6 ANALYSIS AND DESIGN OF WeRCLeA

This chapter presents the analysis and design of WeRCLeA. In the analysis part, functional and non-functional requirements are identified. To illustrate the system processes and data flows, data flow diagrams of the system are addressed. In the design part, WeRCLeA’s data bases and its user interface designs are presented.

6.1 WeRCLeA Analysis

6.1.1 Functional requirements

In Chapter 3, the main characteristics of a reviewing tool were captured. In Chapter 4, the tools and features of CL applications for learners and teachers were identified. The weighted average value (WAV) of each feature, the mean value of each category of tools and the mean values for learner tools and teacher tools were obtained in Chapter 5. Hence, the functional requirements of WeRCLeA are based on this identified information. WeRCLeA functional requirements are as follows:

Tools and Features of CL Applications

1. At the homepage, users will be able to see the main categories of tools for CL applications for both learners and teachers. The categories of tools are Asynchronous Communication, Synchronous Communication, Shared Repository, Group Learning and Assessment.
2. Each of the tools will have its list of features.
3. Each tool and feature will have a linked annotation for its description. At the end of each description is the assigned weighted average value (WAV) for a feature or mean value for a category of tool, calculated from the analysis of the questionnaire as described in Chapter 5.
Inform users of a new system

1. When WeRCLeA is used for the first time (fresh system) only the ‘New’ button will be functional as there is no application has been reviewed.

2. Upon clicking on ‘Compare’, ‘Report’, ‘Add Summary’ and ‘Modify’ buttons, an appropriate message will be displayed to inform the user that these buttons are only applicable when there are reviewed applications in the system.

New review

1. This function allows the user to add a new application which is not listed in the list of reviewed application. It provides the system with the ability to recognise and receive input of a new application.

2. A form will be displayed consisting of an input box to enter the name of the application and checkboxes to select the available features of each category of tools for the application.

3. When the user submits the form, WeRCLeA will produce a result page of the new review which contains several sections. The first section will display the list of available and unavailable features for each category. Asterisk (*) and NA symbols are used to indicate the availability of the features under each category of tools. * indicates the feature is available while NA shows that it is not available. The second section is the results of the automatic scoring and collaborative capability level which will be described in the following functional requirements. The third section is the input text area for user new summary. This will also be described in more detailed in the following functional requirements.
4. Upon posting this summary, a report page will be displayed. The report page is almost similar to the result page, with the list of tools and available features, weighted average scores, collaborative capability level and list of summaries but there is no input text box area.

**Automatic scoring - Calculating Weighted Average Score**

WeRCLeA will automatically calculate the following Weighted Average Scores:

- Weighted average scores for each category of tools both for learners and teachers (CWA). The category weighted average score (CWA) is obtained by using the formula below:

\[
CWA = \frac{\sum WAV(\text{of available features})}{\sum WAV}
\]

Table 6.1 illustrates the calculation of the category weighted average score (CWA) for the learners’ asynchronous communication tool category.

**Table 6.1: CWA Score for Asynchronous Communication Tool.**

<table>
<thead>
<tr>
<th>Features</th>
<th>Weighted Average Values (WAV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group email (Available)</td>
<td>3.07</td>
</tr>
<tr>
<td>Threaded discussion (Available)</td>
<td>3.02</td>
</tr>
<tr>
<td>Announcement (Not available)</td>
<td>0/3.38</td>
</tr>
</tbody>
</table>

Weighted Average score for Asynchronous Communication Tool Category

\[
CWA = \frac{\sum WAV(\text{available})}{\sum WAV} = \frac{3.07 + 3.02 + 0}{3.07 + 3.02 + 3.38} = 0.64
\]

The same formula applies to obtain the category weighted average score (CWA) for other categories of tools. Category weighted average score (CWA) represents the availability of
features in each category of tools. It can be concluded that the more features available for a category, the better the weighted average score for that category of tools. However, the absence of features with greater weighted average value (WAV), will lower the CWA score.

- Cumulative weighted average scores for learner tools (CumL) and teacher tools (CumT).

The Cumulative weighted average score (Cum) is obtained by the following formula:

\[
\text{Cum} = \frac{\sum \text{(CWA}_i \times \text{Mean value}_i)}{\sum \text{Mean value}_i}
\]

where \(i\) represents the category of tools. Table 6.2 illustrates the calculation for the cumulative weighted average score for learner tools (CumL).

**Table 6.2 : The cumulative weighted average score for learner tools (CumL)**

<table>
<thead>
<tr>
<th>Categories of tools</th>
<th>CWA scores</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asynchronous communication</td>
<td>1</td>
</tr>
<tr>
<td>Synchronous communication</td>
<td>0.505</td>
</tr>
<tr>
<td>Group Learning</td>
<td>0.428</td>
</tr>
<tr>
<td>Shared Repository</td>
<td>0.571</td>
</tr>
<tr>
<td>Assessment</td>
<td>0.41</td>
</tr>
</tbody>
</table>

\[
\text{CumL} = \frac{\sum \text{(CWA}_i \times \text{Mean value}_i)}{\sum \text{Mean value}_i}
\]

\[
= \frac{1 \times 3.16 + 0.505 \times 2.87 + 0.428 \times 3.11 + 0.571 \times 3.10 + 0.41 \times 3.17}{3.16 + 2.87 + 3.11 + 3.10 + 3.17}
\]

\[
= 0.584
\]
As shown in the formula, Cum score depends on CWA score and mean value of a category. CWA with a bigger value and the category with a greater mean value, contribute a greater weight towards the cumulative weighted average score (Cum). Knowing CumL and CumT scores for each CL applications allow users to compare the emphasis given for learner and teacher tools by a particular CL application.

- Overall weighted average score (OWA). OWA scores are used to rank among different CL applications. OWA is calculated using the formula below.

\[
OWA = \frac{CumL \times Mean \ value_L + CumT \times Mean \ value_T}{Mean \ value_L + Mean \ value_T}
\]

Table 6.3 illustrates the calculation of OWA for a CL application namely the UCompass Educator.

**Table 6.3 : The overall weighted average score (OWA) for UCompass Educator**

<table>
<thead>
<tr>
<th>Tools</th>
<th>Cum Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learner Tools</td>
<td>0.611</td>
</tr>
<tr>
<td>Teacher Tools</td>
<td>0.818</td>
</tr>
</tbody>
</table>

\[
OWA = \frac{0.611 \times 3.084 + 0.818 \times 3.245}{3.084 + 3.245} = 0.7158
\]

As shown in the formula, since the mean value for teacher tools (Mean value\(_T\)) is more than that for learner tools representing its importance in supporting CL and CumT score is more than CumL showing teacher tools has more available features, teacher tools
contributes a greater weight to the OWA score of that CL application. The overall weighted average score (OWA) is obtained for the purpose of ranking among different CL applications which is done automatically by WeRCLeA.

Figure 6.1 summarizes the automatic scoring process flow.

**Figure 6.1 : Automatic Scoring Process Flow**

**Collaborative Capability Level**
1. WeRCLeA will display the collaborative capability level of the above automatic scoring: CWA, CumL, CumT and OWA scores of the reviewed application. The collaborative capability levels provide an overall picture of how the CL applications give support to collaborative learning. The more features that a CL application provides, the more capable the application is towards supporting collaborative activities. A better weighted average score will contribute to a better collaborative capability.

2. The collaborative capability level is obtained using a 0-1 scale as follows: 0 is the lowest collaborative capability level while 1 is the highest. For example, a score between 0 to 0.2 is considered to have bad collaborative capability level while a score between 0.8 to 1.0 has excellent collaborative capability level.

**List of user summaries**

1. An input box will be available for users to give their opinion on the application being reviewed.

2. WeRCLeA will be able to keep and put together the summaries in a database to be displayed in the result page and the report page.

**Comparing reviewed CL applications**

1. WeRCLeA will display a side-by-side table for the results of all reviewed applications, one column per application. This includes the list of available and unavailable features, the weighted average scores from automatic scoring and the collaborative capability level.
2. WeRCLeA will be able to rank the applications automatically by comparing the overall weighted average score (OWA) and adjusting the table in descending order from the highest score to the lowest one.

*Modifying a reviewed CL application*

1. WeRCLeA allows users to modify the previous review of a CL application by making changes to the checklist to correct mistakes or when features in the application are added or removed from time to time due to upgrading of the application.

2. WeRCLeA will be able to display ticked checkboxes showing available features of the application.

3. WeRCLeA will re-calculate the scores and display new result page and subsequently a new report page.

### 6.1.2 Non-functional requirements

Every system has non-functional requirements, which will be taken into account during the process of designing WeRCLeA. These are some of the main non-functional requirements for WeRCLeA which are usability, maintainability and expandability, efficiency and reliability, portability and scalability. All of these requirements will be further elaborated below.

*Usability*

WeRCLeA will be built to reflect good usability factors. The way that its contents are being presented will affect the users’ acceptance of the system. It will be easy for a user to learn to
operate it, prepare inputs and interpret outputs of the system. WeRCLeA will also provide useful information especially for teachers and decision makers while other stakeholders concerned with CL applications will be able to access it.

**Maintainability and expandability**

WeRCLeA will be easily updated, maintained and expanded. It will attempt to anticipate future requirements if and when they appear. All information systems must be written for easy tracking.

**Efficiency and reliability**

Efficiency is determined by a good response time. Since WeRCLeA is a web-based system, it will consider lessening the response time. The system will be available 24 hours 7 days in a week with a permissible failure rate.

**Portability**

To enable more users to review CL applications which continue to grow in numbers, WeRCLeA will be accessible from the normal web-browser.

**Scalability**

WeRCLeA will be scalable which is to have the same capability to handle the access by one user or by a big number of simultaneous users.
6.1.3 Process Model for the WeRCLeA

Context diagram is an overview or the most abstract diagram, which consists of the external entities, the basic inputs, the overall system and the outputs. It is the highest level in a data flow diagram series and contains only one process (Kendall and Kendall 1999). Figure 6.1 shows the context diagram for the WeRCLeA with the basic inputs and outputs from the reviewer as the external entity.

![Context Diagram for WeRCLeA](image)

**Figure 6.1 : Context Diagram for WeRCLeA**

The context diagram is exploded into Level 0 DFD as in Figure 6.2. Inputs and outputs specified in the first diagram remain the same in all subsequent diagrams.
The following figures show Level 1 DFD for all the processes in the level 0 DFD. Figure 6.3 shows the level 1 DFD for Process 1, which is the method for accessing the homepage.
Subsequently, Level 1 DFD for Process 2 which is for viewing feature descriptions is represented in Figure 6.4.

Figure 6.4 : Level 1 DFD for Process 2- View Feature Descriptions

Figure 6.5 depicts the DFD Level 1 process 3, which is for reviewing new application.

Figure 6.5 : Level 1 DFD for Process 3-Review New Application

Figure 6.6 shows the level 1 DFD for process 4 which is for viewing applications’ results.
Figure 6.6: Level 1 DFD for Process 4 - Display Application’s Results

Figure 6.7 depicts the Level 1 DFD for process 5 of view report of application review.

Figure 6.7: Level 1 DFD for Process 5- View Application Report Page

Figure 6.8 depicts Level 1 DFD for process 6 which is to view comparison of reviewed application.
6.6 Display Comparison page

query for comparison page

6.1 Retrieve Applications' Name

6.2 Retrieve Applications' Features

6.3 Retrieve Weighted Average Scores

6.4 Rank the Applications

6.5 Generate Comparison page

processed information

Figure 6.8 : Level 1 DFD for Process 6- View Comparison of Reviewed Applications

The process of adding summary to reviewed application is illustrated in Figure 6.9.

application name

7.1 Display summary input text area for selected application

summary input

7.2 Insert posted summary

7.3 Redirect to report page

Summary

Figure 6.9 : Level 1 DFD for Process 7- Add Summary to Reviewed Application

Figure 6.10 depicts the Level 1 DFD for the eighth process of modifying reviewed application.
Figure 6.10: Level 1 DFD for Process 8- Modify Reviewed Application

Figure 6.11 depicts the last process of Level 1 DFD where suggestions and enquiries are sent in.

Figure 6.11: Level 1 DFD for Process 9-Send Suggestions and Enquiries

6.1.4 Activities Flowcharts

Flowcharts help one to understand the activities when using the system and how the system makes the responses. Figure 6.12 depicts the activities flowchart of WeRCLeA.
The following figures show only the flowcharts of WeRCLeA major processes. The activity flowchart for comparing applications is shown in Figure 6.13 below. It shows how the system responses on generating CL applications' comparison.
Figure 6.13: WeRCLeA Comparison Flowchart

Figure 6.14 portrays the WeRCLeA’s result flowchart. It shows the generation of the entire reviewed CL application’s result either for new or modified CL application, updating the recalculated weighted average scores and the display of text area for new summary input.
Figure 6.14 : WeRCLeA Result Flowchart

Figure 6.15 depicts the WeRCLeA report flowchart which shows the generation of the entire selected CL application’s report suitable for printing.
Figure 6.15: WeRCLeA Report Flowchart

6.2 WeRCLeA Design

6.2.1 WeRCLeA User Interface Design

The goal of user interface is to “help users gain rapid access to the contents of complex systems, without losing their comprehension as they move through information” (Marcus, 1993). The main concept of user interface used in WeRCLeA is simplicity. According to Occam Razor principle, the most graceful solution to any problem is the one which is the most simple (Brown,
1995). Simplicity in a system is often done by minimising the number of panels being displayed and also the number of mouse clicks or keystrokes to accomplish a particular task. In addition, a quick response time is achieved by mainly concentrating on having text-based interface with hypertext links and little or no graphics, sacrificing the aesthetics or attractive element. It also considers giving clear and simple instruction. It will be easy to learn and use, intuitive, efficient and effective.

WeRCLeA uses a checklist and comparison table for simplicity. It is easier for one to review applications with a checklist than without it, as they are many things in a CL application to look for at one time. A checklist acts as a guideline and is good in giving a quick overall picture of the necessary information. When a checklist is there, one is expected to be able to choose a focus and be in a better position to give an overall summary. Thus, though the result of checklist review is not flexible, the summary or opinion is subjective and flexible. In WeRCLeA, the checklist method is in the form of available or unavailable supporting features that reviewers have to determine while looking at an application or reading about the application document. Checklist has been applied widely in all aspects of quality assurance. The main reason for the wide acceptance of this method is simplicity and efficiency.

Generally, the page layout is designed such that it will be uncluttered and properly aligned. The position of the information is according to its importance and commonality. Below are the descriptions of WeRCLeA’s interface page layout which include the Homepage, Compare Page, Report Page, New Page, Add Summary page, Modify Page and the Description Page.

**Homepage:** Figure 6.16 shows the user interface design of the homepage which has three main areas:
Figure 6.16 : User interface Design of WeRCLeA

1. The title logo pane designed for easy recognition of the system.

2. The navigation pane with link buttons of Compare, Report, Add, Modify and New.

3. The content or action pane. This pane contains the welcoming note and an introduction to WeRCLeA, the main categories of tools for both learners and teachers with links to a list of features for each tool and finally an email link for sending Suggestions and Enquiries.

Subsequent pages have similar interface designs as the homepage described above. The title logo pane is the same for all pages. The navigation pane for all the other main pages has the title of the page and the Home button. The content pane for Compare page and Report page is not interactive whereas the content pane for New Review page, Add Summary page and Modify page, require users to submit information. Details of these pages are described as follows:
**New Review Page**  The input box is provided to enter the name of the application. Checkboxes besides all features for user to select the available features of the application and submit button are provided.

**Compare Page**  The content of the table is divided into a static column on the left and dynamic columns on the right. The static column contains the categories of tools with a list of features for each tool. The dynamic columns are added as new application is reviewed, forming a side-by-side table of the results of all reviewed applications. The results include the list of available and unavailable features and the three weighted average scores. The columns are alternately shaded and the scores are coloured according to collaborative capability level for easy view.

**Report Page**  A title with the name of the particular application is displayed at the top. Next, is the features availability list for learner tools and teacher tools. The second section of the result page displays the weighted average scores for both the learner and teacher tools. These include the CWA scores for each category of tools, CumL for learners and CumT for teachers and OWA scores for the application. The corresponding collaborative capability levels are displayed next to each score. The scores are coloured according to collaboration capability level for easy view. Finally, the list of user summaries is displayed at the bottom of the page.

**Add Summary Page**  A title with the name of the particular application is displayed at the top. There is an input box, usually a scrolling text box, for user to enter a summary or opinion of the application and also a submit button named Post Summary.
Modify Page  A title with the name of the particular application is displayed at the top. The list of features of each tool with checkboxes, ticked to indicate the previous review and submit button to modify the results, are made available.

6.2.2 Databases for WeRCLeA

WeRCLeA uses five database tables to keep track of data inputs. These are described in Table 6.1.

<table>
<thead>
<tr>
<th>Table name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>AppName</td>
<td>Keeps the name of the application reviewed by users</td>
</tr>
<tr>
<td>Available</td>
<td>Keeps all features with respective WAV and feature availability for each application</td>
</tr>
<tr>
<td>AvgScore</td>
<td>Keeps all CWA scores for Learner tools, teacher tools and OWA score separately for each application.</td>
</tr>
<tr>
<td>Feedback</td>
<td>Keeps track of all summaries and opinions for each application.</td>
</tr>
<tr>
<td>SelectedItem</td>
<td>Keeps track of availability status of all features for each application.</td>
</tr>
</tbody>
</table>

6.3 Summary

In this chapter, the functional and non-functional requirements for the proposed reviewing tool, WeRCLeA are identified. The requirements are analysed and transformed into data models using data flow diagrams (DFD). The analysis further leads to the user interface design and databases for WeRCLeA.