CHAPTER 3

METHODOLOGY

3.1 Overview

The researcher will describe the methods employed in this research to assess the suggested research design and methodology for gathering the data needed. With respect to the research purpose in establishing the cause-and-effect relationships, this chapter discusses the issue of threats of quasi-experimental design, sampling method, instruments, population, as well as data analysis techniques employed in this research, which are all disclosed. Aside from that, this chapter went over each phase of the data collection method in detail.

3.2 Research Design

This section details the overall research design that involved the strategies and methods in the data analysis as well as the data collection process. In essence, this research uses Type 2 of the design and development research (DDR) approach to test the theory and validate the developed product. DDR is chosen since it results in the production of knowledge, a deeper grasp of the area, and the capacity to make projections (Richey & Klein, 2014). In addition, DDR is also defined as developing new methods, techniques, and instruments based on a thorough research of individual needs analysis (Richey & Klein, 2007).

Apart from that, the selection of details, the overall strategies and methods involved in the data collection and data analysis process, strategies and methods were considered by integrating all the related components of the research in a relevant and effective way. The systematic research of design, development, and assessment

processes to develop an empirical basis for creating instructional and non-instructional technologies and products, as well as new or upgraded models that govern their development, is referred to as DDR (Richey & Klein, 2014). This is in line with the research's objective of ensuring that the research problem and goal are successfully addressed during the data gathering and analysis phases.

Type 1 of DDR research involves situations, for example., the product development process employed in a specific situation is explained, analyzed, and finally evaluated by Richey, Klein, and Nieson. According to Richey and Klein (2007), this first type of DDR research is formative research. Still, the formative and summative evaluation is conducted as an intervention during the development of the product. Meanwhile, the second type of DDR research involves the process of general design, development, and evaluation (Safarina & Norshidah, 2018). Model studies focus on drawing conclusions in general and not looking specifically at the product but procedures, processes, and situations. Design and development, according to Richey et al. (2004), is a method of establishing new processes, approaches, as well as tools depending on needs analysis.

Furthermore, the ADDIE model was selected as the instructional design model for the research because it best suits the design and development methodologies, aims, and strategies to depict a comprehensive image and knowledge, both conceptually and operationally. To be known, ADDIE is a generic and widely used framework by almost every researcher in an instructional design field. Basically, ADDIE is an acronym for the systematic processes of analysis, design, development, implementation as well as evaluation. Therefore, the authenticity or efficiency of a newly designed module, method, or technique will be the topic of research using the ADDIE model (Almelhi, 2021).

This research clarifies the systematic instructional framework that ensures the effectiveness of an instructional product (Muhammad Sabri et al., 2012). In addition, this framework is easy to be adapted and is applicable to a variety of settings, specifically in developing game-based learning tools. Conversely, Gagne's 9 events of instruction are the learning theory that inspired the game's design. As each step is completed, learners are meant to become more motivated, interested, and invested in the learning topic. As a result, this research employed DDR and ADDIE Model as shown in Table 3.1.

Table 3.1: Research Design

Research Objective	DDR	ADDIE	Research Design
RO1: To research the sustainability elements for game-based learning (GBL) in learning Tajweed	Analysis	Analysis	Thematic analysis Preliminary research
RO2: To develop interactive game-based learning (GBL) in Tajweed using selected sustainability elements	Design Development	Design Development	Design and Development
RO3: To evaluate the impact of game-based learning (GBL) in learning Tajweed.	Evaluation	Implementation Evaluation	Quasi Experimental Design

Table 3.1 shows the research design applied for conducting the research. To establish the theoretical choice and research approach, which aims to develop a sustainable instructional game, an instructional design strategy has been chosen with a combination of sustainability elements, learning theory, and motivation technique. These strategies are adopted with the development and design research (DDR) approach. To answer the objectives listed, this research has adopted a mixed-method approach. The researcher adopts the ADDIE Model in the design phase of the game.

During the evaluation phase, the pre and post-test were conducted to evaluate the impact of game-based learning (GBL) in learning Tajweed.

In sum, the ADDIE model is implemented in phase two that is the design and development phase. This model was selected since it is a method for instructional designers, content developers, and even teachers to employ the ADDIE model's procedures to build an efficient and successful teaching design for any instructional product (Aldoobie, 2015). In reality, items created using the ADDIE model can be applied in any venue, whether online or in person. This methodical process is also symbolized by the acronym ADDIE, which refers to Analysis, Design, Development, Implementation, as well as Evaluation, which are all critical elements in generating instructional design. Thus, in the ADDIE model, every phase is connected to and communicates with the others (Aldoobie, 2015). Table 3.2 explains the relationship between DDR and ADDIE Model.

Table 3.2: DDR and ADDIE Model Relationship

Phase	Design and Development Research (DDR)	Phase	ADDIE Model
1	Analysis	1	Analysis
2	Design and Development	2	Design
		3	Development
3	Evaluation	4	Implementation
		5	Evaluation

Table 3.2 shows the relationship between DDR and ADDIE model. DDR, on the other hand, is founded on the premise that design and development methods are empirical (Richey & Klein, 2007). It emphasizes the parallels between instructional design and scientific problem-solving. In these initiatives, academics develop novel approaches to address real-world issues (Thomas & Rothman, 1994). Designers employ

scientific methodologies across the design and development process to help them comprehend the process (Richey & Klein, 2007).

Hence, DDR encompasses the range of competencies (skills, knowledge, and disposition) that instructional designers are expected to possess. It emphasizes and covers all phases of the design and development process, as well as being appropriate for a variety of educational and training settings. Thus, the research design for this research is figured out and will be detailed in the research framework in subsection 3.3.

3.3 Research Framework

This section discusses the research framework which underpins each action made during the research. It also discusses the scope and the focus of this research. DDR can also be used to design and construct an intervention, for instance, teaching, learning, products, or a computer-based instructional package, to resolve a challenging academic issue (Plomp, 2007). This research is divided into three main phases (analysis, design and development, and evaluation), and each phase's output is an input to the next phase. The detail of the research framework is shown in Figure 3.1.

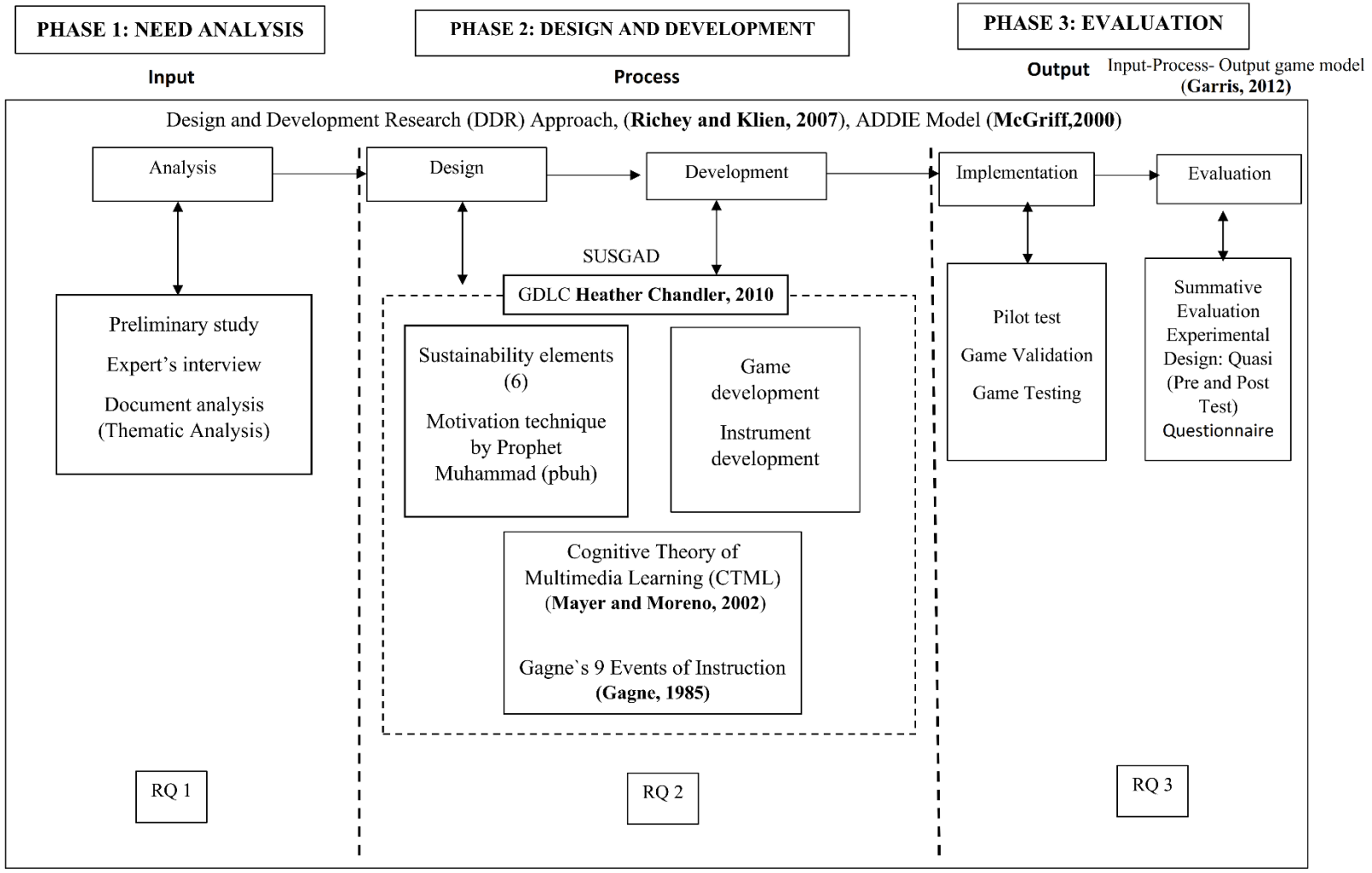

Figure 3.1: Detail of Research Framework

The research design framework is depicted in further depth in Figure 3.1. In general, the DDR Type 2 and ADDIE models are used in this research. The ADDIE approach used in DDR has five steps: analysis, design, development, implementation, and evaluation. During the design and development phase, this research used Cognitive Theory of Multimedia Learning (CTML), Gagne's 9 events of instruction, Prophet Muhammad's (Pbuh) motivating technique, and sustainability elements to influence the game's design. This research focuses on developing an interactive game called i-Tajweed. It will be tested using a quasi-experimental design for primary school students to explore their motivation and achievement.

In order to undertake design and development research, at least three key fields of research and theory are used, namely, teaching and learning design theory and research, theory learning and research, as well as communication theory and research (Richey & Klein, 2007; Smith & Regan, 2008). The summary of the explanation about the research framework is as follow:

- Need analysis: Involve preliminary research with interviewing the experts to explore the goal analysis, learner and context analysis as well as instructional analysis (task analysis).
- Design: The design of the storyboard of the game by setting performance goals, defining, and constructing teaching tactics, and identifying and developing assessment procedures are all part of this step.
- Development: The development or adoption of instructional materials, as well as the creation of a storyboard, are all included in this step (case studies, images, assessment items, presentations, multimedia materials, and others.). This also includes the development of the instruments.

- Formative evaluation: Designing and implementing formative evaluation is part of this process.
- Revision: This final stage is reexamining the instructional analysis validity and using data from formative evaluation to make necessary adjustments.
- Impact of the game/Summative Evaluation: The value of the game is evaluated to determine the effectiveness of the game. Quasi-experimental research was carried out with 120 primary school students.

3.3.1 Analysis

For the context of the research, the DDR approach was implemented in the first Phase. In this phase, the researcher emphasis the needs assessment. Klein et al. (2000), for instance, describe a requirements analysis that was carried out to find the best instructional content and delivery mode for an introductory course in educational technology. The needs assessment findings were utilized to alter an existing course. The purpose of this research was to evaluate the game's effectiveness and to identify the impact on students' motivation and achievement in learning Tajweed. The primary purpose of this phase is to employ demand analysis to establish the requirements for producing a recommended game as well as the sustainability elements that should be incorporated in the game. While in the need analysis phase, research on the importance of using game-based learning approach in enhancing student achievement with the implementation of sustainability elements. In addition, the preliminary research was conducted in the first phase. The following subsection explains the analysis phase that involved an interview with an expert.

3.3.1.1 Interview with Experts

To identify the problems faced by students on a different topic in learning Tajweed and the need to develop an educational aid such as a game to address the problem, interviews were carried out with three expert teachers in Tajweed. All teachers had more than 10 years 'experience teaching Al-Quran, specifically in Tajweed. In this session, eight experts are comprising the expert in the subject (Tajweed), expert in IT, and expert in instrument.

Six questions with six theme that are (the need of sustainable game, elements in game, sustainability definition, method in identifying sustainability elements, student`s motivation and suggestions) were prepared during the semi-structured interview. Before the interviews sessions were conducted, the interviewees were requested to fill up personal details and consent forms for the interview. The interview was recorded and transcribed by the researcher. Then, the transcripts were then translated into English for data analysis purposes. The findings from the interview session indicates that there is a need (majority of expert are agree) to develop game-based learning in Tajweed with sustainability elements. The findings of this phase are mentioned in Appendix E.

Before conducting the interview, the researcher follows the protocol as mentioned below:

1. Require permission from the Ministry of Education (get an approval letter, and others.)
2. Require permission from District Education Office and experts.

After that, the interviews were conducted in six stages, as follows:

1. Introduction
2. Confirming the interviewee background
3. Outlining the purpose of the interview

4. Getting permission to record the conversation
5. Conducting the interview session
6. Conclusion and appreciation of the interviewee

3.3.2 Design

The design process consists of several key features. During this stage, rigorous planning was conducted to identify the objectives, steps taken to determine how the objectives will be achieved, select instructional strategies, and select the right type of media to deliver the objectives (Nor Tutiaini, 2019). During the design phase, content feature, external feature, physical feature, and main activity feature were formulated and arranged and were firmly determined at the outset.

In the design and development phase, the ADDIE Model is chosen as a backbone. When working on such a project, the whole design and development process should be documented. During this phase of design and development, the instructional design (ID) should be followed (Isman, 2011). The first step of ADDIE is analysis, during which instructional difficulties and learning objectives are identified (Tasks et al., 2000).

After the storyboard was completed, a discussion was held with a professional multimedia module expert in the game industry to determine the best method to develop the i-Tajweed game within the proposed timeframe. In the development phase, the finalized elements, contents, activities, and assessments were produced. The development of the i-Tajweed was also determined for its compatibility and suitability to the students 'needs and to meet the learning objective.

All the data gathered during the analysis phase were considered during the design of the game. Furthermore, the objectives and learning outcomes to be reached by students in this research were defined using the MOE's curriculum. Hence, the game's

structure, as well as development, were designed to create learning activities that meet the students learning goals and objectives (Plass et al., 2015; Beard-Gunter et al., 2019; At the same time, the purpose of the developed game is to enhance students` motivation and performance after playing the game.

Based on those findings, this research decided to cover two Tajweed rules, *Hukum Mim Sakinah* and *Mad Lazim*. After deciding the topics covered, all main features were arranged and designed in storyboards. Storyboards are important to create samples to illustrate the envisioned module and to specify the instructional strategy used in the game.

Therefore, a storyboard that outlined the presentation of the i-Tajweed was sketched and designed with details of texts, images, descriptions, notes, and animations in the i-Tajweed. The storyboard canvas is explained in chapter four. Next, the storyboard was created and then sketched on paper.

After that, a scanner was used to copy each frame representing a screen in the i-Tajweed. The content of the presentation was aimed at both low and high cognitive levels of students. During this phase, the design of the module and the implemantation of Gagne Nine Event of Instruction (Table 3.3) was mindful of the three considerations, which are what and how of the assessment, the organization of the instruction, and the physical feature of the assessment.

Table 3.3: Application Gagne Nine Event of Instruction in i-Tajweed

Instructional Event	**Application into i-Tajweed**
1) Gaining attention	▪ Provide the instruction set with a graphic about Tajweed learning.
2) Informing the learner of theobjective	▪ Each learning module begins with the introduction to the specific learning objectives learners are expected to master.

Instructional Event	Application into i-Tajweed
3) Stimulating the recalling ofprerequisite learning	▪ A note in "*Tajweed* Rules" is provided in the main menu to help learners recall the big picture of the rules
4) Presenting the stimulus material	▪ The content of each learning module is delivered via multimedia elements such as text, audio, video, and graphics that act as stimuli for the learners.
5) Providing learning guidance	▪ The Instruction and How to play sections are included in the main menu to provide guidance and references.
6) Eliciting the performance	▪ A short tip is provided at the end of each game. Aligned with the cognitive and motivation technique in design principles, each correct answer will be rewarded with praise to give learners a sense ofachievement and vice versa.
7) Providing feedback aboutperformance correctness	▪ Any wrong answer in the game will be guided with a hint, providing a feedback mechanism (tips) intended to lead learners to give correct answers.
8) Assessing the performance	▪ Provide the Tajweed test after playing the game. The test used to access the understanding of the topic (Tajweed)
9) Enhancing retention and transfer	▪ The repetition of the game. Post-test was given after individual. In addition, each screen will display options for Notes, Instruction, and Tips to help enhance both learning retention and the ability to transfer the newly-acquired knowledge to new learning situations.

3.3.3 Development

This research employs the ADDIE model, which satisfied the Design and Development Research (DDR) approach to establish the suggested game, i-Tajweed. The DDR consists of the three main phases, which are 1) Analysis; 2) Design and development; 3) Evaluation (Muhammad Sabri et al., 2012). In DDR, there were several instructional models outlined by literature to develop an instructional product, such as ADDIE, ASSURE, and the Dick and Carey model. This research employed ADDIE instructional model because the model is generic, and it is currently the standard model for technology-based education (Lee et al., 2017; Tasks et al., 2000). Five Phases of

ADDIE have been recognised and established as the complete phases that covered the design and development process.

3.3.4 Implementation

During this stage, two groups named treatment and control groups were involved in the experiment. There are two sessions (pre and post-test) during the quasi-experiment. In the first session, the researcher conducts the experiment in school. However, due to MCO, the next experiment session is conducted online. Figure 3.2 explains the flowchart of quasi-experimental design.

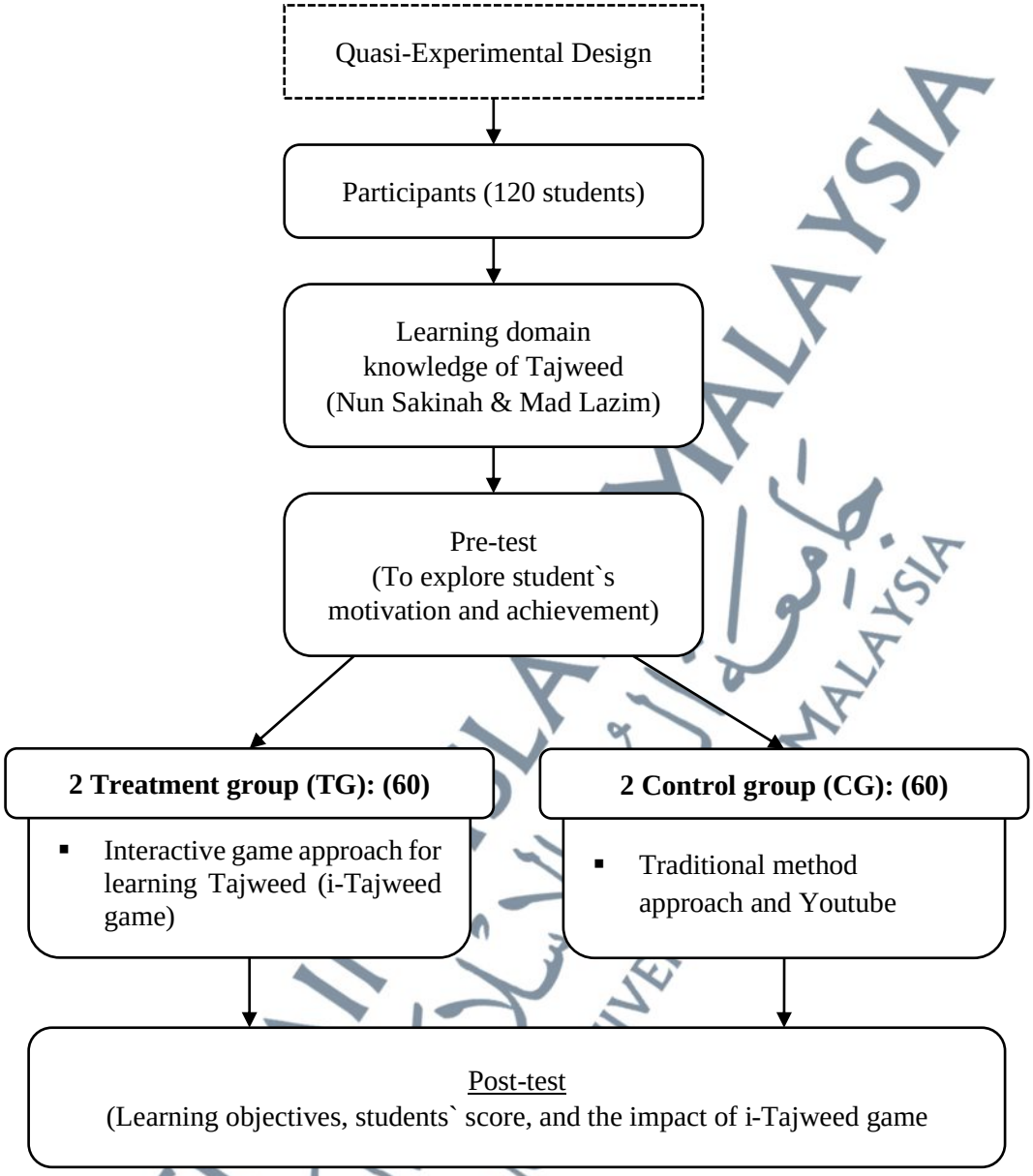

Figure 3.2: Flowchart of Experimental Design

Figure 3.2 explains the flowchart of quasi-experimental design in this research. One hundred twenty participants were involved during the session. Two sessions were conducted in the experiment. Two groups, named Treatment Group (TG) and Control Group (CG), were involved during the experiment.

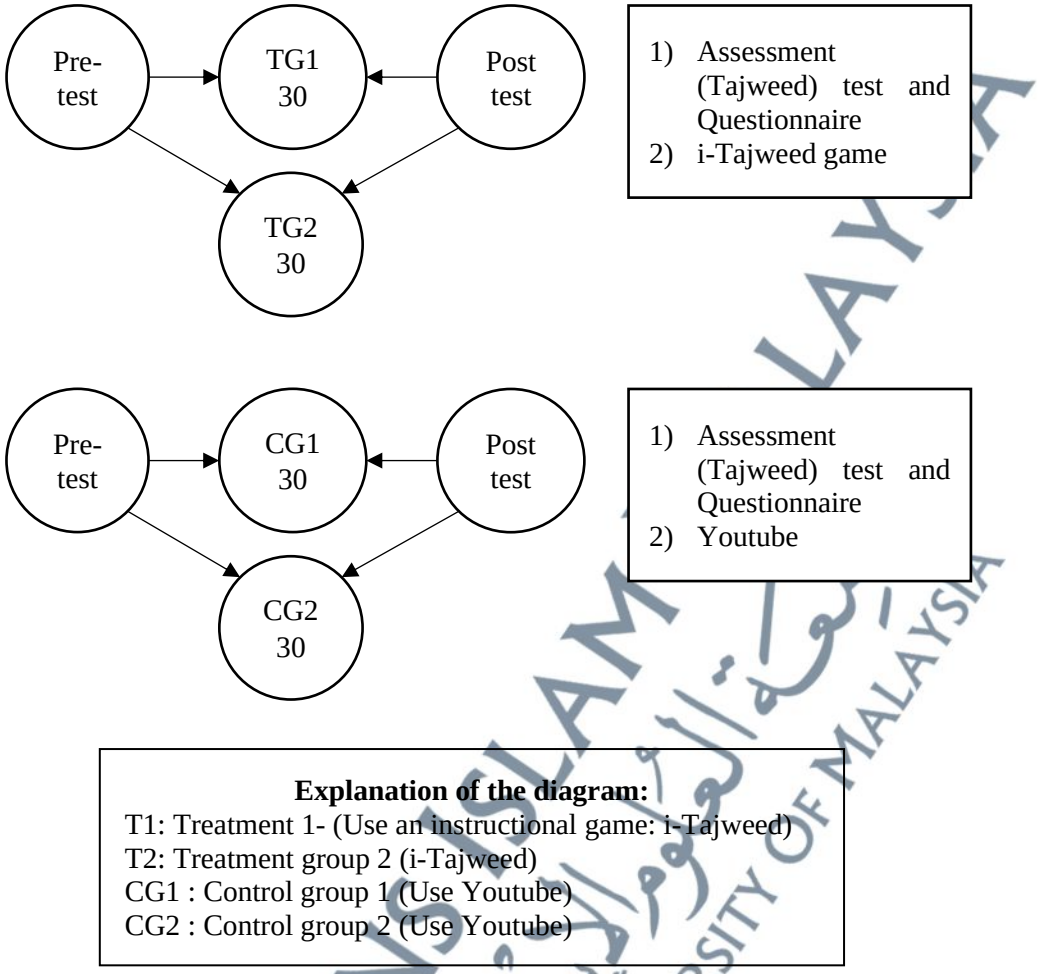

Figure 3.3: Quasi-Experimental Design Diagram

Figure 3.3 explains the detail during the process of quasi-experiment in this research.

3.3.5 Evaluation

To avoid any interference and invalid data collection, the experimental sessions (briefing, pre-test data collection, and learning activities) and post-test data collection were conducted concurrently for all the groups. In addition, each group was briefed about the experimental procedures.

Two groups which are assigned as treatment group and control group were involved during the quasi-experiment. Here, group A is the treatment group, where the

group members learnt through the conventional approach that implemented i-Tajweed game. All the learning, practices, and assessments were conducted in a conventional manner.

Group B learnt using Youtube only, where the practices and assessment parts were completed traditionally and handled by an educator. Group A was involved in the conventional learning approach, Group B only used traditional learning with the combination of Youtube.

For the actual experiment, 120 primary school students were involved in the experimental sessions. The students were randomly assigned into two groups of different learning approaches with approximately equal numbers of students. The game also attracts the learners to learn Tajweed, elicits a variety of emotional feelings such as fantasy, control, curiosity, a sense of challenge, as well as improves learning outcomes.

To evaluate the impact of the game, this research employed pre-test and post-test in the experimental design sessions (Codish & Ravid, 2014). The questionnaires consisted of six main sustainability elements., namely relevant content, interface design, gameplay, usability, reward, and motivation). The construction of this instrument was adapted and modified from the Juan & Chao Motivational Assessment (2015) and the Katsaliaki and Mustafee (2015) questionnaire.

3.4 Data Collection Technique

This section explains the step on how the data was collected in this research. The data collection process is essential in conducting every research. The selection of appropriate techniques in data collection will affect the result (Muhammad & Kabir, 2018). A method that included both quantitative and qualitative data collection was used

in the data collection procedure. This was carried out to guarantee that as much data as possible was captured. Within the first phase, the analysis phase, a semi-structured interview was done to investigate the requirement and determine the best techniques to answer the research question. A literature review was conducted in conjunction with the expert interview to discover the sustainability elements included in game design. A questionnaire session was afterwards performed throughout the development process to verify the module's validity and reliability.

A set of Tajweed tests and a questionnaire were among the tools used to collect quantitative data. An accomplishment test with ten multiple-choice questions was created to assess student achievement. All of the questions were based on the material provided in the game environment and assessed students' understanding of knowledge and ideas relating to countries as well as global continents.

The data was gathered using a method that combined quantitative and qualitative data collection. Since the data gathering took place over numerous days and phases, thorough and thoughtful considerations were taken to guarantee that the best data collection strategy was employed for every occurrence and stage. This was designed to make sure that as much data as possible was captured. In the analysis phase, a semi-structured interview was done to investigate the demand and determine the best ways for developing the game (need analysis). A literature analysis was combined with the interview to determine the sustainability features included in game design and production. A questionnaire session was then performed throughout the development process to verify the game's effectiveness.

Table 3.4: Research Design and Data Collection

Stage	Research Design	Method of Collecting Data
Analysis	Literature Review	Document analysis (thematic analysis)
	Preliminary research	Semi-structured Interview (Expert)
Implementation	Quasi Experimental Design	Pre-test and Post-test (Questionnaire and Tajweed test)

Table 3.4 explains the method of data collection. The quantitative data in this research was collected through the students 'test scores during the pre-test and post-test assessments. The data collection activity was conducted in the students 'natural environment with minimal interference to mimic the students 'normal routine. This measure was performed to assure the data's reliability as well as validity (DeMarrais & Lapan, 2004). To further clarify the experimental results, this research also used a qualitative method by conducting a clinical interview with students who acquired the greatest achieved score from both groups. This measure was taken to gauge the extent of the conceptual change among the group.

The general approach used to gather information in this descriptive research was a cross-sectional survey method based on questionnaires answered by respondents (Johnson & Christen, 2008). This method has been widely used in various research fields and is excellent for gathering behavior-related information (Goddard, 2001). However, because there are so many participants in this research, it's best to apply quantitative methods (Cohen et al., 2007). This is because quantitative methods can gather a lot of information in a shorter time, save costs and avoid the risk of losing data or respondents before the research is completed, for example: respondents are sick, dead, or no longer interested in continuing the research and higher levels of objectivity (Noraini, 2010).

In addition, researchers also use quantitative methods because they can test hypotheses or get answers to questions related to the current situation of the research subject, identify influences between two or more variables and use this form of relationship to make predictions. This method also allows researchers to perform tests to see the relationships between variables using statistical tests (Gay, 2009). Therefore, the researcher chose a quasi-experiment to effectively collect data at once from a large and dispersed population. Second, it can provide descriptive, inferential, and 'explanatory' information about the problem under research (Cohen et al., 2007). Lastly, the researcher can gather primary data from the issues under investigation to define elements or characteristics of the population, for instance, attitudes, views, competencies, opinions, or understanding (Wallen & Fraenkel, 2001).

3.5 Population and Sampling

This section elaborates more detail on the population and sampling method while conducting this research. Each item in the population gets an equal opportunity of being included in the sample when using probability sampling. The researcher should use a random number generating computer program to select a sample from the sampling frame after first constructing a sampling frame (Taherdoost, 2017). The next subsection explains the population involved in the research.

3.5.1 Population

The population of the research is primary school students aged 10–12-year-old—students who took Quranic subjects in two schools in the Selangor area. As postulated by Cook et al. (2002), the responders were chosen for the trials because they were decided by the school administration. Purposive sampling was used to choose all of the

respondents, which resulted in a homogeneous sample. Responding to the effect above, the schools were selected due to their cooperation to participate and their willingness. Also, their facilities in the computer lab that suitable for doing experiment research.

Once children are aware of when they are being educated, they are capable of learning more quickly and effectively (Wang & Wang, 2015). Moreover, as children's theories of mind evolved, so did their knowledge of teaching and learning. Those who learned about erroneous beliefs also knew more advanced teaching and learning ideas, including embedded teaching, imitation, and discovery learning. Younger kids, on the other hand, had not yet grasped the separate character of reality and mental representation. As a result, they missed to perceive the teaching aim contained in play and mistook pure discovery by chance for intentional learning.

As per Piaget (1960), as children progress via developmental stages, play becomes more conceptual, representational, and communal. Play is believed to help children's cognitive development by stimulating schemas in a way that enables them to surpass their immediate surroundings (Plass et al., 2015). If there are moral and logistical obstacles to performing randomized controlled trials, quasi-experimental studies are frequently used (Grimshaw et al., 2000). A randomized controlled trials before and after studies were used in this research. First, a control population is selected before and after research with identical features and performance to the research population. It is predicted to suffer secular trends or rapid changes similar to the research group. Then, before and after the intervention is implemented in the research population, information is compiled in both populations at the same time using the same procedures.

3.5.2 Sample

The research sample included male and female students from primary schools in Selangor. All of the chosen samples have a basic foundation in Tajweed knowledge. Furthermore, the majority of the topics at this level necessitate a rudimentary understanding of Tajweed. The term "simple random sample" refers to the fact that every instance in the population has a fair chance of being included in the sample.

The choice of participants and venues for an investigation is heavily influenced by whether the research is quantitative or qualitative in nature. Random sampling procedures are commonly used by quantitative researchers to ensure that their studies meet the criteria of population validity (Bracht & Glass, 1968). When the results of a small group of people can be applied to a broader population, this is called generalization. Every available member of a population has an equal probability of being chosen to partake in the research through random sampling.

Random sampling is an essential component of experimental and quasi-experimental research designs. The design and development research's survey elements are the most potential candidates for random sampling, which is of particular importance to survey researchers who want to generalize their findings beyond individuals who complete their surveys. "The findings from the survey are no more reliable than the population quality or the sample's representativeness," as Leedy (1985) noted.

3.5.3 Simple Random Sampling

The term "simple random sample" refers to the fact that every instance in the population has a fair chance of being included in the sample. Simple random sampling has a number of disadvantages (Ghauri & Gronhaug, 2005). First, it is necessary to have

a complete frame (a list of all units in the entire population). If the units are geographically dispersed, the costs of getting the sample can be considered in particular investigations, for instance, personal interviews. Third, estimators' standard errors might be quite significant. Table 3.5 describes the summary of sample used in research.

Table 3.5: Summary Sample of Research

Bil	Phase	Sample	Instrument	Type
1	Needs Analysis (A pilot research)	20 students	Questionnaire	5 Likert scale
2	Need Analysis	8 experts. ▪ 3 experts in Tajweed learning ▪ 3 experts in ICT ▪ 2 experts in statistics and instruments	Questionnaire Semi-structured Interview	5 Likert scale
3	Design phase	8 experts. ▪ 3 experts in Tajweed learning ▪ 3 experts in ICT ▪ 2 experts in statistics and instruments	Questionnaire Validation Form for expert	5 Likert scale
4	Implementation	▪ 120 students	Questionnaire Tajweed test	5 Likert scale Percentage

Nevertheless, in an attempt to implement a random selection of volunteers for a research, certain parameters must be met. The population must first be identified. Researchers often do not have access to this type of data, so they try to discover smaller, more recognizable groups to reflect the greater population.

3.6 Research Instruments

This section explains the process of instrument development and its validity. Instrumentation relates to the instruments or methods that used by the researcher to measure variables or objects of interest to acquire data from research subjects on the topic of interest. Furthermore, key stakeholders and methodology experts (for example, experimental methodology as well as educational research) should be included in the development of a common methodology to strike a compromise between an ideal research design in terms of validity and what is attainable.

A set of questionnaires for students were used in this research. It is a set of questions containing 30 questions on the topic studied. These test questions provide information on the results of the student's marks and grades. These results explain student achievement at an early stage. In addition, the gender of the student was taken to see if it affects the student's ability to give answers. A set of questionnaires containing 29 questions after validation process were used before and after the implementation of the game to see the improvement in Tajweed learning.

3.6.1 Instruments Development

This section explains the process of instrument development.

a. Questionnaires for Expert.

Three sets of questionnaires were prepared for expert validation processes, which are content validation of i-Tajweed, the suitability of session and activities, and language validation, respectively. Experts can also jot down additional suggestions in an open-ended section of the questionnaire, including session suitability, content validation, activities, and language validation. To determine the reliability of i-Tajweed,

a set of a questionnaire consisting of 29 items were given to the students during the pilot research.

Two sets of questionnaires were prepared for expert validation processes, which are content validation of i-Tajweed, the suitability of session and activities, and language validation, respectively. Experts can also jot down additional suggestions in an open-ended section of the questionnaire.

b. Expert Validation Form.

A validation form was used to validate the level of thinking skills tested in the assessment sheet (pre-test and post-test) questions. Using the validation form, experts reviewed the level of questions suggested and ticked in the 'Yes' column for agreeing or 'No' column for disagreeing. The form was completed with comment space for improvement and suggestions from the experts.

c. Assessment Sheet-Tajweed Test.

For the quantitative part, there were two types of assessment sheets used as the instrument to gather data which are pre-test and post-test. There are two parts in the assessment sheet. Part A consists of five subjective questions, which give 25 marks, and Part B consists of five subjective questions, which gives 25 marks. Part A discuss about Hukum Mim Mati and Part B discuss Hukum Mad Lazim. Thus, the total score (Part A and Part B) for each assessment sheet is 50 marks.

d. Students Questionnaire.

The open-ended questionnaire offers the opportunity for students to state their views concerning and opinion on the effectiveness of game.

e. Interview Question for Expert

Six questions were constructed based on a literature review to gauge the extent of the need for sustainability elements in game design, specifically to the Tajweed syllabus. In addition, during the interview with three experts of Tajweed teachers, the researcher took the role as an instrument in probing and prompting for their responses to elicit and uncover rich and thick data.

3.6.2 Instrument Validity and Content Validity

Qualitative data were collected through two sets of semi-structured interview protocols (Session 1 and Session 2) among selected respondents, namely and lecturers. Criteria validity and internal validity are used as validity for the interview instrument. Internal validity means the use of independent rating techniques by means of cross-checking for the validation of qualitative data.

The validity of the criteria means interviewing individuals who have knowledge and information on the research field. Cross-checking implies comparing the data gathered from the first respondent to the data gathered from the second respondent in respect of the information, lines, and interview technique. If the information obtained from the respondents is the same, then this technique has a high degree of validity.

To verify the content validity and face validity of the questionnaire instrument, an expert reference panel comprised of three individuals with expertise in Islamic education, Quranic education, and research was established. The internal consistency of the items employed in a research instrument is referred to as reliability (Gall et al., 1999). The internal consistency values for every instrument item were calculated employing the Cronbach's coefficient alpha coefficient values in this investigation. The analysis revealed that all of the instruments used in this research had a great reliability

rating (> 0.80). As a result, these tools can be employed in real-world research. In this work, IBM SPSS V20 was used to perform inferential quantitative data analysis. In addition, the Pearson correlation approach was utilized to analyze the data in this research. The findings of the Pearson correlation analysis are presented in Table 3.6 (refer page 125) as a table of correlation coefficient values.

External validation studies are also available, which confirm the model by demonstrating the consequences of its use rather than proving its components. The influence of the instructional materials created by implementing the model on learners, clients, and organizations is the subject of this research. These studies can be viewed as confirmative or summative assessments of the model in several ways.

3.6.3 Pilot Test Implementation

Once the i-Tajweed had successfully gone through the expert validation process and was accepted to be used, the research moved to the next phase, the implementation phase. I-Tajweed was first tested in pilot research before its real implementation. Since this research employed DDR Type 2, pilot research was included and considered as the phase in the implementation phase (Richey, 1994; Richey et al., 2004;). After the test result was satisfying, the module was implemented to the real sample of students (Koneru, 2010). The pilot test was carried out to find undiscovered issues that were not detected during the previous process and to determine the reliability of the measurement of the module developed.

First, the pilot research was administered to students who have similar characteristics to the experimental group. A number of 20 Year 6 students who enrolled in Tajweed subject were chosen through purposive sampling from one school. For simple experimental research with tight experimental controls (matched pairs, and

others.), successful research is possible with samples as small as 10 to 20 in size (Sekaran, 2003).

The questionnaire session was conducted after the activities were completed. To assess the i-Tajweed game's reliability, participants were asked to evaluate the claims in the questionnaire. The reliability of the game content and questionnaire is vital to be determined to ensure that the module is able to produce consistency when applied to a different group of students. The reliability value is calculated using Cronbach 's Alpha statistical analysis.

Cronbach's Alpha is the most generally employed measurement to examine the reliability of the scale or instrument in educational research (Sekaran & Bougie, 2013). It is viewed as a suitable reliability test for virtually all forms of research (Lodico et al., 2006). The Cronbach's coefficient value should be at least 0.7 for the instrument to be internally consistent (Hair et al., 2010). It means more than 0.7 is good. The perceived task values scale, with 30 items, was subjected to reliability testing. After experts' validation was performed, there were only 29 questions left.

a. Pilot Test Results

The speed of the animation was discovered to be fast, and students were not able to follow the entire procedure if the game was only played once, according to the students' remarks in the pilot research. Therefore, suitable amendments were made to address the feedback given in the pilot research. Aside from the animation issue, no other major issue was reported. It was found that 17 out of 20 students have left positive comments and noted that animation is the better medium to explain the two topics of Tajweed. It was found that 17 out of 20 students have left positive comments and noted

that the animation is the better medium to explain the two topics of Tajweed compared to the explanation of Hukum Tajweed in the textbook.

Table 3.6: Results of Reliability Analysis for Sustainability Aspects and Motivational Aspects

Construct	No of item	Alpha (α) value
Sustainability elements	21	.882
Relevant content	5	.664
Interface design	5	.737
Gameplay	3	.789
Usability	3	.611
Reward	5	.629
Motivation	8	.767

Based on Table 3.6, the results show that the reliability coefficient for the aspect of sustainability is at a relatively high level of α = .882. Referring to Ghazali and Sufean (2016), Cronbach's Alpha value higher than .600 indicates that this instrument is good as well as usable in real studies. Similarly, the Cronbach's Alpha value for each element found under the sustainability aspect indicates that the value obtained is greater than .600. As for the aspect of motivation, the value of Cronbach's Alpha obtained is α = .767, and according to Ghazali and Sufean (2016), the value shows that the research instrument is good.

In conclusion, the results of Cronbach's alpha values for the aspects of sustainability and motivation prove that the items found in the constructed questionnaire are reliable and acceptable in the actual research.

b. Quasi Experiment

All letters of approval were sought from the Ministry of Education, Selangor State Education Department and another letter were issued to the school administration following the field research. Accordingly, contain letters of permission from the Ministry of Education and the Selangor State Education Department. After all, approvals were obtained from the respective personnel, the school that agreed to cooperate was approached for the approval appointment to the Quranic teachers involved in the experimental procedure.

Before the assigned teacher conducts the classes, they receive appropriate training to grasp and be familiarised with i-Tajweed's content and features. This step is critical to ensure that the teachers understood the module and that they would be able to navigate the module without facing any technical difficulties. The procedures for teacher training were as follow:

1. Introduction.
2. Outlining the purpose of the training and research activities.
3. Installing the i-Tajweed game on the desktop in computer lab.
4. Introducing the interface and the button.
5. Conducting training sessions.
6. Expressing appreciation to the teacher.

For the teacher who used the traditional method, a brief explanation of the flow of the experimental procedure was provided to ensure that the teachers could cooperate

Instrumentation relates to the instruments or methods that researchers used to measure variables or objects of interest to acquire data from research subjects on the topic of interest. It has to do with the selection, fabrication, and evaluation of

instruments. In this research, we will explore instrumentation and how it relates to data collection, divided into two parts: instruments used in the development phase and instruments used during the evaluation phase. All instruments were self-developed and validated with the experts as describes in Table 3.7.

Table 3.7: Summary of Instruments

Stage	Method of Collecting Data	Type of Instrument
Analysis	Document analysis	Document checklist
	Semi structure interview (expert)	Interview Questions Questionnaires
Implementation	Quasi experiment	Validation Form (expert)
Evaluation		Pre- test, Post-test
		Questionnaire, Tajweed test (students)

3.6.4 Validity and Reliability

Validity and reliability are two important concepts of 'psychometric properties' on the effectiveness of measurement and evaluation procedures (Johnson & Christensen, 2008). The instrument's reliability and validity can impact how much a researcher can learn about a topic from the phenomenon under investigation, as well as the likelihood of acquiring statistically significant outcomes in data analysis and the ability to bring valuable insights from the data gathered (Leedy & Ormrod, 2010).

Table 3.8: Summary of the Form

Type of Form	Purpose	Instrument
Questionnaires for students and teacher	To evaluate the impact of the i-Tajweed game	Questionnaires
Assessment sheet (Tajweed Test)	To evaluate the student`s understanding of the topic of Tajweed	Tajweed Test set

Type of Form	Purpose	Instrument
Expert validation form	For experts to validate the game	Validation form
Interview Question	For experts to answer the question during the interview session	Checklist

Instrument validity, according to AERA, APA, and 'National Center for Educational Statistics (1999), states that instrument validity as an individual score of the instrument is acceptable, meaningful and allows the researcher to make the best conclusions from the sample to the research population (Creswell, 2008). There are three types of instrument validity assessments, according to Nunnally and Bernstein (1994), including item validity, content validity, and construct validity. Content validity serves to determine the extent to which the instrument used can meet what should be measured (Ary et al., 2010). In addition, it aims to prove that item content is necessarily representative of and relevant to the variables studied (Flowers, 2006).

3.6.4.1 The Validation of the i-Tajweed Game

To determine the validity of i-Tajweed, expert validation was carried out to determine the usability of the module at an acceptable rate. Expert validation was accomplished by allowing experts to review the first draft. As a result, the text, phrase structure, and nomenclature have all been improved. The revised draft was then scrutinized to guarantee that the suggested module was appropriate for its intended audience.

The content validation test requires at least three expert assessments, according to the validity methodology (Rubio et al., 2003). Three experts were recruited for content validity and the sessions and activities' suitability in this research, and 2 experts were used for language validity in the instruments. For the level of thinking accuracy, scores

were taken from two experts since the inter-rater agreement value was calculated using Kappa analysis (Landis & Koch, 1977).

3.6.4.2 Advantages of Multi-Method

This method has been widely used in various research fields and is very good for gathering behavior-related information (Goddard, 2001). However, since there are so many respondents in this research, it is best to adopt a quantitative method (Cohen et al., 2007). This is because quantitative methods can gather a lot of information in a shorter time, save costs and avoid the risk of losing data or respondents before the research is completed. For example, respondents are sick, dead, or no longer interested in continuing the research and higher level of objectivity (Noraini, 2010).

In addition, researchers also use quantitative methods because they are able to test hypotheses or get answers to questions related to the current situation of the research subject, identify the influence between two or more variables and use this form of relationship to make predictions. This method also allows researchers to test the relationship between variables using statistical tests (Gay, 2009). Therefore, the researcher chose this method because it can collect data all at once effectively from a large and scattered population. Second, it can provide descriptive, inferential, and 'explanatory' information on the issues studied (Cohen et al., 2007).

Lastly, the researcher can collect raw data on the issues being researched to define elements or characteristics of the population such as capabilities, opinions, sentiments, values, or understanding (Wallen & Fraenkel, 2001). Richey, Klein and Nielson first type of DDR research comprised circumstances in which the product development process employed in a specific circumstance is reported, studied, and eventually assessed.

According to Richey and Klein (2007), this first type of DDR research is formative research, but the formative and summative evaluation is performed as an intervention during product development. Meanwhile, the research of the second type of DDR involves a general design, development, and evaluation process (Alijah, 2016). Model studies are more focused on concluding in general and not looking specifically at products but on procedures, processes, and situations. According to Richey et al. (2004), design and development establish new procedures, approaches, and tools focused on a needs analysis.

Many academics believe that survey instruments have a limited length beyond which the likelihood of random responding, premature termination, or other behaviour patterns increases, resulting in lower-quality results. The general concept of respondent motivation underpins this argument. Motivation is important for gaining ongoing involvement and accurate data (Cannell & Kahn, 1968; Sudman & Bradburn, 1974). Motivation is thought to deteriorate as the interview progresses past an optimal point (Cannell & Kahn, 1968). Some think that a survey can be rather long without losing a significant number of respondents or deteriorating the responses' quality, especially if the survey appears essential or engaging to the respondents (see, for instance, Bradburn, 1977). The argument is founded on a motivational idea, as the author refers to the survey's intrinsic interest or credibility.

3.7 Research Procedures

3.7.1 Procedure

This research uses a multi-method methodology aided by a subject matter expert (Tajweed domain) and a game designer. In sum, the evaluation of the multimedia

courseware was formative and summative, where 120 students were required to answer the survey form. Then, the data collected from the survey will be analyzed using SPSS Version 20 for Window to generate the percentages, mean, tables, and graphs. Finally, the descriptive statistic was used to obtain percentages and mean scores on the basis of the data obtained. For the purpose of the courseware evaluation and interpretation, the researcher employs a five-point Likert Scale in which 1 = Strongly disagree, 2 = Disagree, 3 = Moderately Disagree, 4 = Agree, and 5 = Strongly Agree. The participants, instructional context, research instrument, and procedures will be briefly explained in the next section.

For the purpose of collecting the data required, the researcher utilized the questionnaire in the survey design, which involves 120 students, a checklist, and a semi-structured interview (for teachers and experts). The total number of participants involved in the questionnaire is 120 primary school students. In contrast, seven experts, including an expert in IT, an expert in Tajweed, and an expert in instruments, are being selected during the interview session. All participants, including teachers and students, are selected randomly. This is because the researcher wants to see a better result from the implementation of the i-Tajweed game among j-QAF students.

Data collection will be conducted by researchers in two sessions. First, all the students will take a pre-test. The intervention classes were taught utilizing the i-Tajweed game, whereas the non-intervention classes were taught in the traditional method and using Youtube by the school teachers. After an intervention session, one short post-test will be administered. In addition, a questionnaire will also be conducted to see the effectiveness of the game, where this question covers the six constructs (relevant content, interface design, gameplay, usability, reward, and motivation).

The students were given a standard questionnaire to fill out in order to assess their motivation for advancement. The questionnaire was provided to the students twice in the experimental group: once before they were introduced to the computer game (pre-test) and once after they were introduced to the computer game (post-test). The experimental group's findings were then analyzed before and after (pre-test and post-test), and the findings were contrasted to the control group's findings. A questionnaire was used to gather information regarding the level of motivation. The researcher employed the standard questionnaire for the research after conducting numerous studies. There are three parts to the student questionnaire:

1. General and demographic information: The objective of the questions is to gather general and demographic data from the respondents. There are four questions in this part, covering aspects like age, gender, and education.
2. The Sustainability elements: (Part A). It consists of six elements that are relevant content, interface design, gameplay, usability, and reward.
3. Motivation elements: (Part B) consist of eight items.

3.7.2 Step by Step Research Procedures

The steps involved in research procedures are mentioned as follows:

Step 1: Request permission from the headmaster of the school. Initially, the researcher arranged an appointment with the headmaster to request permission to investigate the school.

Step 2: Select participants and class. After that, the researcher starts selecting purposively the participants, including teachers and students.

Step 3: Select participants and class After that, the researcher starts selecting purposively the participants, including teachers and students.

Step 4: Start doing pre and post-tests/ distribute the survey and checklist. After selecting all the participants, the researcher starts pre and post-tests and disseminates the checklist forms and survey to gather the necessary information.

Step 5: Data collection. Then, all the data from the participants will be collected for further analysis.

Step 6: Analyse the data to answer the research question. To address the three research questions relating to the research, the process of data analysis begins.

Step 7: Write the report. After that, the final process is to write the report of the findings from the research.

3.8 Data Analysis

The first method in interview analysis is transcribing the data according to the theme manually—the number for each line of data generated from the transcript. The data obtained from this method are more related to the sustainability elements and opinions from the expert about game-based learning. Thus, the selection of data by theme is important and necessary (Miles & Hubberman, 1994). Data according to the given categories will be seen to suit the themes and patterns related to the research model. Next, sub-categories are formed and coded. Next, the data is sorted based on themes and sub-themes. Table 3.9 shows the process of data collection and analysis for the evaluation phase. An independent samples t-test with mean correctness as the

dependent variable was used to determine whether students progressed from pre- to post-assessment. Correlation analyses were conducted to investigate the relationship between motivation and achievement (pre-test and post-test) and sustainability elements.

Table 3.9: Data Analysis

Research Design	**Data Analysis Type**
Literature review	Narrative
	Thematic
Semi-structured interview	Narrative
Experimental design:	Independent t-test
Pre-test	Correlation, Mean and Standard deviation
Post-test	Correlation, Mean and Standard deviation
Tajweed test	Descriptive, Percentage

A Likert scale was used in the questionnaire to determine i-Tajweed's percentage value that has been validated by an expert. All the content validation data will be analysed using the same formula. i-Tajweed's reliability value, on the contrary, was determined using statistics by computing Cronbach's alpha coefficient. All the students' score from the test was analyzed using IBM SPSS Statistics 20 to examine the significant differences before and after the treatment. In addition, the scores between the groups were also subjected to the effectiveness of the game. Meanwhile, the scores for the similar group were compared using the independent t-test in examining the difference between two unrelated (independent or unpaired) or sets of measurements (Samuels, 2015).

3.9 Summary

This section concentrates on design and development research techniques, with the goal of answering the research questions provided in Chapter 1. The description of the inquiries is specific to the instructional design and technology area and committed to the generation of new knowledge and the confirmation of current practice. The design and development research (DDR) Type 2 approach was used in this research with the implementation of ADDIE model in design and development the game. An interactive game called i-Tajweed was developed as an output of this research. It involved rigorous processes by using the ADDIE model and selected learning theory. Data were collected through experts` interviews, questionnaires, and assessment sheets (Tajweed Test) during pre and post-test. The research framework is presented as a backbone and an underlying structure to support the research. Other explanations related to variables in scope, also represented to answer all research questions. The ADDIE model, in combination with new information and communication technologies, encourages the structuring and construction of innovative, helpful, and creative spaces in the educational context. The game design and development process is discussed in the following chapter.