CHAPTER III
METHODOLOGY

3.1 INTRODUCTION

This chapter presents the methodology for the development of the multimedia courseware. This chapter discusses the life cycle model, the tools used and the methodology of usability study adopted in the study.

3.2 BC-C LIFE CYCLE

The development of a multimedia Black Cat Courseware (BC-C) will be interpreted according to the BC-C Life Cycle. The cycle is adapted from ADDIE Methodology which acts as the Instructional Design Method. The process of BC-C Life Cycle consists of Analysis, Design, Development, Implementation and Evaluation phases.

3.2.1 Analysis Phase

Analysis is a process of making one or more detailed study or examinations towards understanding a topic (Oxford 2001). In the case study, the analysis for development of a BC-C prototype has been made in accordance to the students' needs and their requirements of English Literature course in UTP. The flowchart of the analysis phase of the BC-C Life Cycle is presented in Figure 3.1. Interview sessions with

both lecturers and students were carried out after the analysis method has been developed.

During the analysis phase, a pilot study was conducted. Data were collected through interview sessions, which form the basis for the courseware development. Besides, interview is the first technique commonly used to gain information. The interviews were conducted involving two English Lecturers of UTP and 10 students from the Foundation program. Interviews conducted with the English literature lecturers have addressed the questions related to the following aspects of analysis:

- Identifying the learning outcomes of the Black Cat story.
- Identifying the content of Black Cat learning.
- Identifying the suitable time duration for a Black Cat class session.
- Identifying the number of students who have taken the subject mentioned.
- Selecting samples of student for the implementation and evaluation process.
- Identifying the methods used by lecturers to teach the Black Cat story.
- Identifying the difficulties faced by students in learning the Black Cat story.
- Identifying the constrains during the teaching period.
- Suggestion for more effective ways, a better tool and methods to teach the Black Cat story.

The questions that were asked to the students during the interview sessions were concerning:

- Their motivation for studying the Black Cat story.
- Difficulties faced by them while learning the Black Cat story.
- Their stimuli toward the content presented by lecturers during the Black Cat lesson.
- Their needs during the lesson (e.g.: presentation method used in class).

Salmi (2000) suggests that before making any design structure, the syllabus content of the story must be studied and understood by the researcher (Salmi 2000). Therefore in this work, additional to the information obtained from the interviews and the story book, other materials related to the Black Cat story such as text of the Black Cat story, any printed sheets, and the web site were carefully studied to ensure the teaching and learning objectives could be achieved.

Based on the interview, discussion and survey six types of data were identified: Teaching and learning objective, teaching and learning tool, syllabus content, problem statement, constrains and the target group. All data were analyzed and the outputs are: the content, teaching and learning tool and the students' needs were used for the next phase.

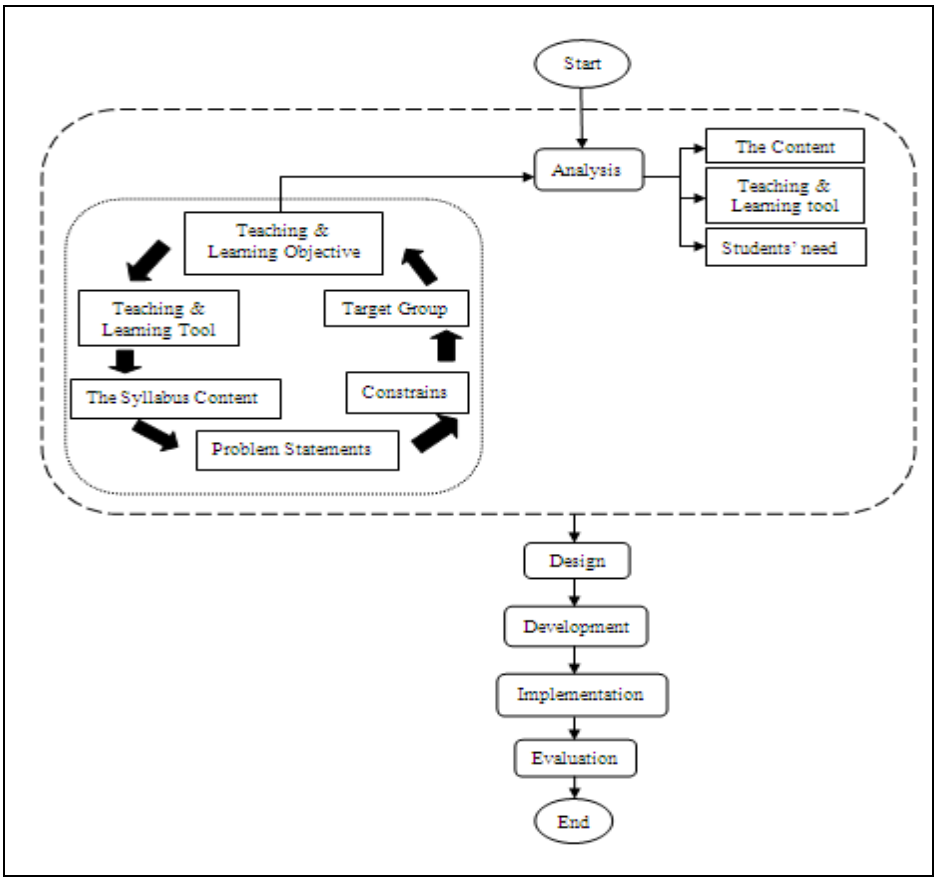

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Figure 3.1: Analysis phase in BC-C Life Cycle

3.2.2 Design Phase

The design phase is the second phase according to the ADDIE methodology. From the analysis results obtained in the first phase of the BC-C life-cycle, the literature syllabus and the Black Cat story scene flow (content design) are determined. These are used to design the structure, interface and prototype, which become the input for the courseware design during the designing phase. Figure 3.2 shows the flowchart for the design phase.

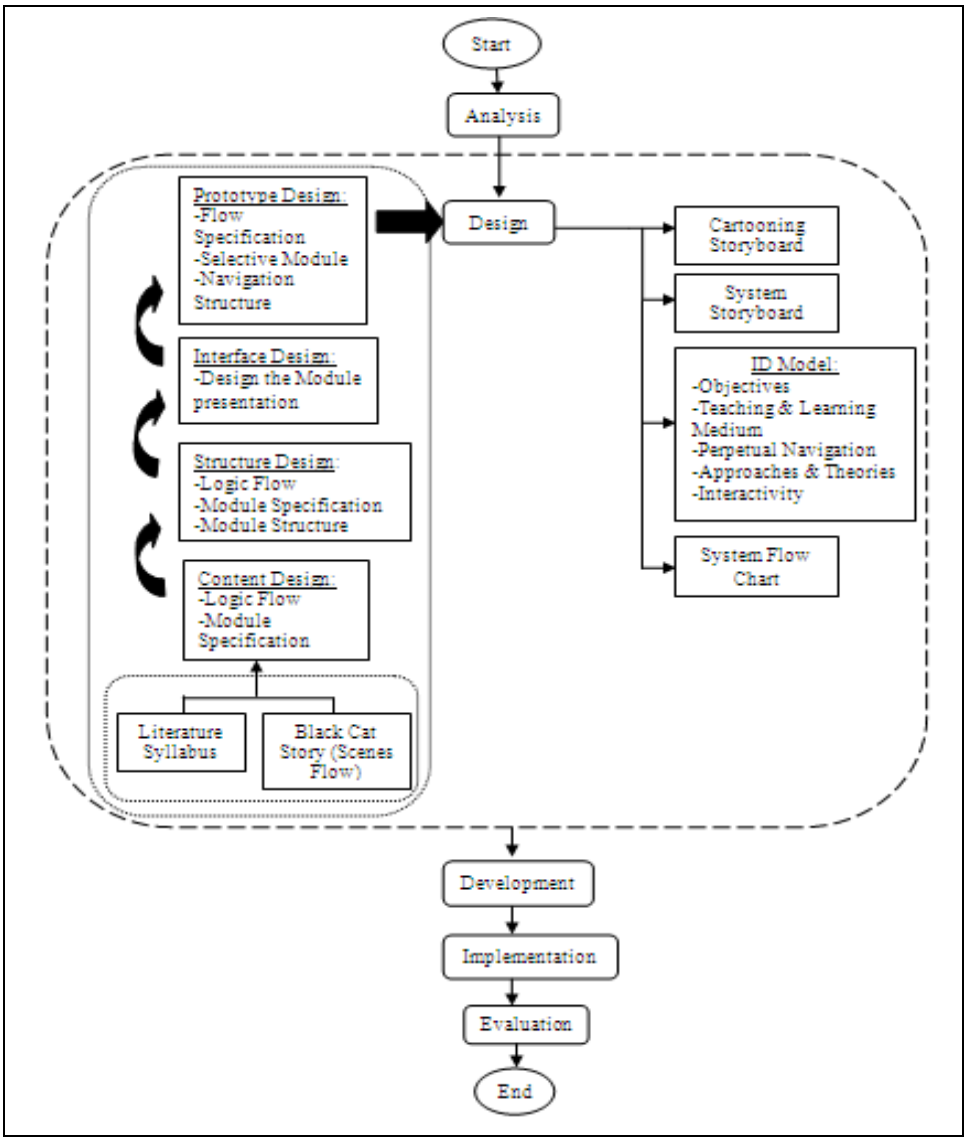

Figure 3.2: Design Phase in BC-C Life Cycle

i. Input to the courseware design

There were four designs have been constructed during the design phase which are the content, structure, interface and prototype designs.

(a) Content design

The literature syllabus is designed according to the literature elements in the Black Cat story, which are the theme, setting, characters and the conflicts. The Black Cat story content is designed according to the separated scenes. Hence, both contents are designed through the logical flow and the module specification.

- Logical flow

  Logical flow is the mode for showing the relation between contents; for example the flow where students need to explore and learn the first scene before going to the second scene in the story.

- Module specification

  Modules are created specifically according to the content classifications. Contents might be separated into one or more related modules. For example, the content of the Black Cat story are divided into the story presentation and story exploration modules. Hence, the integration between modules is needed in the logical flow sequence.

(b) Structure design

After the content design, the next step is the Structure Design. Structure Design involves the logical flow, module specification and module structure. The logical flow and module specification is the same as in the Content Design. However, module structure is about sorting the content based on the students' capability,

their requirement and so on. For instance, the content should be structured in a way that best suited the students by considering the variation of learning style among students, and the scope of teaching and learning method that is relevant to the students.

(c) Interface design

Designs of the system interface for each module involves consideration of the Graphic User Interface (GUI) principles. According to Hobart (2008), a good software is one with a high performance application, easy to use, attractive appearance, reliability, adaptability, interoperability and great mobility. Through the established opinion by Apple Inc. (2008), the principles of good GUI include the criteria of:

- understanding people; the application must respond to the users' perspective and behavior,
- users' perspective: designers must be aware of the different perspectives among their users,
- reserve icon; reserve icons such as message box for showing the error, information, question or warning must be included,
- design for clarity, for instance the function of a button or menu item must be its function (e.g. button OK is for accepting the entered data),
- visual feedback must be provided; progress indicator must be displayed for users' information while waiting for the application response,
- aware with the audible feedback,
- the text from the user error message; label, on-line help message and so fourth must be clear in terms of presenting the information,
- traceability; a traceable path must be provided to the user,
- the application must be supported by keyboard accessibility,
- the interface must be in condition of good "look and feel" presentation,

- appropriate use of the modal and modeless dialog boxes for presenting the fixed or nonfixed duration time progress,
- user interaction control; must be provided to avoid user from feeling lost in the system; examples of user controls are using the spin button, menu bar, slider pop-up menu, push button, check box, radio button and etc.

(d) Prototype design

All the twelve principles have been adapted into this research study. However, the prototype courseware has been designed according to the flow specification, selected module and navigation.

- Flow specification

  Since there are many different interface designs for each module that have been created before, the interfaces must be arranged according to the priority of flow specification and flow series. The flow must be specific as it is important to make sure users are aware of their position during the navigation process.

- Selected module

  During the interface design, there must be more than one module that has been created. Thus, the decisions on choosing the best and appropriate module must be made. The selected modules then will be applied to the prototype design and development. The modules and other related elements are selected based on LEAS concepts as mentioned by Mazyrah et al. (2008). Four elements that support learning and teaching processes which are **L**earning, **E**xercises, **A**ctivities and **S**upport are incorporated in LEAS. The selected aspects applied in the BC-C prototype are as depicted in Figure 3.3.

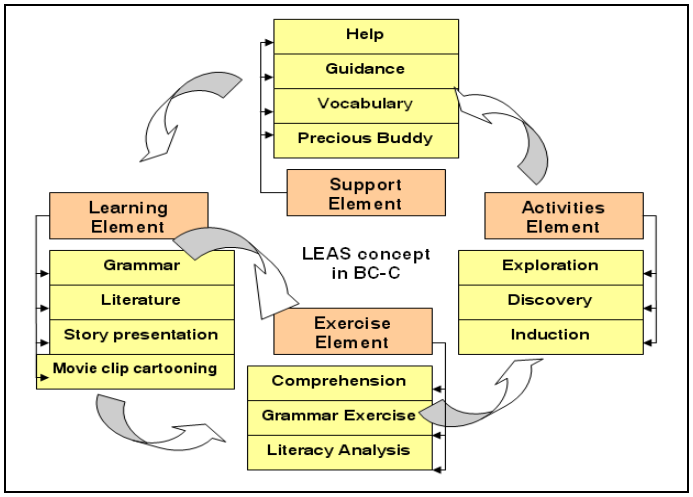

Figure 3.3: LEAS concept in BC-C development

- Navigation flow

  It is most important to plan the navigation flow for the whole application. Navigation can influence user during their learning in terms of increasing their stimuli towards the learning process, avoid user from getting lost in the system and it can affect users' satisfaction on usability.

ii. Output from the design phase

The effect or output from the design phase occupies the Cartooning Storyboard (from the content of the Black Cat story), the System Storyboard (from design process of structured, selected and specification modules), the Conceptual Framework as the Instructional Design Model (IDM) and the Module Flow Chart (from the design of logic flow and flow specification). The cartooning storyboard and system storyboard are as per Appendix B, Appendix C respectively. The ID Model is discussed in details in the following subsection while the system flowchart is discussed in 4.2.

The IDM consists of five elements that provide the reference for the development phase. The five elements in IDM are: the objectives, teaching and learning medium,

perpetual navigation, approaches and theories, and the fifth is interactivity. The IDM for BC-C can be seen in Figure 3.4.

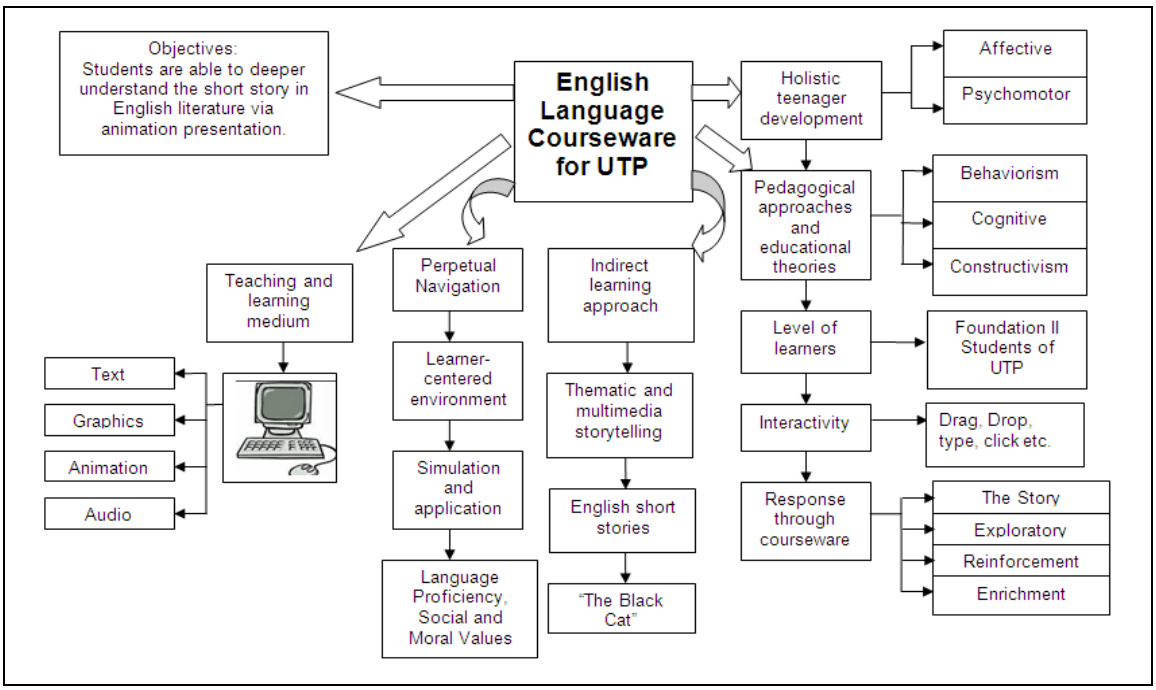

Figure 3.4: ID Model

The followings are based on Figure 3.4.

(a) Objectives

There are three objectives of developing the BC-C prototype. Its aim is to achieve the goals of:

- BC-C as a tool to better understand the Black Cat story.
- BC-C can acclimatize the elements of pedagogical approaches and educational theories during the development.
- Students will be able to learn the Black Cat story via the interactivity elements, and the animation of 2D cartoon presentation contained in the BC-C.

(b) Teaching and Learning Medium

As mentioned in the previous chapter, a combination of different media will be applied in the prototype development since it is beneficial to the education field. The chosen multimedia elements to be used in BC-C are:

- Text - can be seen for major slot in the prototype.
- Graphic - visual images for the 'see' process.
- Animation - moving graphic in the prototype to ensure the 50% of 'see' and 'hear' activities as reported by the Computer Technology Research.
- Audio - hearing activity that contributes about 30% of learning.

(c) Perpetual Navigation

Perpetual means continuous mode. Navigation in the BC-C is planned to be a continuous navigation. Students can navigate the courseware sequence nonstop and as frequent as they wish. Using this type of navigation, the learner-centered environment method also plays a role during students' learning process.

Learner-centered environment is important to increase students' focus to control their learning based on their abilities and desire. Learner-centered via courseware environment is better than learner-centered via teacher since teacher is unable to control students' motivation because most teachers cannot fulfill every student's interests and needs maximally (Salmi 2000). Besides, students' learning experience in class is less than their experience via courseware. This is because, while using the courseware, students will become active in experiencing the navigation, clicking icon, up and down the mouse, mouse drag, typing the answer and so on.

On the other hand, perpetual navigation also involves the simulation and application for learning the language, social and moral values, which all of these three elements are presented as an indirect learning approach through the Black Cat story.

(d) Approach and Theories

There are three approaches and theories applied in the BC-C development; the storytelling approach, holistic teenager development and educational theories.

Based on the discussions in sections 1.3 and 1.4, a simple model of storytelling has to be designed as a guideline during the multimedia courseware development. From the literature review in section 2.5.1, Per Cristiansson and the MJO opinions will be adapted and combined in the model design for this study. A simple model of storytelling for the BC-C prototype has been designed as depicted in Figure 3.5.

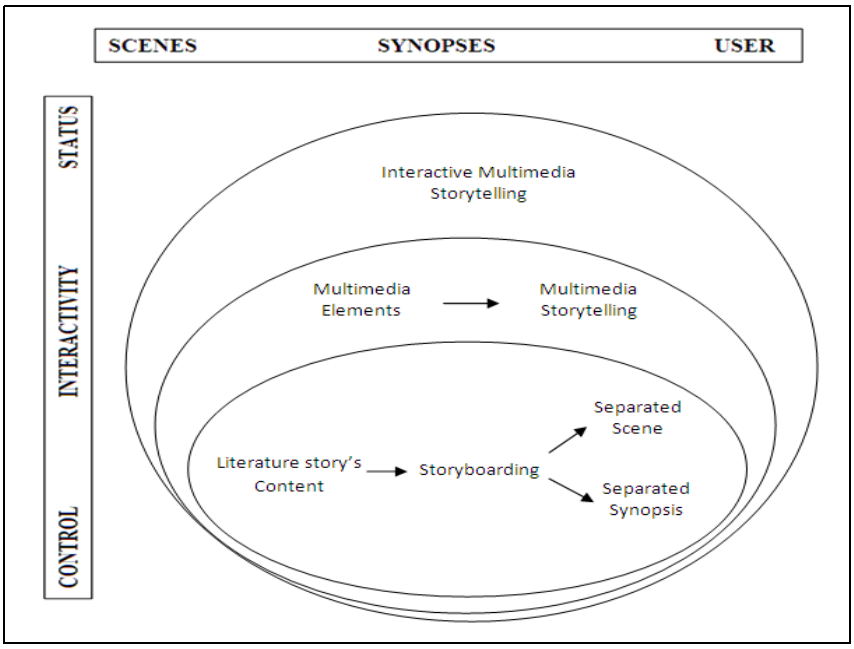

Figure 3.5: Storytelling Model for BC-C

As depicted in Figure 3.5, there are three stages of storytelling design for the BC-C. The first stage is adapted from the MJO concept which involves analyzing the contents of the story for the storyboarding. Storyboarding is divided into separated scene and synopses. The separated scene offers the users the flexibility to go to any pages to see the scenes wanted, and the separated synopses offers clear explanation of each scene.

The second stage is based on the outcomes of the first stage, which has incorporated the multimedia elements for the multimedia storytelling design. Simple images are designed to represent the attributes in the story. The third stage is the creation of the interactive multimedia storytelling from the combination of the first and second stages, where there will be interaction between users with the scenes and synopses using the interactivity, status and control elements. This storytelling model has served as the guideline during the multimedia courseware development.

The second approach applied in the BC-C IDM is holistic teenager development, which consists of the affective and psychomotor elements. According to Salmi (2000), affective is referred to the individual's behavior, self-value, individual interest, self-appreciative value and individual feeling toward what they are committed to. While psychomotor is referred to the coordination of physical movements of the individual. Figure 3.6 shows the amalgamation of the holistic teenager development that has been designed for BC-C. Both holistic approaches are hoped to give good effect to the students.

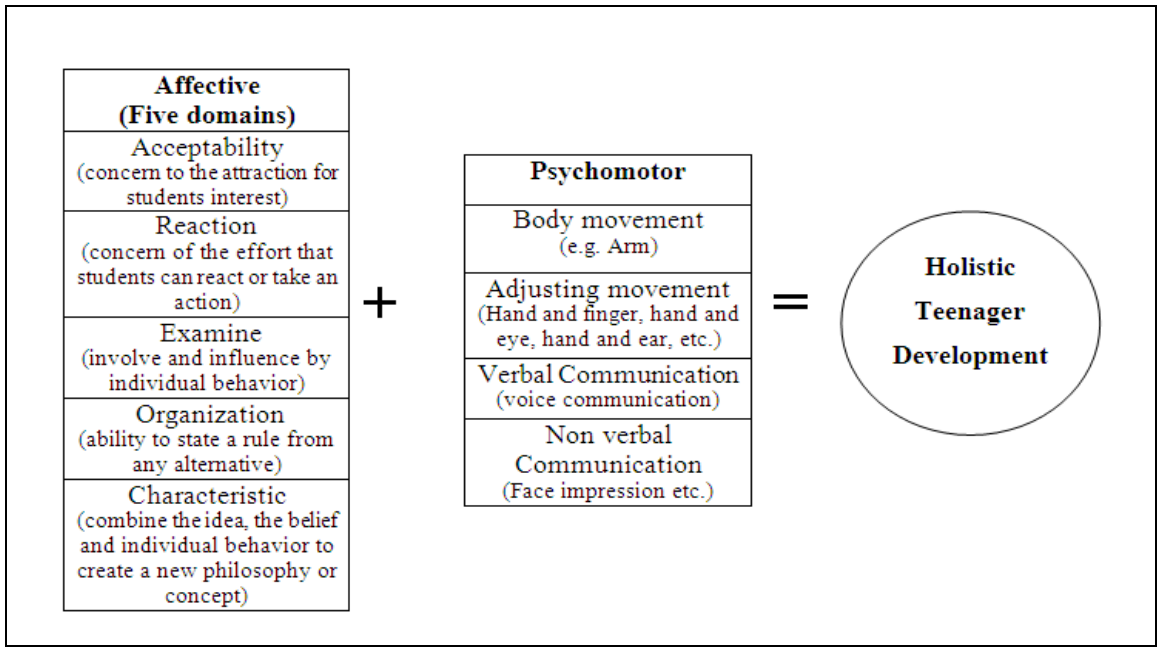

Figure 3.6: The Holistic Teenager Development: Combination between Affective and Psychomotor strategy

The third approach and theory applied in the BC-C IDM is the Pedagogical approaches, and the Teaching and Learning theories: Behaviorism, Cognitivism and Constructivism. These theories have been discussed and elaborated earlier in section 2.3.

(e) Interactivity

The interactivity involves: the drag, click, typing, up and down the mouse, navigation, text link etc. Students will interact with four design modules which are: The Story, Exploratory, Reinforcement and Enrichment that will be explained in section 4.2. However, there are also some other related and helpful pages such as induction, objectives page, topic map page and others to support the four main modules.

3.2.3 Development Phase

The step in the development phase applies the output from the design phase. The cartooning storyboard, system storyboard, and the Module Flow Chart are used for the planning stage of the BC-C courseware development. The designed storyboards and the module flow chart was used to compose the system design, and the system was validated and examined to ensure its functionality before progressing to the next phase, which is the implementation phase. The instruments for the development phase will be explained in section 3.3. The development phase is complete when the prototype of BC-C is ready for the implementation phase. Figure 3.7 depicts the development phase of BC-C.

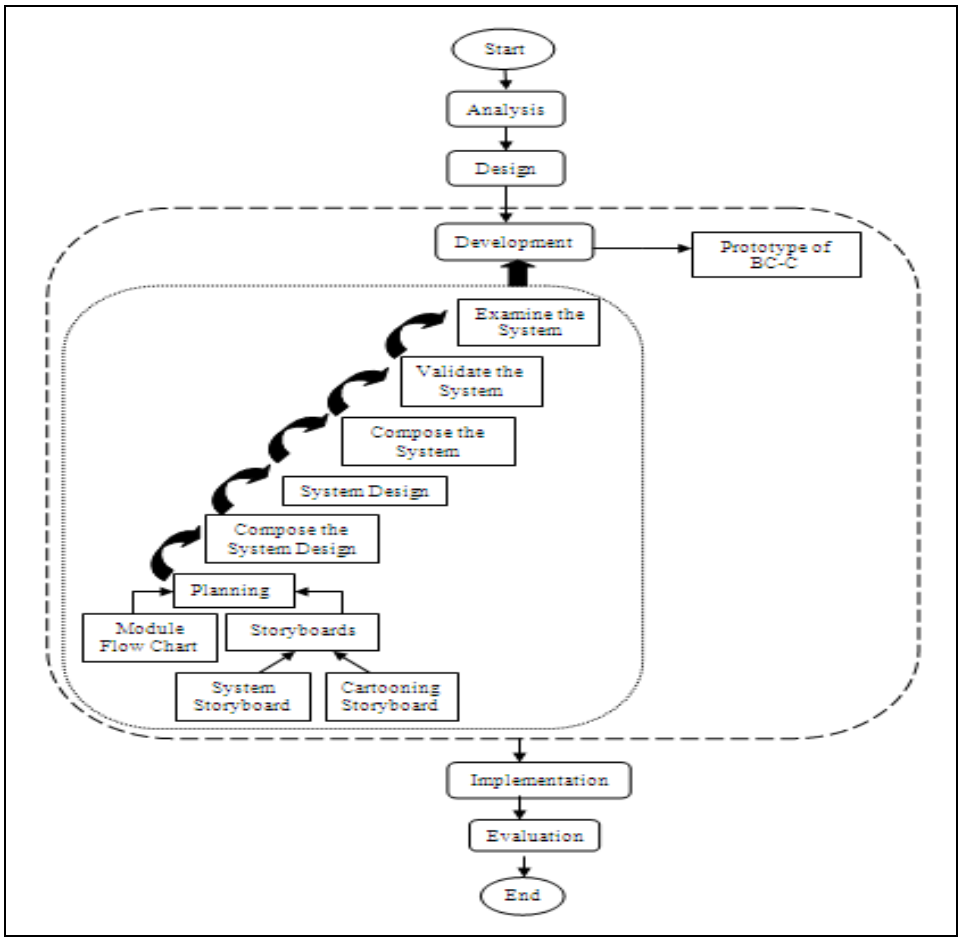

Figure 3.7: Development phase in BC-C Life Cycle

3.2.4 Implementation Phase

The implementation process as depicted in Figure 3.8, starts by applying the Prototype Implementation Guideline which involves the preparation on established time-table, scheduling the venue for the process, notifying the lecturer and the students who have been selected for control and experimental group. Nonetheless, the implementation process also involves the confirmation with the technicians to install the software of BC-C into thirty computers in the labs.

After the Prototype Implementation Guideline sheet has been examined; a pre-test was conducted for both selected groups. 60 students were involved in this study. The students were divided into two groups; 30 students in the conventional class conducted by a lecturer and another 30 students using the BC-C application. Both groups had to spend three weeks to complete the Black Cat syllabus. Table 3.1 shows the composition of each group that has participated in the experiment. At the end of the study, a post-test was given to both groups. The pre-test and post-test are attached in the Appendix D and E. For the group that had used the courseware, a set of questions on the usability was also given. This will be explained in section 3.4.

Table 3.1: Sample Number for Testing

Type of group	Number of students		Total
	ME	PE	ME & PE
Control Group (X_1)	15	15	30
Experiment Group (X_2)	15	15	30
		Total:	60

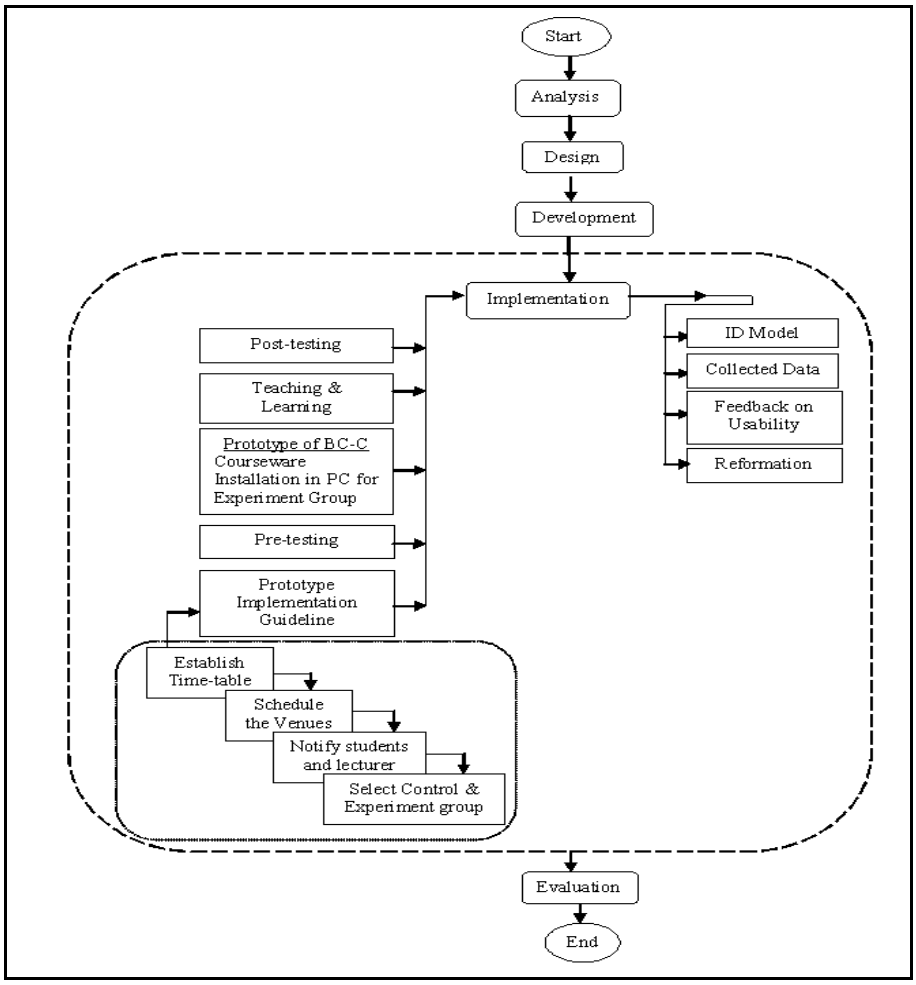

Figure 3.8: Implementation Phase in BC-C Life Cycle

3.2.5 Evaluation Phase

At this stage, all data from the implementation stage were being examined. Data of pre and post-tests were tested for the effectiveness and usability of the BC courseware. The results will be further elaborated in section 4.3. Figure 3.9 shows the evaluation phase.

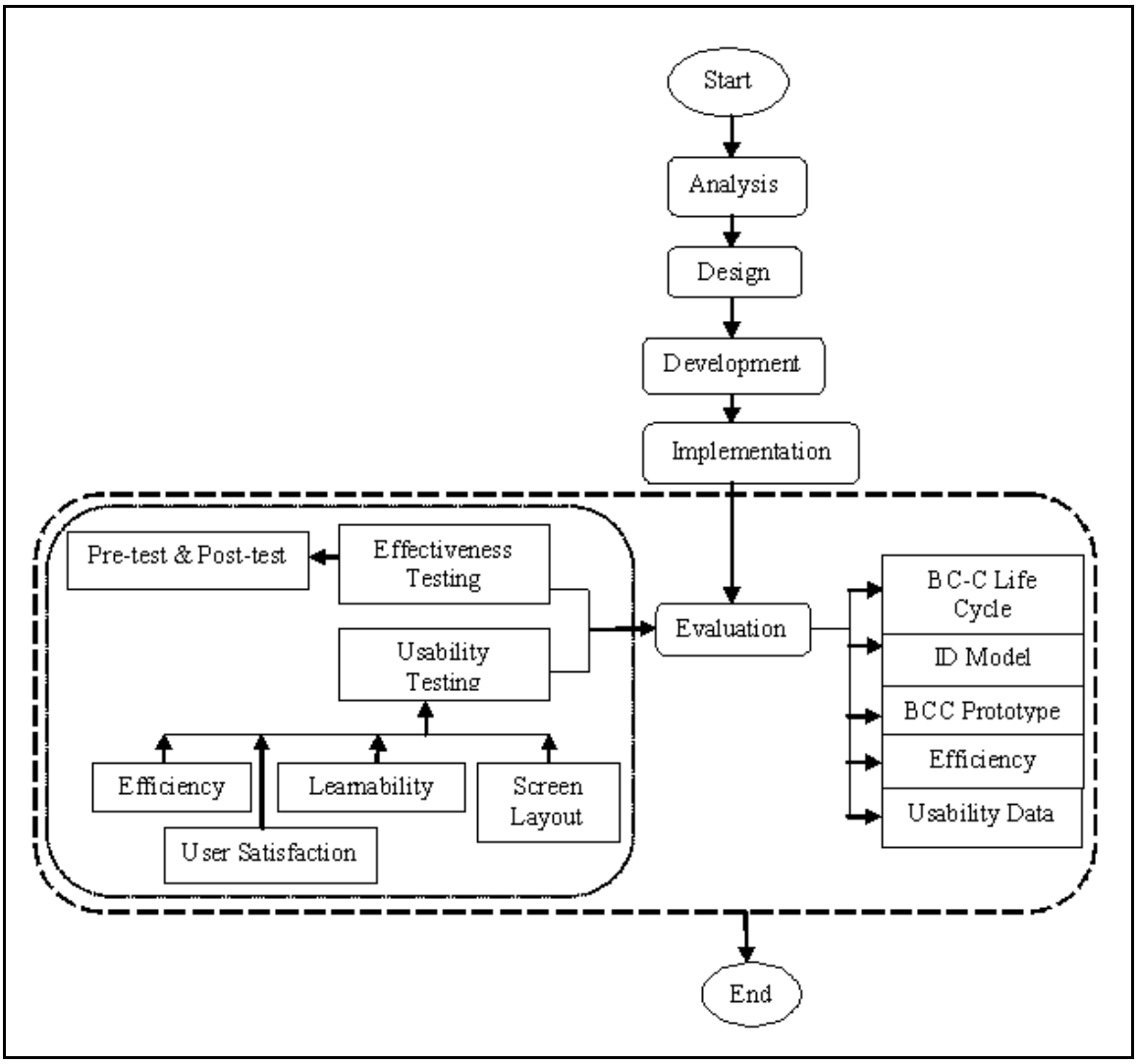

Figure 3.9: Evaluation Phase in BC-C Life Cycle

3.3 SOFTWARE AND TOOLS FOR DEVELOPMENT

The Development Phase of BC-C Life Cycle involves the use of some related software to compose the prototype. The software involved are; the Macromedia Director 8.5, Macromedia Flash 8.0, Adobe Photoshop, Sound Forge 6.0, Windows Media Player, the Bytescout SWF to Video Scout software, Swishmax version 2.0 and Mix-FX software.

Macromedia Director has been chosen as the main software to compose BC-C due to its credibility of being a powerful software to support different type of multimedia. Some files of the format such as *file.ppt, file.avi,* files from Microsoft office and so fourth can be imported easier in the Macromedia Director without any format changing. Besides, this software is easy to use as it applies the 'window interface' concepts. The programming language used is lingo script as the main language in this software. Thus, the developer can easily create many kinds of multimedia presentation, animation, interactive side, kiosk, demonstration and simulation. This software contains seven main windows and is shown in Figure 3.10.

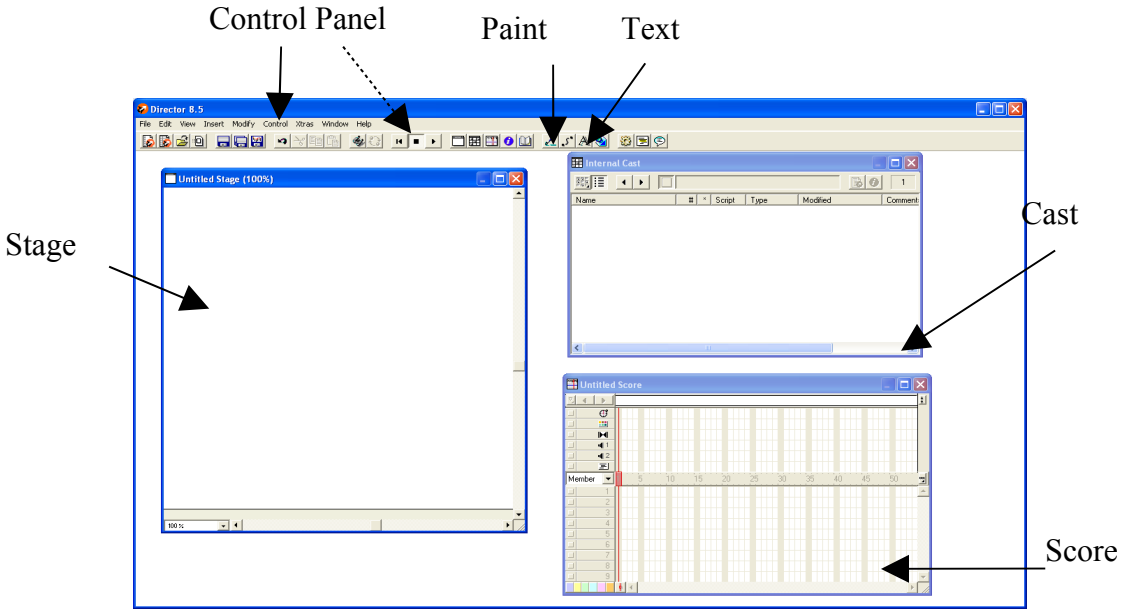

Figure 3.10: Interface of Macromedia Director 8.5

Macromedia Flash 8.0 is the software for drawing an animation of images. Movie also can be created through this software but the movie is in the format of *file.swf*. This software also contains the timeline, tools for drawing and provides scene button to detach the plot in the movie as can be seen through Figure 3.11. In this study, this software becomes the major software used in the composing process of 2D cartooning. Majority of images for the movie cartooning were drawn using this software. For an attractive image effect, image from Macromedia Flash was edited using the Adobe Photoshop. Besides

that, Swishmax version 2.0 is used to create a montage player and the Mix-FX software is used to create the flashy text effect.

Nonetheless, since the file from Macromedia Flash is saved as format file.swf, so Byte-Code Converter software is used to convert the *file.swf* into *file.avi*. It is necessary to convert the file format because the Macromedia Director is compatible to the movie format file rather than flash file. Thus, Windows Media Player is used to support *file.avi*.

Sound Forge software is used to edit and manage the audio that has been recorded using the Digital Recorder Olympus VN-3100PC. The audio editing involves processes such as extending the length of audio time for smooth sound, cutting the recorded audio into pieces and deleting the external unnecessary sound in the recorded audio.

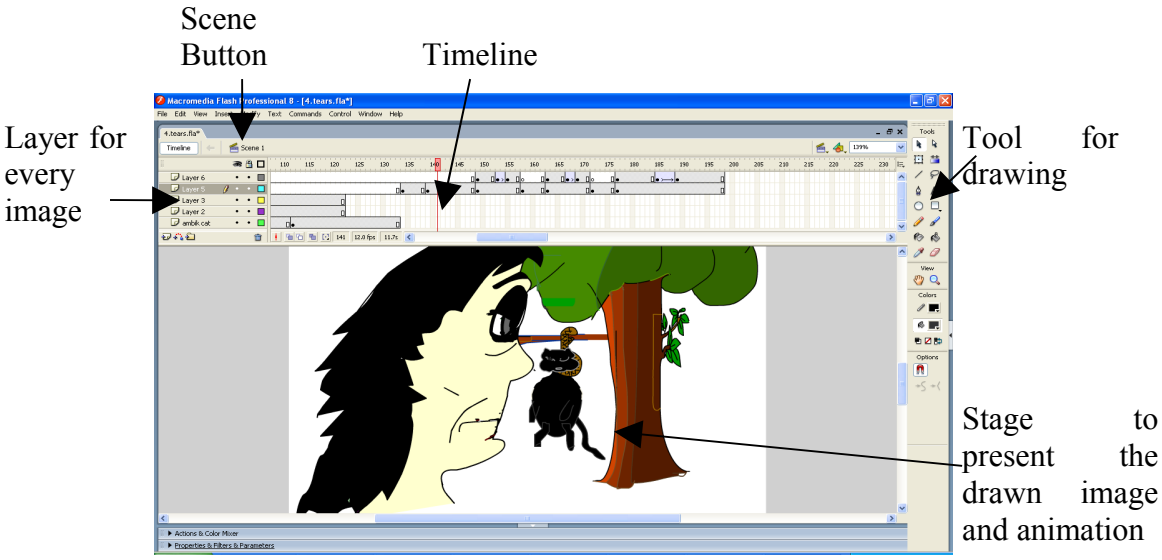

Figure 3.11: Interface of Macromedia Flash 8.0

In addition, the tools to develop a BC-C prototype are a Personal Computer 516MB of RAM, CD-ROM Player, Digital Recorder Olympus VN-3100PC, software for Olympus installation, scanner, mouse, keyboard and Digital Camera.

3.4 METHODOLOGY OF USABILITY STUDY

Usability can be designed as extend to which a system can be exercised in order to achieve specific graph and tasks (Rentro Bonito et al., 2006) effectively, efficiently and satisfactory. Besides, according to Silius & Tarvakari (2003), *"the importance of usability is consistency regardless of the focus of teaching either traditional or web-based teaching"*. Nevertheless, Shahliza et al. (2007) stated that usability is a quantitative and qualitative measurement to test the user interface design. Five key factors on usability testing are the learnability, efficiency, memorability, errors and satisfaction. However, during the Evaluation Phase, usability testing for BC-C was evaluated according to only three factors which are the learnability, efficiency and satisfaction.

- Learnability: is measured based on the ease of using the software and completing the system task.
- Efficiency: is measured based on the students' productivity once having learnt the software.
- Satisfaction: is measured based on the students' satisfaction level while using the software.

The usability of the BC-C also involves testing of the screen layout. Here, the GUI principles will be applied to ensure the effectiveness of software interface that have been designed.

Additionally, Carsen & Patterson (2005) have categorized usability by techniques such as:

- Performance measurement

  It is the quantitative measurement, for example the measurement on the quantity of task that students are able to complete, quantity of right answer provided by the students and etc.

- Thinking aloud protocol

  This method requires students to tell or vocalize their opinions on the courseware, which might be either positive or negative interpretation for every feature of the system. Demonstrator also would be able to observe the mistakes made by a user, see the user's actions, and able to analyze why the user has done that kind of action in the application.

- Coaching method

  Users can ask the demonstrator any question while running the courseware, and the demonstrator can consider the questions to improve the courseware design to suit the needs of the users.

- Questionnaires

  It is a type of testing to provide a chance to gather more usability comments from users after testing sessions.

On the other hand, Carsen & Patterson (2005) have also categorized two other techniques which are the Retrospective Testing and the Constructive Interaction. However, these two methods are not used for BC-C evaluation.

3.4.1 Design for Usability Study

The usability study for BC-C prototype is divided into two types:

(i) Quasi Experimental Design to test students' achievement and to evaluate the efficiency of learning the Black Cat story using the BC-C courseware.
(ii) Data from Thinking Aloud Protocol method to observe students' attitude and actions towards the courseware.

Quasi Experimental Design is an experiment involving two groups: control and experiment (Sekaran 2000). The procedures to implement the Quasi in BC-C starts by selecting the control group (X_1) and the experimental group (X_2), both groups must attend the pre-test (O) before learning the syllabus of the Black Cat; then they will complete the teaching and learning through the two planned treatments. After completing the teaching and learning, students in both groups must take part in the post-test: (O_1, O_2). The hierarchy of Quasi Experimental Design and its explanation is presented in Table 3.2 and Figure 3.12.

In Quasi Experimental Design, the variables for the testing must be identified. The variables involved in this case study are based on the hypotheses statements as discussed in section 4.3.2.

Table 3.2: Hierarchy of Quasi Experimental Design

Entity	Explanation
Control Group (X_1)	This group has been chosen to attend the treatment class for three weeks (a class session was handled for one hour per week) with the lecturer using the conventional learning and teaching methods (See Table 3.3). This group was subjected to the following: (i) Teaching and learning process was held in the classroom. (ii) Teaching and learning materials for the Black Cat syllabus was based on the text book and handout from the lecturer. (iii) Teaching and learning tools used were the OHP (slide presentations), printed materials, text book and handout from lecturer.
Experiment Group (X_2)	This group has been chosen to attend the treatment class of the Black Cat multimedia courseware (See Table 3.3). This group of students was subjected to the followings: (i) Teaching and learning process was held in the computer laboratory where 30 computers were made available. (ii) Teaching and learning materials for the Black Cat syllabus is based on interactive multimedia package. (iii) Teaching and learning tools used are the

	courseware of the Black Cat (BC-C) and printed materials. (iv) Students in this group were required to answer the usability questionnaires after completing the study.
Pre-test for the Black Cat Comprehension (O)	Both groups had to take part in the pre-test before entering the class session. The pretest was conducted to assess students' understanding of the Black Cat story before the treatment classes. The test was based on the Black Cat comprehension.
Post-test for the Black Cat Comprehension (O_1, O_2)	Again, the students in both groups were tested for comprehension of the Black Cat story. Their performance at this test mark was compared against the pretest mark to see their achievement after attending both class sessions.

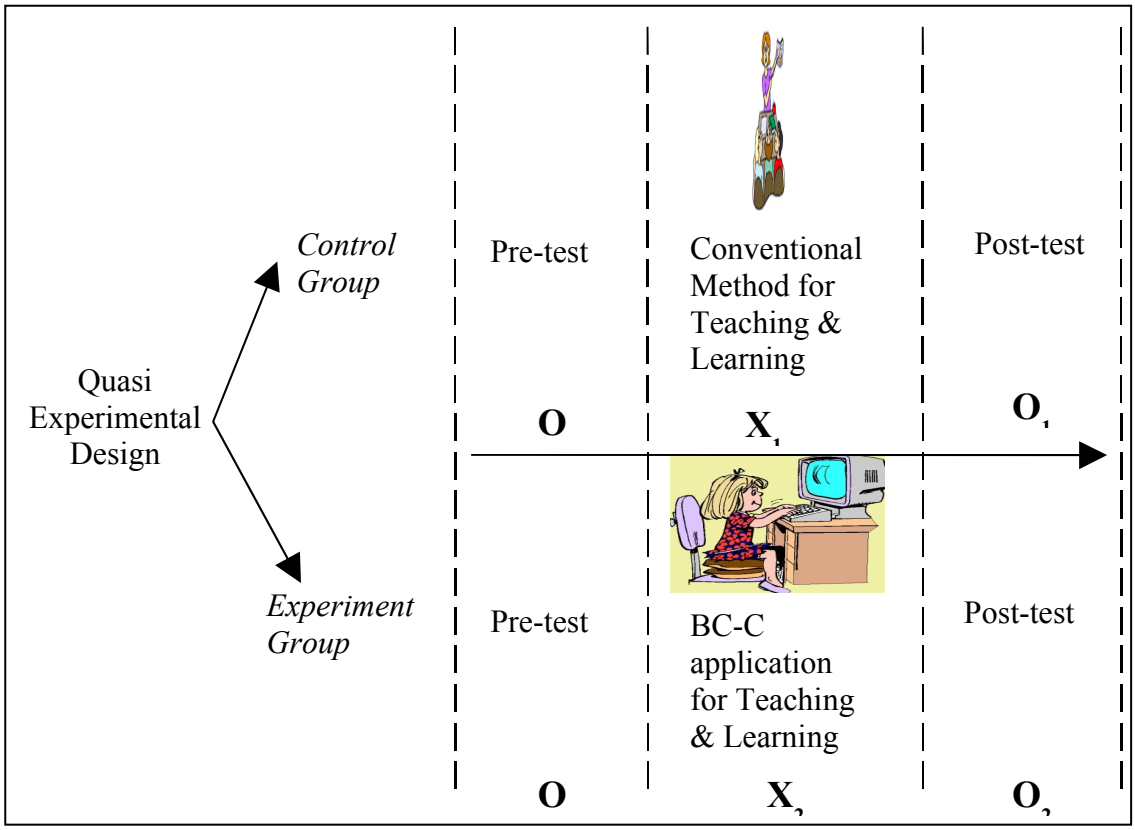

Figure 3.12: Hierarchy of Quasi Experimental Design

3.4.2 Sample of Study

The Quasi experiment was conducted involving two groups of namely control and experiment groups. Students from two programs; Mechanical Engineering (ME) and Petroleum Engineering (PE) of UTP Foundation study have been selected as the sample set. These students were chosen following the lecturer's schedule where students from both programs were combined to be in the same literature class. According to the lecturer, both groups have been identified to have the same level of interest towards the literature study. For that reason, they were selected as the sample set. 30 students each from ME and PE were involved in the experiment. Table 3.1 shows the composition of each group that has participated in the experiment.

The number of samples in each group was decided after considering several suggestions that have been made by previous researchers. According to Wan Fatimah (2004), a group of 31 samples should be involved in a study. Nielson and Squires agreed that for 5 samples used in the study, only about 75% of usability problem can be detected during the heuristic testing. However, Norizah @ Norazah (2001) and Munir (2002) in Wan Fatimah (2004), had used sample set of 27 and 12 samples respectively. Thus, in this case, the number of 30 students in each group is considered sufficient for accomplishing the experiment.

3.4.3 Tools for Testing Process

In this study, the tools used for testing are the Usability Questionnaires, interview, survey, direct observation, pre and post-test.

- Survey

  A survey was conducted among the students to gain information pertaining to their needs during the English literature learning (e.g.: presentation methods used in class) and their perspective towards using multimedia courseware for learning English literature. The survey set is as in Appendix A.

- Pre-test and post-test

  A set of question for Pretest and Post-tests were created before and after the treatment class. The questions are to test for comprehension on the Black Cat story as discussed earlier with the English literature lecturer. The question sets are as in Appendix D.

- Direct observation

  Implementation of the BC-C was conducted in two ways.

  (a) First is the pilot study. During the pilot study, about 5 students were tested with BC-C in the Usability Lab. Each student was tested individually as scheduled. There was a camera to record the interactivity between student and the courseware through out the entire laboratory study, which was carried out for two days. The 5 students were from Foundation first semester.

  (b) Second is using the Quasi Experimental Design on the 30 students as the respondents. The BC-C implementation process on X_2 group was held in a

Computer Aided Language Learning (CALL) Lab from 7 to 21 October 2008. The CALL Lab was furnished with the 30 accessible computers.

Direct observations on the students during the BC-C implementations have been done according to the Thinking Aloud Protocol. Students' questions, opinion and interpretation were recorded manually.

- The usability questionnaire

  The Usability Questionnaire contains the elements to measure the usability of multimedia elements such as user interface, audio, animation and to ask for the efficiency of BC-C application. The questionnaire is as in Appendix E.

- Interview

  The interview session with the UTP English literature lecturers was to obtain information about students' computer skill, to identify the difficulties that students face during the Black Cat learning and to discover the constrains during the teaching period.

3.4.4 Analyzing the Usability Data

Two types of data had been collected in this study which are the quantitative and the qualitative data. The quantitative data were analyzed using the Parametric Statistic which was divided into two styles of calculation: Descriptive and Inferential Statistic. In the quantitative analysis, the Statistical Package for Social Science (SPSS) version 11.5 was used for the calculation. Meanwhile, in the qualitative analysis, the data were analyzed from observation and the interview session. A description of every collected data is elaborated further and the results from the analysis will be discussed in section 4.3.

i. Quantitative analysis

Quantitative Analysis was performed according to the hypotheses that had been created previously. In this study, three hypotheses were proposed as follow:

Null Hypothesis 1 ($H_0$1) There is no significant difference in the pretest scores between the Control and the Experimental group.

Null Hypothesis 2 ($H_0$2) There is no significant difference in the post-test scores between the Control and the Experimental group.

Null Hypothesis 3 ($H_0$3) There is no significant difference in students' increment scores between the group using the BC-C courseware and the students with the conventional methods of learning.

The Parametric Statistic technique has been applied to analyze the data as Descriptive and Inferential on the X1 and X2 groups, each consisting 30 students.

Descriptive Statistics is to describe the data structure. It involves four types of calculation which are Mean, Variance, Frequency and Percentage, which are calculated using the Statistical Package for Social Science (SPSS) version 11.5.

Inferential Statistic is to summarize and make a conclusion on the relationship between the samples that have been used in the experiment. *"Independent T-Test is used to see if two means are different from each other when the two samples that the means are based on were taken from different individuals who have not been matched",* (Udayton 2006). These formulas will be calculated using the Statistical Package for Social Science (SPSS) version 11.5.

- Independent T-Test

  This test had been chosen since there are two different sample sets (control and experiment) involved in the experiment. When two samples are involved, the samples are from different individuals who are not matched (the samples are independent of each other).

  The formula used is sample mean 1 minus sample mean 2 divided by the square root of (sample variance 1 plus sample variance 2, over n) or as the formula as follows:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

Where;

$\bar{x}_1$ is the mean of the first sample.

$\bar{x}_2$ is the mean of the second sample.

S^2 is the variance or standard division squared.

n_1 is sample size of the first sample.

n_2 is sample size of the second sample.

The subscripts 1 and 2 refer to sample 1 and sample 2.

ii. Qualitative analysis

Data from interview and observation are classified as qualitative data. These data will be analyzed using the descriptive method to elaborate and explain the data in a descriptive structure.

3.5 CONCLUSION

This chapter has discussed the details of methodology for the Black Cat multimedia Courseware (BC-C). The BC-C life cycle is based on ADDIE which

involves Analysis, Design, Development, Implementation and Development phases. The main results from ADDIE are: ID Model, the Module Flow Chart, the prototype of BC-C, the collected quantitative and qualitative data.

Data are classified as quantitative and qualitative to measure the efficiency, learnability, screen layout and user satisfaction towards the BC-C application. Besides, the data have been accumulated by using Thinking Aloud Protocol and the Quasi Experimental Design. Two sample sets from UTP foundation students second semester have been selected for the experiment. The groups are control (X_1) and experimental (X_2). Both groups were separated according to the two treatment classes of conventional teaching method and using BC-C application. The students also had to take pre-test and post-test before and after the treatment class. There was also a questionnaire to survey the usability of BC-C. The data from quantitative analysis were measured using the Statistical Package for Social Science (SPSS) version 11.5.