



Computer Supported Learning
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Visualizations of Learner Models

Master Thesis Proposal

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1 Motivation

In the research paper [2] Judy Kay and Bob Kummerfeld listed six roles of lifelong learner model and their challenges. Figure 2.1 shows all these roles and challenges. One role was to provide open learning modeling(OLM), which has the challenges of user interfaces for reflection and planning, attention, forgetting. Second role was aggregation of information about the learner from diverse sources, which has the challenges of middleware infrastructure for aggregation, user interfaces to control aggregation. Another role was the interpretation of learner information which also has challenges of user interfaces and new tools for different interpretations.

Across the range of roles, one of the recurring technical challenge was the user interface of the represented data. This refers to the intuitive user interface with visualization of the data. And also by visualizing the information in correct way, user will be easily able to interpret it. For the challenge of aggregation, by importing data from different learner models at one place and visualizing them together will give chance of aggregating the information, comparing them and identifying required knowledge. VisuLeMo(Visualizations of Learner Models) will become aggregation point for the information for the learner using data from different learner models.

"A picture is worth 1000 words." Visual representation of the data gives quick glance and easily understandable format of the content. It also saves the time to understand the flow of the data.

There are so many types of visualization like Scientific visualization, Information visualization, Knowledge visualization etc.. Scientific visualization covers visualization of three-dimensional phenomena[11.1] and is one branch of the computer graphics. Our concentration is on the Information visualization, which focuses on the use of computer-supported tools to explore large amount of abstract data[11.2]. In information visualization, there are so many tools and techniques available. Which visualization technique will be the best and efficient, depends on what is your area of focus from the abstract data. Take an example, when the comparison of number values from the data is our area of focus, we can represent the data with bar chart and you can easily compare and identify that which section has high or low value. In contract to that, when your area of focus is increase or decrease of data with time, in this case line chart will give you the quick required results.

Visualization is the representation of available information in graphical way, so that we can ease the interpretation of data and elaborate the important thoughts from the data. Large amount of data will be perceived and understood easily with the visualization. Even simple graphical representation like (bar chart or pie chart) makes it meaningful to understand the large amount of data.

Easily interpreted visualization saves time, cost and energy of person. These factor relates to the *self reflection* and *awareness* of the learner. For an example of *self reflection*, if some professor had published only 2 publications in the last year. It will shown in the visualizations of learner models and it will reflect herself to the counter questions like why I have only 2 publications in the whole year? I should work more and do research to have more publications. For an example of *awareness*, Learner will be able to see the visualization of whole learner model, so she will get the overview of the whole learner model, can also compare herself with others and will be aware of it.

2 Introduction

There are three basic terms related to this thesis topic and those are Learner model, Lifelong learner modeling and Open learner model. Learner model is also known as student model. Learner can have publications, educational activities, social activities, virtual/web learning activities, some activities from learner portals like L²P. These all activities creates learner profile, which is represented by learner model. “The learner model is a model of the knowledge, difficulties and misconceptions of the individual. As a student learns the target material, the data in the learner model about their understanding is updated to reflect their current beliefs”[4]. Lifelong learner modeling deals with the learner model over long period of time. “Lifelong learner modeling is process of creating and modifying a model of a learner who tends to acquire new or modify his existing knowledge, skills, values or preferences continuously over a longer time span”[1]. “Open learner models are learner models that can be viewed or accessed in some way by the learner, or by other users (e.g. teachers, peers, parents)”[4].

Role of learner model	Technical challenges
1. <i>Open learning modeling (OLM)</i>	user interfaces for reflection and planning, attention, forgetting
2. <i>Aggregation of information about the learner from diverse sources</i>	middleware infrastructure for aggregation, user interfaces to control aggregation, ontologies
3. <i>Sharing the learner model with people</i>	user interfaces, particularly for privacy management, middleware infrastructure for control of privacy and security, ontologies
4. <i>Interpretation of learner information</i>	user interfaces, new tools for different interpretations
5. <i>Reuse by different applications for the learner's personal use</i>	user interfaces, middleware infrastructure for controlling release of parts of the model and active delivery of parts; ontologies, standards
6. <i>Institutional use of long term learning data from many learners</i>	user interfaces, middleware infrastructure associated with both sharing and reuse of the model, ontologies, standards

Figure 2.1: Roles for the lifelong learner model and technical challenges [2]

What was the problem ?

Now, we know that why good visualization is important. We have different learner models (i.e. Lifelong Learner Modeling in Academic Networks (PALM), Lifelong Learner Modeling in Social Networks). These frameworks help us to know academic interests of the person or social interests of the person. For an example, PALM mines the information from the well known publications using data mining algorithms to allow us to find person's educational interests. The information mined using PALM are very good and efficient, but the data shown are too abstract[1]. The problem here is that these data lacks good information visualization. We wanted to visualize the abstracted data from different learner model, in such a way so the it became very easy and clear for the normal user to understand important data and useful trend and patterns.

According to Dugošija in [1], we have right information* at right time from different learner model but not in right way. So, visualizations of learner models will give the computer scientist the ability to use information efficiently without the need of high expertise.

* The evaluation showed that PALM provides good results[1]. That means we have good and right information.

3 Thesis work

After analyzing the roles and technical challenges of the learner models, we have decided to focus on below challenges during this thesis work.

- Aggregation of data from different learner models
- Self-reflection
- Awareness
- Usability
- Different visualization techniques

With keeping above mentioned challenges in mind, we came to the following **research question**:

How to best visualize learner models to achieve self-reflection and awareness of the learner ?

Hypothesis :

Visualize the information such that it becomes easy to identify the pattern, idea or concept from data and helps to understand the data quickly. By visualizing the information extracted from the learner models in good way, we will achieve self-reflection and awareness of the learner.

4 Related work

Learner models	Aggregation of data from multiple learner models	Promote learner reflection	Provide awareness	Support of different visualization techniques	Usability
DynMap+ [5]	No	Yes	Yes	No	Good
QuizGuide [6]	No	Yes	No	No	Poor
Mr Collins [7]	No	Yes	Yes	No	Poor
C-POLMILE [8]	No	Yes	No	No	Poor
WILLOW [9]	No	Yes	Yes	Yes	Good
ViSMod [10]	No	Yes	Yes	No	Good

Figure 4.1: Related work

In the following sections, we have checked six learner models, which are listed in Table 4.1. We have checked these learner models based on whether they are providing any aggregation of data from multiple learner models, whether they are promoting learner reflection, whether they are providing awareness, is there any support for different visualization techniques and how is the usability of the system. Table 4.1 shows answers to all these questions.

5 Conceptual approach

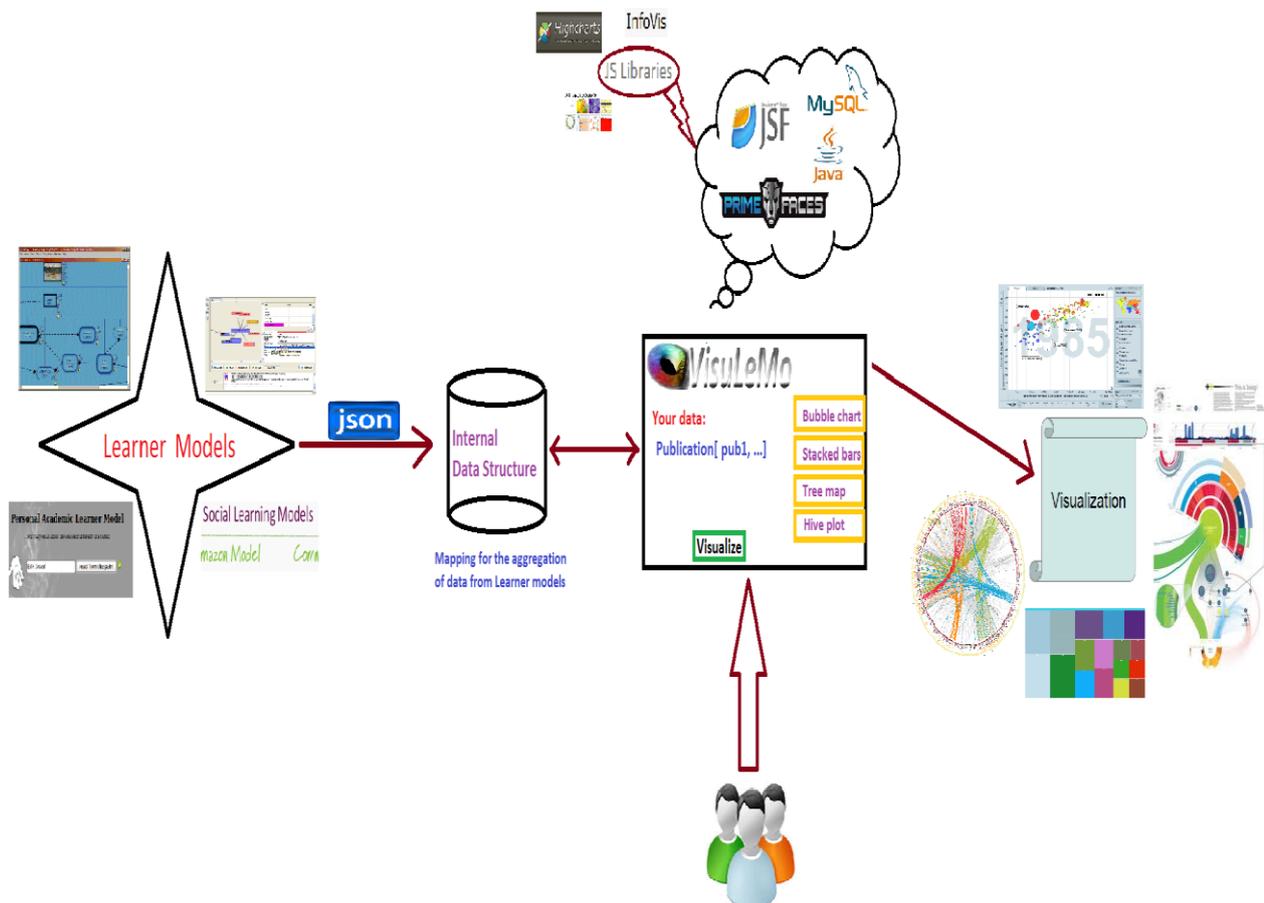


Figure 5.1: Conceptual approach

Figure 5.1 represents the abstract conceptual approach for solving the recommendation problem for the Visualizations of Learner Models. The work of the master thesis will be split in four parts – GUI of the framework, importing data from the different learner models, choosing appropriate visualization techniques and visualization.

5.1 GUI of the framework.

First thing to start with the project will be good GUI of the framework. It will provide tabs for the sections, where you can import data from different learner model and visualize it. The GUI should be easy to use and simple.

5.2 Data import.

The second task would be data import from provided APIs of different learner models. It will be done by reading JSON data from the provided restful web services of learner models.

5.3 Challenge task.

Main challenge of the thesis will be to create mapping between APIs of the learner models and internal data storage.

5.4 Visualization.

Visualization of the data is the main core part of the thesis. The whole outcome of the thesis depends on how good the visualization of the data is? The user interface which gives the user the control and provides him with the display of the obtained results in a user-friendly way.

6 Technologies Used



Figure 6.1: MVC architecture of used technologies

Below is the short list of the technologies , which will be used for the development. Figure 6.1 shows the planned MVC architecture of the system using technologies.

GUI - HTML5, CSS3 , jQuery,

Data import- Restful API of other Learner Models, JSON

Visualization - JS libraries (infovis , d3js.org, highcharts) and/or primefaces

In all - Java , JSF and Primefaces

Database - MySQL

7 Evaluation

As shown in the Figure 7.1, the whole project will run according to DIA(Design-Implement-Analyze) cycle of the software development. In DIA cycle, initially design of the framework will be done, then it will be implemented and afterwards it will be evaluated. The cycle of these 3 phases will run until we get the required software.

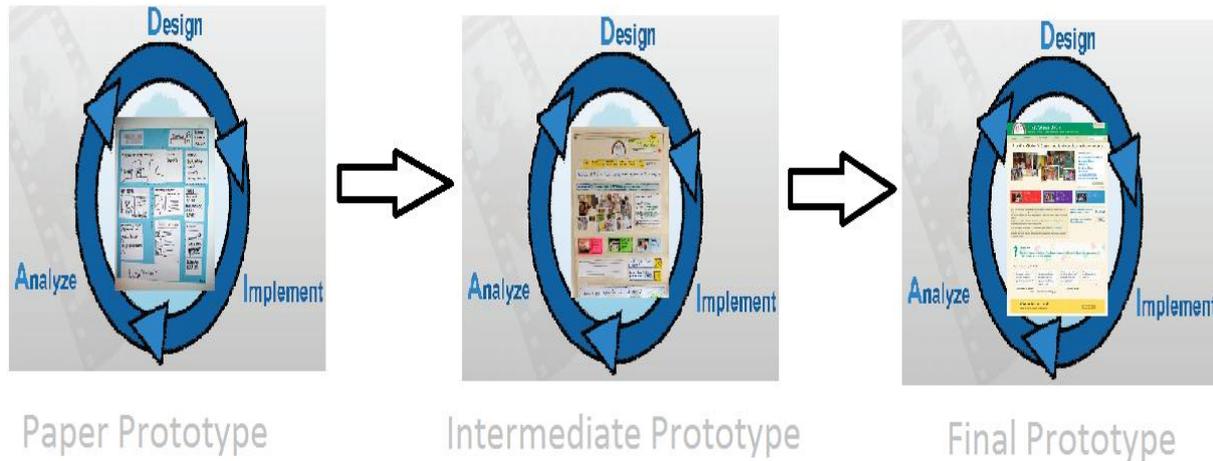


Figure 7.1: **DIA cycle of the Development**

In the first month, paper prototype of the framework will be developed, that will include the GUI of the framework and idea of importing data from learner models and visualizations techniques. In the next month, user testing and evaluation of the first prototype will be taken. Based on the user suggestions and improvements, the intermediate prototype will be developed in the later month, which will be the actual implementation of the system using all mentioned software technologies in section 6. Again the user testing and evaluation will be done for the system and will be changed accordingly to the final version of the system. User testing and user evaluations will be done by taking personal interviews of the users by giving them chance to use the system and taking user's feedback. Evaluation will be also done by taking user survey. In the personal interview and user survey, users will be asked questions like..

Evaluation Questions can be :

- _How is the usability of the system?
- _How is the support for awareness and self-reflection?
- _From the provided visualization techniques : Which are the best visualization?
- _Does it has good interface to import data from different learner models?

8 Project Plan

The master thesis will be continuous process with evaluation of the software and verification of proposed hypothesis. It will consist of several phases like development, user evaluation, expert suggestions and testing. As mentioned in section 7, the project will run according to DIA cycle of the software development. Below is the expected time plan of the thesis.

2013						
Phases	May	June	July	August	September	October
		Paper Prototype	Intermediate Prototype		Improvement	Final Prototype
Literature Research	✓	✓				
Proposal	✓					
GUI		✓	✓	✓	✓	
Importing data from Learner Models			✓	✓	✓	
Mapping data structure			✓	✓	✓	
Visualization			✓	✓	✓	
Evaluation		✓		✓		✓
Writing Thesis			✓	✓	✓	✓

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