

# OP4L: Online Presence Enabled Personal Learning Environments

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## Abstract

*Social software tools, being a core element of a PLE, support knowledge sharing [2] and community building [3]. Great majority of these social software tools favors direct and frequent communication among users and allows them to maintain their online presence. In a PLE, especially important is the notion of global online presence, i.e., student's online presence expressed on different social tools integrated into his/her PLE. This global online presence can provide missing nonverbal cues typical for face-to-face interaction which can further increase students' awareness of each other and positively affect their willingness to collaborate [6].*

*In this paper we present OP4L environment aimed at providing social awareness to PLE which is being used for recommendation of relevant learning resources (both digital and human).*

## 1 Introduction

Personalized Learning Environment (PLE) governs the approach of an autonomous learner taking control of and managing his own learning process [1]. It assumes a selection and integration of different tools and services comprising a learning environment fully customized to the needs of an individual learner.

Social software tools, being a core element of a PLE, support knowledge sharing [2] and community building [3]. Great majority of these social software tools favors direct and frequent communication among users and allows them to maintain their *online presence*. The notion of online presence encompasses user's overall presence in the online world and is composed of posted status messages, chat availability indicators, geo-location, etc [4]. By assembling all that data, user's peers can form an overall image of his/her presence in the online world and sometimes get a clue of his/her activities in the real world. In other words, online presence can help users to maintain some form of passive interaction with their peers. It contributes to the constructing of a group's online sixth sense [5] and significantly improves group cohesion, and thus allows for advanced forms of cooperation within the group. These cohesive features make online presence highly

relevant for improving social and collaborative aspects of online learning environments.

In a typical classroom learning setting when establishing a communication with others, students can rely on their peers' nonverbal communication such as body language, facial expressions, physical proximity and dress to establish relationships. But this is missing in the online learning environment and online communication. In a PLE, especially important is the notion of *global online presence*, i.e., student's online presence expressed on different social tools integrated into his/her PLE. By giving students insights into their peers' activities, availability for chat, information about work overload, emotional state, current location, and other, regardless of the social tool they are using in the given moment, this global online presence can provide those missing nonverbal cues typical for face-to-face interaction. This can further increase students' awareness of each other and positively affect their willingness to collaborate [6].

However, there is still no formalized solution to exchanging and integrating online presence data from different social software tools. This is due to the fact that different social tools support different aspects of online presence, but also have different representations of semantically identical data [7]. These problems of tool interoperability and data integration are not specific just to online presence, but one of the key technical challenges for the realization of the PLE concept is exactly the integration of different tools and services a PLE should comprise [8].

A recent trend that tries to offer a solution to this problem relies on the use of Semantic Web technologies. They can enable the integration of data originating from different and often heterogeneous sources and thus allow for combining and exchanging data among the tools and services integrated in a PLE. In addition, they are already applied for modeling the semantics of one's presence in the online world, with the final aim of enabling interoperability among services that collect and use online presence data.

This paper presents the work conducted in the scope of the OP4L (Online Presence for Learning, <http://op4l.fon.bg.ac.rs/>) project aimed at using ontologies to unambiguously represent all relevant data

about students online presence and their interactions with learning resources. We have developed educational services for recommendation of relevant learning resources (both digital and human) based on the student's overall learning context taking online presence as one its core determinants.

## 2 Scenario of Use

In order to illustrate OP4L approach, this section will walkthrough a scenario involving a student named Tom who is working with his classmates on a software design problem. In order to get the information required for performing the task, he searches through online repositories for content related to his problem. Afterwards, Tom uses a UML modeling tool enabling him to draw a solution to the given problem in the form of UML diagrams, and upload it to the Learning Management System (LMS) used for the course. Unfortunately, Tom got stuck with his assignment and would like to ask his peers for help, but he is not sure who is the most competent to ask and also willing to help at that specific moment. He would highly appreciate a recommendation regarding whom to contact for assistance.

In the OP4L solution, Tom would be recommended to contact Alex, Sheila or Mark, his colleagues who, based on their user profiles, have enough knowledge of the concrete or similar software design problems and would be able to help. Tom could look up for them on the LMS's online chat tool, but they might not be online there at a specific moment Tom performs the lookup. However, as many of today's students often are, they could be online on their favorite social networks - socializing with their friends on Facebook, following news updates on Twitter, wandering around the town but updating their location via Foursquare, etc. In the proposed solution, Tom's LMS is able to gather this information and present it to him. It is able to pull his peers' online presence data from the popular social networks and display their status, recent activity or availability for chat. Based on Mark's 'work overload' custom message and 'busy' chat indication, the system is able to detect that he should not be considered for asking for help as he probably wouldn't have time for it. Similarly, Sheila's custom status 'available for friends' indicates that she is available only for her friends, and Tom is not one of them. Luckily, Alex is currently online on Facebook, so the system recommends Tom to contact Alex by sending him a message to his Facebook message inbox. If the system had not have access to the Tom's peers' online presence data, it could have made incorrect recommendation by suggesting Tom to contact any of the three knowledgeable peers even though they wouldn't be able to help him.

## 3 OP4L Solution

OP4L is designed to support the use of online presence as a mean for improving students' collaboration and foster content and knowledge sharing while learning online. Online presence data is also being used for enhancing the recommendations of peers able to help.

### 3.1 DEPTHS

The main component of OP4L environment is DEPTHS (Design Patterns Teaching Help System), a comprehensive learning environment for collaborative project-based learning of software design patterns [9]. It relies on a common ontological foundation (Sec. 3.2) to integrate several existing educational tools and systems, namely: an LMS, a Domain Modeling tool, Online Repositories of Learning Resources and a Feedback-generation tool. It also includes several context-aware educational services whose purpose is to enrich and foster learning processes by recommending appropriate learning content, as well as to foster informal learning activities by finding potential collaborators among experts and peers having experience in solving same or similar software problems.

In order to be able to utilize online presence capabilities and integrate with different social services, DEPTHS relies on its ontology stack (Sec. 3.2), Online Presence Ontology Server (Sec. 3.3) and Online Presence of Recommended Peers Module (Sec. 3.4).

### 3.2 Ontological Foundation

LOCO (Learning Object Context Ontologies) [10] is a comprehensive and generic ontological framework aimed at formally representing diverse kinds of learning contexts and interactions that occur during a learning process. Accordingly, the framework integrates a number of learning-related ontologies, such as Learning Context ontology, Domain Model Ontology and User Model Ontology<sup>1</sup>. DEPTHS relies on Learning Context Ontology for semantic representation of student's overall interaction with the learning content and other participants in learning activities. This data is then used for performing context-aware retrieval of resources on software design patterns from online repositories and DEPTHS's own repository of software artifacts.

For annotating semantically relevant online resources and extracting metadata that is used for finding resources appropriate for a student's current learning context, DEPTHS uses the description of software design patterns and other software engineering related concepts in form of domain vocabularies. These vocabularies are modeled using SKOS (Simple Knowledge Organization Scheme)<sup>2</sup>, a formal model for describing structured controlled vocabularies. It allows for easy extending of the domain vocabularies, publishing and linking them with other data on the Web.

<sup>1</sup> <http://jelenajovanovic.net/LOCO-Analyst/loco.html>

<sup>2</sup> <http://www.w3.org/TR/skos-reference/skos.html>

Online Presence Ontology (OPO)<sup>3</sup> enables formal representation of all fragments of a user's online presence description dispersed on a wide variety of social software tools and networks and enable integration and exchange of those data [7]. OPO has a goal of enabling interoperability between applications publishing online presence data. In OP4L, OPO is used for representing and unifying students' online presence over different tools and services integrated into DEPTHS.

### 3.3 Online Presence Ontology Server – OPOS

OPOS enables users to connect accounts from various social services into a single application capable of pulling online presence data from these accounts, represent it in semantically unambiguous way, integrate them and make them accessible to other applications user has chosen as trusted ones. Since different social services support different aspects of online presence description, OPOS relies on OPO to translate the data into a unique semantically-rich representation without the loss of the data semantics. This way, it is capable of constructing a *global online presence* and synchronizing it over different services making all of them to be up to date with the user's latest online presence description.

The architecture of OPOS consists of:

- *OPOS Core*. It is a central component of the application and is in charge of managing of all online presence data coming in to OPOS. It is aware of the social services user has registered for the OPO data pulling and synchronization.
- *Social services*. Online presence data is part of every user profile on any online social network and instant messaging service. Depending on the type of the social service, online presence data is pulled from the service using either a custom developed plug-in, or the service's public API.
- *OPOS mediators*. Since every social service offers specific parts of online presence data and different ways for accessing that data, for every social service, a specific mediator service acts as a bridge between the OPOS Core and the social service itself. It knows how to handle all the data and any requests between OPOS and specific service.
- *OPOS data repository*. All online presence data gathered by OPOS is stored in its data repository in the form of RDF triples. This enables the integration of users' online presence data from various social services across the Web. Furthermore, SPARQL endpoint and RESTful services are established in order to give the possibility for external querying over the data repository.
- *OPOS web application*. Users are able to access OPOS through a web application where they can specify which social services they want to connect with OPOS. For every service, it is possible to declare whether a user wants to receive his/her online presence data from and/or send the data to that service.

<sup>3</sup> <http://online-presence.net/ontology.php>

The very fact that OPOS handles one's online presence data – considered by many as a highly sensitive data – raises privacy concerns. This issue is yet to be tackled by OPOS as it now doesn't have a completely secure solution for user's data. The primary focus up to now was to materialize OPO's goal of aggregation and online presence data exchange over various services. A potential approach would be to implement OAuth protocol (<http://oauth.net/>), a de facto standard authorization method with all popular social applications. The crucial point will be to endow users with fine grained configuration and full control over which data is being shared and with which applications.

### 3.4 Online Presence of Recommended Peers Module

Online Presence of Recommended Peers (Fig. 2) is developed as a module of the LMS integrated into DEPTHS PLE. This module uses DEPTHS's Peers Recommendation Service responsible for analyzing student's learning context and based on that creates a list of peers potentially relevant for the considered learning context. For each peer found as potentially relevant, a query is sent to the OPOS to retrieve his/her latest online presence data. The retrieved data is used to provide visual indication of the peer's presence on different social services integrated in the PLE.

When a student is in a need of contacting a colleague, e.g., to ask for assistance with the current assignment, he/she can utilize the Online Presence of Recommended Peers Module's list of peers and choose one whose online presence indicator suggests is free to be contacted. The chosen peer can be contacted directly within the social tool he/she is using at the given moment (i.e., the tool his/her latest online status originates from) and after receiving the notification message, the peer is able to respond by giving answers directly from that social tool.



Fig. 1 Online Presence of Recommended Peers Module

## 4 Implementation

OP4L is composed of the two frameworks we have developed in our previous research projects, namely DEPTHS [9] and OPOS<sup>4</sup>. DEPTHS environment integrates Moodle (<http://moodle.org>) LMS and ArgoUML (<http://argouml.tigris.org>) software modeling tool. It also uses semantic annotation services of the KIM framework (<http://www.ontotext.com/kim>) to provide semantic annotation of the online resources and internal content produced within the LMS. For the purposes of OP4L project, DEPTHS is extended to support integration with Facebook and Twitter. As for OPOS, up

<sup>4</sup> [http://goodoldai.org/project\\_opos](http://goodoldai.org/project_opos)

to now, it supports the following social services: Facebook, Twitter, Foursquare and instant messaging client Spark (<http://www.sparksocialmedia.com/>). For communicating with these services, it uses their corresponding public APIs. Communication of external services with OPOS is enabled through the use of RESTful services implemented using the Jersey framework (<http://jersey.java.net/>). RDF repositories are implemented using Jena SDB (<http://openjena.org/SDB/>) which enables scalable storage and query of RDF data using relational databases. As our backend applications are based on the Java technology, we used Jenabean framework (<http://code.google.com/p/jenabean/>) for bidirectional mapping between RDF triples and Java OO model.

## 5 Related work

There are several research efforts related to the work described in this paper. Due to the space limit, we present just a few of them. meNow Schema (<http://crschmidt.net/semweb/menow>) is a simple formal model for describing a variety of aspects of a person's current status in terms of their activities. However, the schema is relatively poor in capturing the semantics of status messages and states of availability – areas where our solution provides a richer support.

In [11] a theoretical model for capturing the semantics of Presence in Social Networks has been suggested. Unlike other models, this model emphasizes the process of presence data publishing and consumption aspects, as well as the purpose of the presence data. However, there is no available information about the formal specification of this model and thus we were unable to evaluate its richness in expressing the semantics of online presence.

Passant et al [19] have suggested the SemSLATES approach that makes use of Semantic Web technologies and Linked Data principles to provide support for knowledge integration and re-use, and efficient information retrieval. The aim is to integrate various existing tools in a transparent manner, and to reuse existing models and data already available on the Web. However, comparing to our work, SemSLATES did not address social and pedagogical issues.

## 6 Conclusion

In this paper, we have proposed an approach of making use of Semantic Web technologies to integrate students' online presence data coming from different social services. These data are further used by advanced educational services able to leverage students' overall learning context in order to recommend them relevant learning resources (both digital and human). This work is a part of our research effort conducted within the scope of the OP4L project, to better support collaborative learning and social awareness in PLEs.

Currently, we are in process of stabilizing the testing the developed software components (see Sec. 3) and designing the evaluation study. The study will be conducted during the winter semester of the 2011/12 academic year in high education institutions of our four project partners. The study will be focused on investigating the role of *global online presence* in PLEs, namely, its influence on 1) the perceived usefulness and usability of the peer recommendation service, and 2) students' overall learning experience.

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