An Activity Theory Evaluation of a User Interface for a Web-based Virtual Research Environment (VRE)

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Erasmus Mundus Dependable Software System (DESEM)
Project Background

CRADLE:
• A virtual research environment (VRE), supporting teaching, learning and engagement with cultural heritage.

• Founded on Scandinavian Activity Theory principles: collaborative objectives fulfillment by researchers and learners having distinctive roles, division of labour and community rules.

Project objective:
• Use Activity Theory as the framework for software evaluation (together with user experience testing).

• Present a design and improvement for a new user interface which incorporates user and community presence.

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Background Research

- Humanities Scholarship

  Humanities Scholarship is concerned with the study of human culture including languages and literatures, the arts, history, and philosophy from a multitude of perspectives.

  CRADLE, a software tool, that assists scholars manage the information arising from comparative practices in humanities scholarship.

  It was developed using Activity Theory to model scholarly activity, and focused on human engagement with source material, utilizing resources for research purposes, and collaborating and debating using discourse tools.

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Activity Theory & HCI

Activity Theory is an analytical framework to describe collaborative objective fulfillment by actors using tools within a community of users having distinctive roles, division of labour and community of rules.

Activity Theory, along with some other frameworks (distributed cognition and phenomenology) - a leading post-cognitivist approach in HCI and interaction design.
Background Research

➤ Activity Theory & Software Dependability

User Interfaces are the “critical coupling” between humans and computers, and undependable user interfaces, therefore, are considered to be a major obstacle to achieving “overall system dependability”.

Current research includes investigation into what kinds of human error and limitations of humans result in making user interfaces undependable, together with work on robust evaluation methodologies, task and user modeling, design and testing of dependable interfaces, fault tolerance and reliability, etc.

This project’s research, while not conducting a dependability analysis specifically, is also concerned with the representation of information in the user interface of a system (CRADLE) used by humanities’ scholars interested in the management of digitized cultural objects. Specifically, we are interested in User Experience (UX) issues.

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Background Research

- **Software User Experience (UX Development)**

  Focuses on having a deep understanding of users, what they need, what they value, their abilities, and also their limitations.

  It also takes into account the business goals and objectives of the group managing the project.
Key Deliverables

1. Activity Theory Analysis of Existing CRADLE Software (from Theory and Analysis).

2. Activity Theory Model of New Feature Proposal (From Theory and Analysis).

3. User Study of Suitability for Humanities Scholarship Activities (From Workshop).

4. Two Candidate Proposals for User Interface Update (A - Document Focus; B - User Focus).


6. Thesis and Reports on Studies

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Research Plan

Activity theory Analysis of CRADLE

Proposal of Candidate Designs for Updates

Activity Theory Evaluation (workshop on current interface and proposed designs)

Workshop Results Analysis Design Refinement

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Activity Theory Evaluation Framework

• Combined with cognitive science

• New advanced usability test methodology which focuses the role of interface as the mediating tool for user activities instead of discrete interface elements.

Workflow of Activity –Theory based UT methodology
Workshop flow:

5 participants (scholars)
Royal Irish Academy

Project Introduction
Video of CRADLE
Pre-study Questionnaire
Experience CRADLE (perform task scenarios)
Post-usability Questionnaire

Pre-Study: Real needs of users
- What would you want to use CRADLE (purpose).
- What do you expect from CRADLE, the activities should be supported?
- What are your motives for these activities?
- What kind of rules should scholars follow when doing these activities?

Post-Study: Usability testing
- Learnability
- Usefulness
- Ease of use
- Satisfaction

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## Workshop flow:

### Workshop test scenario and cases:

<table>
<thead>
<tr>
<th>Test Scenario</th>
<th>Test Cases</th>
</tr>
</thead>
</table>
| Search digital objects (collection/document etc.) | Search without keyword  
Search with matching results  
Search with invalid keyword                        |
| View Digital objects (metadata, relationship graph, content etc.) | View text documents/slideshow  
View images/video  
View collections/bundle  
View links                                       |
| Relationship graph management                     | View the graph  
Manipulate graph by dragging, clicking  
Editing graph by adding/removing discussions, factlets |
| Document discussion management                    | Create/delete a discussion  
Reply a discussion  
View discussion on relationship graph and its details |
| Document factlet management                        | Create/delete a new factlet  
View factlets on relationship graph and its details or on tab |
| Document annotation management                     | Create/delete new annotation  
View annotations on text view or on image view |
| Document comparison (text view, image view)        | Text view and text view  
Image view and image view  
Image view and text view                           |
| Study resources management                         | Adding new study resource (currently doesn’t support frontend)            |

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Workshop result analysis:

Contradictions identification:

- Contradiction analysis by mapping primary and current activities:

<table>
<thead>
<tr>
<th>Number</th>
<th>Primary activity</th>
<th>Current activity</th>
<th>Contradiction analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Querying or access primary source, its metadata and lead me to other related sources and studies, view sources in CRADLE from the library even though CRADLE does not actually hold the original source, Ability to handle multiple metadata standards.</td>
<td>Digital object search and Digital object content (text, relationship graph, metadata etc.) study.</td>
<td>Doesn’t support source view from external library. Only support one metadata standard.</td>
</tr>
<tr>
<td>2</td>
<td>Individual source management and examination with visibility control.</td>
<td>My collection management</td>
<td>Current CRADLE includes this feature, but it is not implemented yet. Now the upload function can only done from backend and all the collections are public visible.</td>
</tr>
<tr>
<td>3</td>
<td>Sharing content which I own the copyright of.</td>
<td>/</td>
<td>Not available in current CRADLE</td>
</tr>
<tr>
<td>4</td>
<td>Discussions within a group and setting restrictions on these discussions</td>
<td>Discussion management</td>
<td>Doesn’t support setting restrictions</td>
</tr>
<tr>
<td>5</td>
<td>For literature view, provide a way to make and save structured annotations that are linked directly to either certain words or classes of words, or certain areas of the physically represented document and support exporting those in an ordered format; private annotation and factlets both in comprehensive structure; annotate in external library</td>
<td>Documents annotation management and Document factlets management</td>
<td>Text annotation is not structured, factlets structure is too specific and not user friendly; no link to primary documents; no support for data exporting and external library annotation.</td>
</tr>
<tr>
<td>6</td>
<td>Generate descriptive relationships between digital objects</td>
<td>Generate relationships between digital objects in star structure (with colored lines).</td>
<td>No description of relationships (how documents are related).</td>
</tr>
</tbody>
</table>

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**Workshop result analysis:**

**Contradictions identification:**

- Contradiction analysis by mapping primary and current activities:

<table>
<thead>
<tr>
<th></th>
<th>Activity Description</th>
<th>Learning resources management</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Upload a digital object easily.</td>
<td>Learning resources management</td>
<td>CRADLE has its own special way to upload digital object, scholars must have good knowledge of XML, TEI and VRA. Therefore, it is not easy to upload digital objects in CRADLE.</td>
</tr>
<tr>
<td>8</td>
<td>Reference management: support reference across other objects, save my references in a structured manner and export them to a bibliographic reference system.</td>
<td>/</td>
<td>Not available in current CRADLE</td>
</tr>
<tr>
<td>9</td>
<td>Provide examinable record of the evolution of my sources</td>
<td>/</td>
<td>Not available in current CRADLE</td>
</tr>
<tr>
<td>10</td>
<td>Organize sources in structured hierarchies for example: traditional folders.</td>
<td>Hierarchical organization of documents in collections/bundle</td>
<td>Support hierarchical organization in relationship graph, but not in a folder and it is hard to rename</td>
</tr>
<tr>
<td>11</td>
<td>Annotate images, timecode audio with publication control.</td>
<td>Documents annotation management</td>
<td>No support for video annotation and no control for publication when annotation is not completed.</td>
</tr>
</tbody>
</table>

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Workshop result analysis:

- Contradiction analysis between activity system nodes:
Human Community Representation

- Previous users’ feedback
- Current participants pre-study and post-study

The inclusion of user and user-community representation within the system would enhance the user experience significantly.
Exiting CRADLE Interface

- Only document representation of Activity (products).

- Where is the important Human Representation?

- What do the lines between documents mean?

- Factlets (personal) and Discussions (group) look similar!
Human Community Representation

- **Interface update - Proposal A**

- Document focused (+human)

- Preserve Document

- Some human representation

- Differentiate between relationships.

- Can not represent the relationship between users e.g: owners & contributors?
Human Community Representation

- **Interface update - Proposal B**
  - Human focused (+document)
  - Preserve human
  - Some document representation
  - Differentiate between relationships: ownership or contribution
  - Can not represent the relationship between documents.

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Human Community Representation

Contradictions in Proposal A:

Contradictions in Proposal B:

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Human Community Representation

Proposal Refinement

The Hist and radical politics (video) is a video created on The Hist document (translation_2 and 1)
Technical challenges

• Learning Activity Theory and applying it to CRADLE’s special context.

• Conducting User Experience (UX) research is technically challenging - choosing suitable methodology.

• Using Activity Theory to analyze the qualitative data collected from the humanities study.

• Representing the human community that users like.

• One of the more difficult challenges relates to the study sample size.
Project limitations & Future work

• The concept of Activity Theory needed to be more clear and operationalized so that researchers can know how the theory should be applied in concrete cases.

• It was difficult to collect actions, not even operations using questionnaires or interviews.

• The evaluation framework we used in this project works well but too time-consuming.

• Propose solutions to solve identified contradictions and present them to users for evaluation and seek feedback. This process will be iterative until users are satisfied with the design. The same process will be used in the refinement of proposal A & B as well.

• Dependability analysis of CRADLE interface. As mentioned before, the contradictions we identified are important sources of CRADLE undependability. Therefore, we are expecting to see whether the removal of contradictions can improve system dependability in future work.

• Invite more participants and seek for better way to collect data in order to save time and money.

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Thank you!