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Usage Metadata Based Support for Learning Activity Reflection

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Abstract: An important activity for the learner while learning is the reflection on the learning path and strategy. So far, not many tools provide an automatic support for the reflection on the learning activities. Here, we describe our approach to enable reflection with the help of usage and contextual metadata. We describe how we capture usage information and provide algorithms like the identification of similar users, contents and tools for reflection like a learner Zeitgeist application or the elicitation of learning paths.
Key Words: usage metadata, learning path, learning reflection, learner zeitgeist
Category: H.4, M.6, J.5, L.2

1 Introduction

Today, an increasing amount of educational activities is carried out online. Many courses offer supplemental learning material needed to pass. Teachers provide access to their learning resources, include students within the respective learning management system that is used to manage learning resources, assignments and learning outcomes. Students use the web to find learning resources using respective learning management systems, search engines like Google or specialized portals like MACE[1]. Furthermore, students use the web to collaborate on their learning assignments using respective tools like ALOE[2] or just simple email, chat and file sharing tools.

Reflection on the learning path is one of the key principles to improve the learning process [Moo99]. So far, the tools used by students and teachers provide only little support for the reflection on the learning path and behavior. Instead, tools provide access to formal results of learning activities like the grades obtained on an assignment. Or, if students are asked to continuously publish their

[1] http://www.mace-project.eu
[2] http://aloe-project.de

work progress, teachers use the opportunity to give direct feedback to the student work. Furthermore, ePortolios are used to collect the works and results of students and thereby represent the student's achievements. Consequently, reflection is provided only at the end of the learning activity.

We strive to provide the learner with reflection on her learning path even during the learning activity. In other words, we aim to be able to continuously provide feedback on the various learning steps taken. In addition, we enable students to review their activities in the light of the achieved results. Note that if the used learning system provides access to the learning results, the correlation of learning activities and achieved results can be done automatically to some extent to improve learning strategies. Such an example is described in [WMD07].

From our perspective, a learning path is a simple time-sequence of activities of a user within a certain environment geared towards achieving a learning goal. The activities are represented as observations on the application level, therefore unifying observations from all applications. In general, the observations can be captured locally on a user's computer by observing her interaction with applications. Additionally, the observations can be captured remotely by observing the interaction of a user with a server or over a network. Both sources – local applications and network servers – can be exploited at the same time. Here, we focus on one learning environment that encompasses a number of servers.

In this paper, we describe the necessary technology that enables us to provide feedback on the learning path taken. Specifically, we describe how the observations about student activities with the combination of the specialized thematic portal MACE and the social community hub ALOE enable learning path feedback. The MACE-ALOE system provides the environment in which the observations about the user are captured. We therefore concentrate on the server-side collection and exploitation of observations.

The combination of MACE and ALOE is described in Chapter 2. Chapter 3 discusses the MACE Zeitgeist application while Chapter 4 presents steps towards the derivation of learning resource profiles and learning paths. Chapter 5 concludes the paper.

2 Metadata in the MACE and ALOE systems

The MACE system [SVC+07] provides a specialized thematic portal that makes architectural learning resources available across repositories. Thereby, we provide access to digital learning resources that are distributed in various world-wide repositories. In order to facilitate access, various types of metadata about the learning resources and the user activities are employed. The learning resources are described utilizing an extension of the Learning Object Metadata (LOM) standard , thus forming an application profile [DHSW02] of LOM for the use within the MACE system. The learning resource descriptions are stored centrally in the MACE store whose mechanism is described in [PTdJ+07]

In addition, we capture the usage of the learning resources through and within the MACE system. The observations, represented in the contextualized attention metadata (CAM) format [WNVD07], are stored in the usage metadata store of the MACE system.

The MACE system is intertwined with the ALOE system. ALOE is a web-based social media sharing platform that allows to contribute, share and access arbitrary types of digital resources such as text documents, music or video files. Users are able to either upload resources (using the system as a repository) or by referencing a URL (using the system as a referatory; called bookmarking). Users can tag, rate, and comment on resources, they can create collections of resources, join and initiate groups etc. Furthermore, arbitrary additional metadata can be associated with resources.

The ALOE system provides observations of user activities related to the MACE system. These observations are also stored in the MACE usage metadata store. See [MS07] for more information about ALOE and the underlying system architecture.

3 Zeitgeist as means of reflection

Here, we briefly describe the Zeitgeist application as an analytical statistic tool for learner reflection that is based on CAM. It provides a simple time-based overview of activities in the MACE system as a first step towards a reflection on the learning path of a user. The learner is able to analyze which learning resources she accessed when, how she found them and which topics have been relevant to her and when. These reflective information can then be used to make learning paths more explicit, e.g. to modify and control them to make learning activities better targeted to the respective learning goals.

Figure 1 shows the Zeitgeist dashboard that we use to confront the user with her history of activities within the MACE system. In the figure, the "Usage Summary" (top grey box) shows the user activities for January 2009 when she viewed the metadata ("Viewed") of 136, downloaded 84, bookmarked 60 and tagged 34 learning resources, thus describing the behavior of the learner within the MACE system. Detailed information are provided through the link called *Details*. The middle grey box titled "Usage History" shows the activities of the user per week indicating when she viewed metadata, downloaded learning resources or tagged or bookmarked them. With this statistic, a learner can determine when she was looking for learning resources and when she found suitable ones. For example, in the given graph, the learner searched for contents in the beginning of the week and started downloading learning resources only in

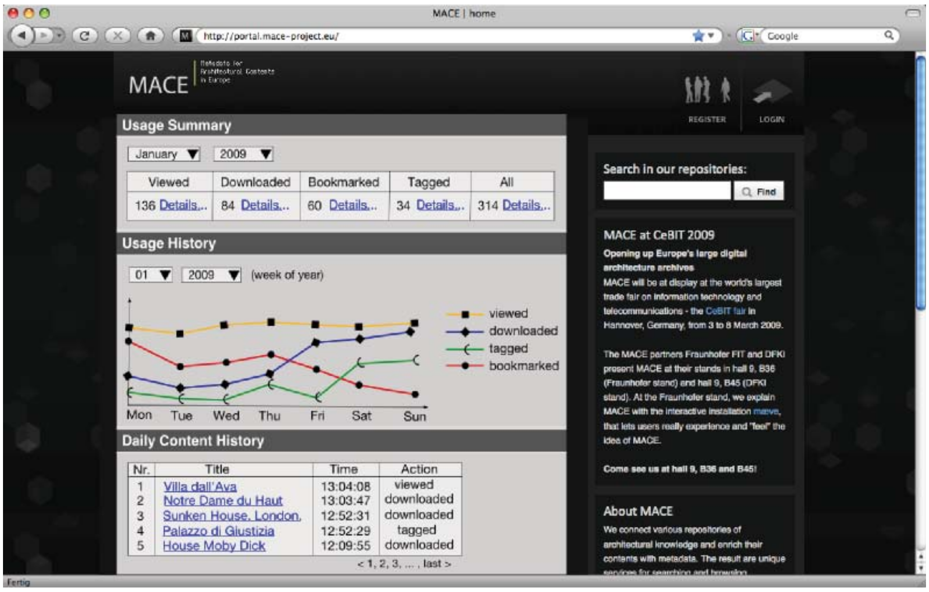

Figure 1: MACE Zeitgeist dashboard

the second half of the week. The continuously high "viewed" line indicates the search and later on the download while the "downloaded" line shows the number of downloads per day. The download line correlates with the "bookmarked" line that continuously decreases towards the end of the week. The grey box at the bottom titled "Daily Content History" shows the most recent learning resources that the user viewed and when, including the respective action. For example, the learner viewed the metadata of "Villa dall'Ava" at 13:04:08 and downloaded the learning resource "Notre Dame du Haut" at 13:03:47. For quick access, the title links to the respective learning resource.

The Zeitgeist dashboard provides hints on the learning trend, e.g. by showing an overview of which learning resources and topics have been relevant to the learner and when. Complementary to conventional user profiles, the trend reveals when the learner carried out which activities and with which learning resources and thus serves as the bases for an insight into learning paths and strategies.

The CAM based statistics provide a first step towards supporting the learner in reflecting on her learning activities. The confrontation of the user with her activities within the portal helps her to understand her steps towards the respective learning goal [Moo99].

4 Learning paths and contexts

As described before, the MACE usage metadata store entails learning paths through the MACE system usage. Here, we describe some highly conceptual approach to elicitate the context of usage for learning resources. We pick up intuitions from discourse and text processing according to which the context of a discourse act is (partly) defined by the discourse acts that have been carried out before (see [KR93]). That is, for an action a that occurs within a sequence of actions $b_1 \ldots b_n \ a \ c_1 \ldots c_m$ we define a's pre-context as the sequence of actions that occurred right before a ($b1 \ldots b_n$), and we define a's post-context as the sequence of actions that occurred right after a ($c_1 \ldots c_m$). The lengths of these sequences are subject of further experiments. In two further steps we simplify context representations. First, for all actions that are related to a learning resource, we reduce the actions and their contexts to learning resources and learning resource sequences. That is, we define the contexts of a learning object o as the sequences of learning resources used right before and right after o was used. Secondly, we reduce learning resource sequences to bags or even sets of objects. The representation of contexts as bags or sets of objects allow us to apply a very simple and straightforward similarity measure. The similarity of two context is related to the number of learning resources they have in common; it is defined as the fraction of the number of joint elements and the number of all context elements.

Similarity measures can be extended when learning resource profiles rather than concrete learning resources are taken into consideration. One can then evaluate and compare contexts not only regarding the learning resources they contain but also regarding the *types* of learning resources they contain: two contexts that contain different objects can be similar because they contain different objects of the same types.

Again picking up intuitions from language processing (especially from the notion of a paradigmatic relation, see [Sau66], [HQW06]), we assume that context similarities give rise to content similarities. That is, comparing the use contexts of objects provides us with insights into their semantic relations.

We intend to use the similarity and closeness information of contexts and learning resources in combination with Zeitgeist analysis like trends for the provision of suitable learning paths, suggestions of modifications to learning paths and generally for learner guidance in responsive learning environments.

5 Conclusions and Future Work

The reflection on the learning path and activities enables the learner to significantly improve her learning. Nevertheless, supportive tools are missing so that reflection is often only possible after concluding a learning activity or through evaluation measures (test, etc.) In order to enable reflective information for the learner within the learning process, we provide simple Zeitgeist-like statistics that show which activities the user carried out on which resources at which time. Furthermore, we provide the basis, e.g. identification of similar users and contents, to elicitate the learning path followed by a learner. The actual learning path can then be used to identify errors and take corrective measures. While we describe the conceptual approach here, apart from its evaluation, future work includes the derivation of the learning path using similarity measures for users, learning resources and their correlations. Experiments have to show that the derived learning paths actually show the real learning paths.

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