accurate than the values of r *KR*20 but the differences are not usually substantial.

**Collecting Secondary Data**

They are the data that you, as a researcher, did not collect from the field personally. They are published data found in journals (e.g. education journals), textbooks, publications of ministries of education and National Bureau of Statistics, etc.

Note the following when collecting secondary data:

1. Make sure you collect the data you need. In deciding on the data you need, take note of the variables you want to measure, the research questions you want to answer or the research hypotheses you want to test. You also need to confirm that the manner in which the data you are collecting have been reported has remained the same over the years.
2. You must endeavor to collect the most current data/figures. It is possible that the data you need and want to collect have been reviewed when more data were collected by those who published them in the secondary sources you consulted. If you collect current data first before you obtain those reported some years back, you may get a clue on how reliable the data you are collecting are.
3. You need to write down the sources of the secondary data you have collected. You may need to consult those sources again. Follow the American Psychological Association (APA) format for writing a source of information. For example, if the source of the secondary data is a book, you need to write down the full name(s) of the author(s), title of the book, town (and in some cases, name of country) where it was published, year of publication, name of publisher and the page(s) where the data are reported. If it is necessary, you have to obtain the permission of the copyright owner stated in the book before you report the data in your project. You must acknowledge the sources of secondary data reported in your project report.
4. When you report secondary data in your project, make sure it is done correctly so that your findings will not be based on incorrect data. You need to make sure that accurate data have been reported by the secondary source. For example, if you got some secondary data on student enrolments in public universities from a source, but not the National Universities Commission (NUC), you can get relevant publications of the NUC to confirm the accuracy of the data or go to a sample of the universities to confirm the data reported for such universities.
5. If you did not copy the data as reported in the secondary source or sources, mention in your project the source or sources from which the data were compiled/adapted.

**Field Work**

1. Get a Letter of Introduction from our Department which will indicate you are a student from the University of Lagos.
2. If necessary, get approval from relevant authority to collect data. For example, if you are going to administer your Instrument (e.g. a Questionnaire) to public primary school teachers in a local government area in Lagos State, you need to obtain approval from the State Universal Basic Education Board.
3. Be friendly with the participants. Be courteous when you interact with them.
4. Follow the research procedure you stated in Chapter 3 – identify the population, select the sample with the sampling method you mentioned in Chapter 3, train research assistants you want to use on how to administer the instrument for data collection and ensure that the assistants administer the instrument properly.

Make use of responsible people as research assistants, not those who will sit in a place and personally fill all the copies of the instrument given to them.

1. Report the limitation(s) of the data collected, if any.
2. You need human relations skills to get the needed data. Do not antagonize the participants.
3. In some cases, you may be asked to personally compile needed data from the records of agencies, educational institutions, Ministries or organizations from where you need data if their staff members who are supposed to help you do not have the time to do so. This may be necessary to quicken the process of data collection.

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