

CHAPTER 3: RESEARCH DESIGN AND METHODOLOGY

3.1 INTRODUCTION

This section provides the methods used to collect data to answer this study's research questions. According to Creswell and Creswell (2017), identifying the research methodology is important because it ensures that a study can be undertaken in an organised manner. The elements of research methodology that are discussed include research questions, research methodology, the adopted design, the research approach, the study site, the population of the study, the sample size and the techniques, instruments, data analysis as well as the considerations that were undertaken concerning ethics.

3.2 RESEARCH QUESTIONS

The research questions that guided the study are:

- What are teacher views of Art Integrated Learning in the mathematics classroom?
- What is the Effect of Art Integrated Learning on Academic Achievement in Mathematics of 10th Grade Students?

3.3 RESEARCH METHODOLOGY

Scholars describe research methodology as a set of logical and systematic procedures which are to be followed in research to gather the appropriate data for the study (Kothari, 2012). The research methodology therefore validates and justifies how the data was obtained. There are two research methodologies, namely quantitative and qualitative methodologies (Naoum, 2012), and this study adopted the quantitative approach. These two approaches are thoroughly discussed below in section 3.5 about the research approach.

The study was quantitative, using a pre-test and post-test design. According to McMillan & Schumacher, (2010), a quantitative study makes use of numbers, statistics, structures, and controls. It was convenient to use a pretest and posttest experimental design because there was no randomised sampling. In an experimental design, an intervention is administered to the experimental group. The control group must not get in contact with the intervention

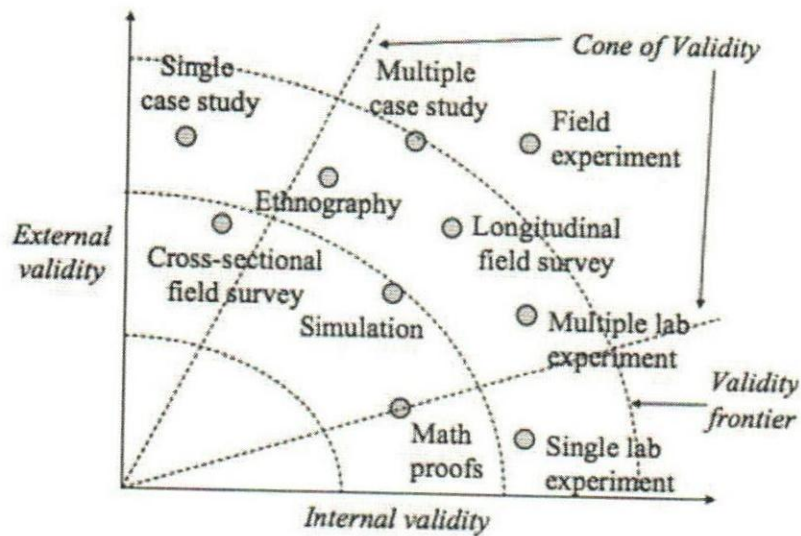


Figure 3: Internal and external validity

The researcher in this study collected data through pretest & posttest marks, semi-structured interviews, observation for three weeks. The pretest and posttest experimental design of Grade 10 mathematical AIL classroom was used to collect data and to analyse students' understanding and effect of academic achievement of mathematics when Art Integrated Learning was used.

3.5 RESEARCH APPROACH

The study was quantitative, using a pretest-posttest experimental design. According to McMillan & Schumacher, (2010), a quantitative study makes use of numbers, statistics, structures, and controls. It was convenient to use a quasi-experimental design because there was no randomised sampling. In a Pre-test and post-test experimental design, an intervention is administered to the experimental group. The control group must not get in contact with the intervention (McMillan & Schumacher, 2010). Below is a discussion of the



(McMillan & Schumacher, 2010). This is to avoid diffusion of the intervention to the control group. Two groups of Grade 10 mathematics classes Named Group A and Group B have participated in the study. The Group A of grade 10 was an experimental group and group B was the control group.

3.4 RESEARCH DESIGN

A research design describes the actionable part of the research which is crucial to connecting the research questions to the eventual implementation of a study (Creswell & Clark, 2017). This design is, therefore, the guideline from which a study can be developed and concluded (Sekaran & Bougie, 2016). It is a basic plan that guides the data collection and analysis processes of conducting research. According to Castellan (2010), the experimental method is typically distinguished, as the researcher has control over one or more independent variables. Castellan (2010); Johnson and Christensen (2019) also mentioned that it is mainly of three types; true experimental, quasi-experimental and pre-experimental method. Furthermore, Castellan asserted that the true experimental method is uniquely characterized by its random assignment of sample participants into experimental and control groups. It is also used to investigate the cause-effect relationship between variables. Quasi-experimental does not involve the technique of random assignment of participants, but rather employs intact groups. As with true experimental design, quasi-experimental design can also be employed to confirm the cause-effect relationship between variables, especially on humans (Fraenkel & Wallen, 2009). However, this can be done by paying special attention to those extraneous variables that equally bring rival explanations with that of the independent variable in the conclusion of the study (Castellan, 2010; Johnson & Christensen, 2019).

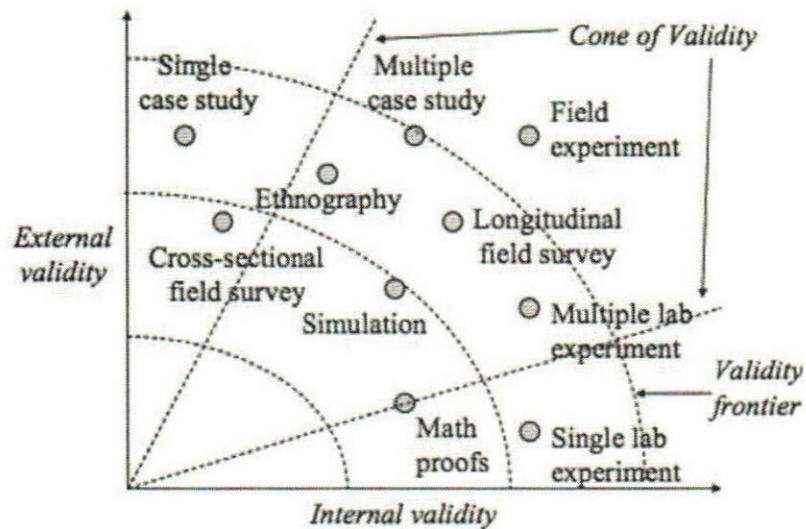


Figure 3: Internal and external validity

The researcher in this study collected data through pretest & posttest marks, semi-structured interviews, observation for three weeks. The pretest and posttest experimental design of Grade 10 mathematical AIL classroom was used to collect data and to analyse students' understanding and effect of academic achievement of mathematics when Art Integrated Learning was used.

3.5 RESEARCH APPROACH

The study was quantitative, using a pretest-posttest experimental design. According to McMillan & Schumacher, (2010), a quantitative study makes use of numbers, statistics, structures, and controls. It was convenient to use a quasi-experimental design because there was no randomised sampling. In a Pre-test and post-test experimental design, an intervention is administered to the experimental group. The control group must not get in contact with the intervention (McMillan & Schumacher, 2010). Below is a discussion of the two paradigms as well as an explanation of how they influence the research being conducted and what makes them distinct from each other.

3.5.1 QUANTITATIVE RESEARCH APPROACH

According to Walliman (2017), quantitative research refers to studies that seek to measure some concepts or phenomenon of interest using variables, hypotheses, and units of analysis. Quantitative studies are aimed at describing novice ideas, situations, or concepts (Sekaran & Bougie, 2016). It is grounded in the positivist philosophy that views reality as objective, observable, value-free, inert, and stable. According to Creswell and Clark (2017), a quantitative research approach begins with research questions or hypotheses and thereafter design an approach that is appropriate for providing the numerical bases for confirming or refuting the hypotheses or to answer the research questions. Quantitative research applies deductive reasoning methods to argue from what is unknown to reach a logically certain conclusion. This method was not used in this study because the study sought an in-depth understanding of Art Integrated Learning and numerical description of the phenomena was deemed insufficient. A qualitative approach was used instead.

3.5.2 QUALITATIVE RESEARCH APPROACH

Qualitative research was used in this study. The qualitative research approach refers to a method of study that displays, analyses, summarises, and interprets words and images based on the raw data that was collected by a researcher (Brace, 2018).

Walliman (2017) describes qualitative research as “studies that are subjective, but in-depth, using a probing, open-ended and a free-response format.” Qualitative research was chosen for this study because it allowed the researcher to gather data that is rich in depictions of how school students experienced the phenomenon of Art Integrated Learning as a way of learning mathematics (Noaum, 2012). The approach helped the researcher understand the meanings constructed by students; how students make sense of their own experiences and knowledge they have about mathematics (Merriam, 2009:13).

3.6 RESEARCH PHILOSOPHY

Research philosophy can be described as the views about how empirical data can be gathered, analysed, interpreted, and utilised (Saunders, Lewis, & Thornhill, 2016). According to Saunders, Lewis, and Thornhill (2016), research philosophy can be described in terms of ontology and epistemology. Ontology centres more on the nature of reality whereas epistemology deals with what is regarded as truth (Saunders, Lewis, & Thornhill, 2016). The philosophical assumptions are important because they determine the method used to collect data as well as the approach for a study.

In this study, the positivist paradigm was employed to find the academic achievement in mathematics of grade 10 students under the use of Art Integrated Learning in a mathematics classroom. Creswell and Creswell (2017) are of the view that the interpretive paradigm is appropriate for such studies because in this case, it helps with the understanding of the perceptions of students through their experiences within an Art Integrated Learning environment. Therefore, this study used the responses of students to Art Integrated Learning to construct and interpret their understanding from the collected data.

3.7 POPULATION AND SAMPLING TECHNIQUES

The target population is described as a group of people that share the same characteristics with which the researcher can use to make generalisations to the general population (Welman, Kruger, & Mitchell, 2005).

3.7.1 Research site

The population of this study was sixty (60) Grade 10 students and their teacher at a school in Government High School, Laxmipur was purposely selected mainly because of its diversity and COVID-19 situation. This rural school is located at Laxmipur village, Koraput in Odisha. The school has an average enrolment of about 600 students from Grade 9 and grade 10.

The school is well resourced with three (1) computer laboratories, two (2) science laboratories, and one (1) library. The school is considered as one of

the best schools in the Laxmipur block as it has a large number of student enrolments from various villages around the school. Also, the school is always in the top 5 best performing schools in terms of matric results at the block level. Students of Grade 10 mathematics classroom was selected at this school for data collection purposes.

Table 1: THE TEACHER'S DEMOGRAPHIC DATA

Characteristic	Teacher S1
Gender of teacher	Male
Professional qualification	B.Sc in Mathematics & B.Ed.
Subject major	Mathematics
Mathematics teaching experience	24 years

Table 2: SUMMARY OF SELECTION CRITERIA OF THE PARTICIPANTS

Participant	Instrument used	Selection criteria
Teacher S1	Interview	Purposive sampling
Student L1 –L60	Achievement Test	Purposive sampling

3.8 SAMPLING

Sampling involves choosing the appropriate sample that can represent the entire population during a study (Sekaran & Bougie, 2013). The probability sampling strategy and the non-probability sampling strategy form the main types of sampling (Sekaran & Bougie, 2013). According to Van Zyl (2014), a probability sampling strategy is one where every item in the population has a chance of being selected whereas, in nonprobability sampling, some elements of the target population have a higher chance of being chosen. In this research, a probability sampling method was selected. The sampling was purposive as the researcher selected the school that had many mathematics students and the school was Close to the researcher's home. Purposive sampling ensured that respondents who could answer the research questions were selected to participate in the study.

All the secondary school students constituted the population of this study. Sixty students in 10th grade of the Government High School Laxmipur consisted of the sample for this study. The pre-test and post-test research instruments were used for this study. These instruments were used for accessing students' performance which would reflect their level of knowledge in mathematics before and after the experiment. The pretest and post-test equivalent group design was considered to be the most useful for this study.

3.9 DATA COLLECTION TOOLS

The instrument that is used to gather data is referred to as the data collection tool (Van

Zyl, 2014). The collection of data in this study was through: a document (groups' written task), structured interview, and lesson AIL class observation.

3.9.1 Interviews

An interview is a two-way conversation where the interviewer asks questions to learn about the ideas, beliefs, views, opinions, and behaviors of the participants. Interviews are the most widely used method of data collection, they are in-depth and either semi-structured or unstructured (McMillan, 2012: 291). Semi-structured interviews were used in this study because they allowed the researcher to have an interactive dialogue with research participants. The semi-structured interviews also allowed the researcher to

ask follow-up questions and better understand the responses of participants instead of taking responses at face value. The same interview questions were used to get their views, opinions, and beliefs of learning in small groups than in the traditional textbook. Mathematics teacher was interviewed to get more understanding of how they felt and thought about the use of Art Integrated Learning in a mathematics classroom.

The questions were open-ended and each question was allowed to respond. While the questions were open-ended, the researcher ensured that the interviewees kept time to provide in-depth information that was only relevant to the questions posed. The questions were posed using simple language and were kept concise.

For example, The teachers were asked questions such as *“What are the benefits of learning mathematics using Art Integrated Learning?”* and *“What is your preferred method of teaching and why?”*

3.9.2 Experiments

For convenience, two groups of Grade 10 class were involved in the study. It was easy for the researcher to work with these groups. A self-prepared pre-test was administered to a sample of 60 students. Based on achievement scores in the pre-test, the students were assigned to either the experimental group or control group through paired random sampling. Each group had 30 learners and their mathematics teacher. The participants wrote a pre-test and a post-test after school hours to assess their academic achievement before and after an intervention program was provided to the experimental group. The time allocated for each test was one hour. The tests were conducted under examination conditions. The invigilator was the research administrator, marking the tests and recording the marks obtained by each learner.

3.10 INTERVENTION

Art integrated learning method was used for teaching and learning selected Grade 10 mathematics students. Learners explore creatively while building connections between different concepts through various art forms. Art experiences, both in visual (drawing and painting, clay modeling, pottery, paper crafts, mask and puppet making, heritage crafts, etc.) and performing arts

(music, dance, theatre, puppetry, etc.) lead to a better understanding and construction of knowledge about different concepts. Arts have the flexibility to accommodate age-appropriate opportunities for learners who can explore at their pace. This resonates with the experiential learning approach. Learners performed exercises, watched videos, read the theory, and learned from examples on mathematics. Each session took an hour. The intervention programme was done for three weeks.

3.11 DATA ANALYSIS

A self-prepared pre-test was administered to a sample of 60 students. Based on achievement scores in the pre-test, the students were assigned to either the experimental group or control group through paired random sampling. Each group consisted of 30 students. Two teachers were selected - one for the experimental group and one for the control group. The control group was taught by expository strategy while the experimental group was taught by the problem-solving technique. The experimental group was taught using a series of lesson plans put together with the help of AIL guidelines, which include heuristic steps of Art Integrated Learning. This experiment was completed for three consecutive weeks. Immediately after the treatment ended, a self-developed post-test was administered to both the experimental and control groups. Scores obtained by pre-test and post-test were presented in tabular form for interpretation. The data analyzed by means, standard deviation, and difference of means were computed for each group. Significance of difference between the mean scores of both groups on variable pre-test and post-test scores were tested at 0.05 levels by applying a t-test and ANOVA on the variable of the pre-test achievement in mathematics.

3.12 ETHICAL CONSIDERATIONS

Ethical issues are about negotiating how to get access to the people and sites being studied, how long to stay in the field, and the way of collecting data - how to interact with participants respectfully (Ryen, 2009). The researcher explained the purpose of the study to all Grade 10 mathematics students and their teachers.

3.13 CONCLUSION

This section outlined the research methodology of the study and the various elements of the research process, such as research design, research approach, and data collection instrument, and data analysis. This study adopted a quantitative research approach and collected data were analysed using t-test and ANOVA analysis. The next chapter presents and discusses the results of the study.