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## Ontological user profile for E-orientation platforms

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### Abstract

In recent years, E-orientation systems have played an increasingly significant role in the proposal of an academic and professional orientation to students. Research efforts have grown to provide more useful and effective E-orientation systems for research or other purposes. The implementation of E-orientation systems resulting from these efforts utilizes several techniques including Artificial Intelligence (AI) methodologies. This study proposes a personalised approach to support an E-orientation system that is tailored to the student's characteristics. A key component of this system comprises an ontological model of the user profile. The objective of this research was to propose an ontology that is able to collect and analyze the user related information as well as customize the profiles with the most appropriate recommendation or orientation. The ontology employed in this study was developed using the OWL (Ontology Web Language), a knowledge representation language for authoring ontologies. In this paper we will present a definition for the user profile, and then we present our methodology of ontological modeling of the user profile, and finally the conceptual model of the user model for e-orientation systems.

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### 1. Introduction

Previous work in E-orientation systems is based on a unique approach to provide guidance regardless of user goals, knowledge, abilities or preferences [1]. This consistent problem of providing the same guidance proposal to all users can be solved by using personalization strategies to tailor the process or guidance plan to the user's needs.

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This raises the challenge of designing a user profile model that is lacking in current electronic guidance systems. User profiling is the process of designing a structure that will capture the attributes determined from the relevant characteristics of the user. The result of modeling the user profile is the definition of a user model, a uniform model of the attributes to be included for each user [2]. The task of representing user profiles in a model that integrates various types of data provided by various sources motivates the use of ontological technologies in this study. Specifically, ontologies are recognized to support flexible use and reuse of captured information as well as integration of collected information. To address the limitations of existing E-guidance systems, the objective of this article is to provide an ontological model for user profiles that will be used by an E-guidance system to support academic or professional guidance. The remainder of this chapter is organized as follows: Section 2 presents the related works; Section 3 discusses the importance and benefit of using an ontological user profile for personalization. Section 4 explains the methodology used for the development of User profile ontology. Section 5 focuses on Ontological modeling of a user profile for E-orientation systems.

## 2. Related works

In education, profile modeling is one of the tasks that require continuous updating due to a change in the student's profile over time. Many approaches are used for user profile modeling, such as in [7] where an Elo Rating System was used for profile modeling in an adaptive computerized system for evidence-based practice. Another author [12] uses a review of artificial intelligence techniques for student profile modeling in order to personalize and tailor student tutoring to suit their needs, profiles and preferences. The authors of [13] propose a personalized learning process that can be adapted to the needs and characteristics of students using student model ontology. In [15], for example, the author presents a new ontology-based learner modeling approach to simulate the learning context, environment and learner behavior. Several studies have focused on the modeling of the learner profile.

## 3. User Profil

A user model represents various characteristics of the user, which can be used to tailor content, presentation or navigation. The user model is defined as beliefs about the user that include preferences, knowledge and attributes for a particular domain [3] or as an explicit representation of the properties of individual users or classes of users [4].

Based on the differences which do not lie only in terminology, it is evident that the user modeling area needs to be standardized, the first attempt being the user modeling meta-ontology [5]. As an example of using the user characteristics of an E-guidance system in the adaptation process, assume that a characteristic of the user model describes the grade level for a specific student. If the system knows that the user is not interested in training courses where the proposed level of education is lower than his level of study, he will not present training or diplomas that do not meet this condition. The system adapts the information to the name of the user using the user template.

### 3.1. Definition of ontology

As defined in [6], ontology is an explicit formal description of a domain, made up of classes, which are the concepts found in the domain (also called entities). Each class can have one or more parent classes (is-a or inheritance links), thus formulating a specialization / generalization hierarchy; a class has properties or locations (also called roles or attributes) describing various characteristics of the modeled class and restrictions on the locations (also called facets or role descriptions). Each location, in turn, has a type and can have a limited number of allowed values, which can be of simple types (strings, numbers, Booleans, or enumerations) or instances of other classes. Classes can have instances, which correspond to individual objects in the domain of speech; each instance has a concrete value for each slot of the class to which it belongs. Ontology with a set of individual instances of classes constitutes a knowledge base.

### 3.2. Benefits of using an ontology-based user profile

Ontology has gained popularity and importance in recent years for knowledge representation. The ontology-based solution has been well known in recent years to allow a higher level of abstraction. Ontologies have been shown to perform better in profiling users when compared to other methods used [2]. There are many advantages to creating an ontology-based profile. We can use the reasoning support offered by ontologies. We may also use ontology relationships, conditions, and restrictions as a basis for inferring additional user characteristics. The ontology provides a shared understanding of the domain that supports the reuse and sharing of user profiles, which is the most important point in using the ontological user profile.

## 4. Our methodology of ontological modeling of the user profile

This section describes a detailed development process for building user profile ontology. An ontological engineering methodology [7] is adopted. The choice of this methodology (in the context of E-orientation) is based on three steps to facilitate the reuse and reengineering of ontological and non-ontological resources, in order to build a complete and coherent ontology of the user profile. Figure 1 illustrates the ontological development methodology that was carried out in a set of sequential steps. The arrows associated with the numbered circles represent the different stages. These are represented by colored rounded boxes. Figure 1 also shows (in the form of dotted boxes) the existing knowledge resources. In this section, we focus only on the first two steps of building the ontology of our user profile.

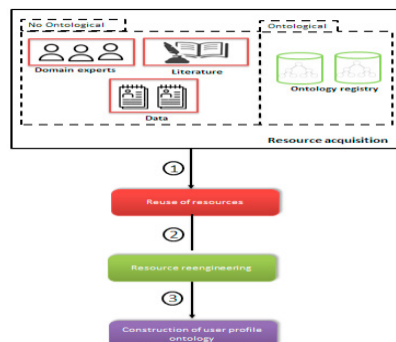


Fig. 1. Methodology for developing a User profile ontology.

Step 1: Reuse of resources. This step covers the analysis of ontological and non-ontological resources and the choice of the latter that can be reused according to the requirements of the E-orientation platforms, to build the network of user profile ontologies.

Step 2: Resource reengineering. This step covers the task of reengineering the selected ontological and nonontological resources.

Step 3: Construction of the ontology of a user profile. This step covers the restructuring of ontological and nonontological resources to integrate them into the ontological model of the user profile.

### 4.1. Acquisition of Resources

As we have seen in the methodology presented above, the first phase consists in acquiring the resources, in this case the knowledge required to build the ontology comes from several reliable resources, in particular the opinion of experts in the field (advisor of guidance, guidance centers), the TICE is an excellent reference system, makes it possible to highlight the three axes of pedagogical orientation, namely: Self-knowledge, Knowledge of the socio-economic environment, Knowledge of training [8], the portfolio or E-portfolio which can be considered as a space containing various textual, iconographic or even mediatized documents relating to the learning outcomes and professional experiences of an individual [9,10], the ontology repositories such as the ODP, literature and recent

guidelines. First, we determine the source of the information to build the user profile. To determine the concepts and relationships between the terms, first of all, we performed a literature analysis through textbooks and research articles, but the results are insufficient and incomplete to meet the requirements of the E-orientation system. . After meeting the experts in the field, we obtained several sources of knowledge which were useful in generating the concepts and relationships.

#### 4.2. Step 1: Reuse of resources

We carried out a process of reuse of ontological and non-ontological resources, to choose the most appropriate resources (thesaurus, glossaries, databases, portfolio, etc.) to use to build the user profile model for E-orientation systems.

- Methodology

Once we have defined and categorized the resources to be processed, we present the methodological guidelines for their reuse. The goal of the resource reuse process is to choose the most appropriate resource for the ontology construction of our user profile based on the activities explained in Table 1 below:

Table 1. Activities for the non-ontological resource reuse process

N°	Activity	Explanation
1.	Find resources	The purpose of the activity is to find resources related to the field of guidance.
2.	Evaluate all candidate resources	The aim of this activity is to evaluate all the candidate resources obtained in activity 1. To carry out this activity, taking into account the following criteria: coverage, precision and consensus on knowledge.
3.	Select the most appropriate resources	The aim of this activity is to select the most appropriate resources among the candidates obtained in activity 2.

The result of the last activity is a ranked list of resources that covers the concepts of the user or student profile in the field of E-guidance. These resources will be ready for the reengineering process.

#### 4.3. Step 2: Resource reengineering

- Methodology

As shown in Figure 1 (by the arrow with the number 2), after performing the resource reuse process to select the most appropriate resources to use in order to build our user profile ontology network, we need to perform the process of reengineering these resources to modify them, drawing on the process of reengineering the software (Byrne 1992).

So we transformed the non-ontological resources into an ontology by following the activities explained in Table 2 below:

Table 2. Activities for the reengineering process of non-ontological resources

N°	Activity	Explanation
1.	Reverse engineering of resources	The goal of this activity is to analyze a resource in order to identify its underlying components and to create representations of the resource at different levels of abstraction (design, conceptual requirements)
2.	Transformation of non-ontological resources	The goal of this activity is to generate a conceptual model from the non-ontological resource

The main output is an ontological model that represents the domain of the user profile of E-orientation systems.

#### 4.4. Step 3: Construction of the ontology of a user profile

The construction of ontology is the main phase, which involves the creation of an ontological framework. Section 5 below shows the process of building this new ontology to model the user profile.

## 5. Ontological model of the user profile for E-orientation systems

The data captured in the user model is represented by the concepts. The main concepts of ontology are presented in Table 3 illustrated below. This follows a top-down design approach, where "high-level" or general concepts relating to the user (eg: "center of interest", "personal profile", etc.). The main concept, User represents any user of the E-orientation system and the User Profile file. It is semantically linked to a number of key concepts and breaks down into more detailed or specialized attributes or properties. This ontology makes it possible to store and maintain a dynamic profile of the user. For example, the user can be continuously updated when a change is noted in the Tutoring file. The important concepts of the user profile ontology are explained in detail in the next section:

Table 3. Important concepts in a user profile of E-orientation platforms

Concept	Description
Personal profile	This concept is related to the personal or professional characteristics associated with a user profile. This is useful for categorizing or classifying individuals or for identifying particular user needs or requirements.
Student Profile	This concept is linked to academic information concerning the course, the knowledge of the student, etc.
Center of interest	This segment gathers information describing the interest of the user. The latter are identified with the help of key words, or a subject such as for example "Institution, Higher school" (this can be the messages, the number of clicks, the number of visits, etc.).
Preference	This concept defines any existing information related to the user's (preferences / likes) area: for example "likes orientation videos", "sharing contest announcements".
Goals	This concept makes it possible to define and specify the objective intended by the user, for example orienting him on trades in the IT sector, or else orienting him on artistic training.
Tutoring	This concept represents the data that helps supports and advises users in their training journeys. This data can be lessons, exercises and tests, etc.
Context	This concept represents the data that helps supports and advises users in their training journeys. This data can be lessons, exercises and tests, etc.

The next step is to build the ontological structure of the user profile which consists of different steps represented in a flowchart as shown in Figure 2.

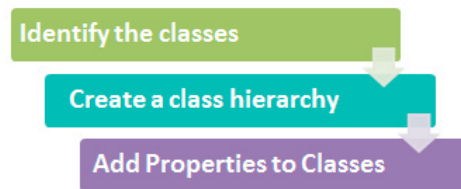


Fig. 2. The steps in creating the student profile

The ontology of the user profile has been described to define the basic elements: 1) classes, 2) properties and 3) individuals [13]. These elements are used to describe concepts, members of a class, relationships between individuals of two classes (object properties) or to link individuals with data type values (data type properties). After carefully studying the sources of knowledge described, and as illustrated in figure 2, the first step is to define the classes using the names of the concepts defined previously. We include the names of unique identifiers for all classes. The second step is to build a diagram by bringing all the concepts together in a single user profile. The third step is to add object (class) properties that help to link classes to other classes, and add data properties that help provide more information.

Figure 3 below represents the User model of the E-orientation platforms. This model is used to clearly show the necessary and sufficient concepts for the proposal of such a User Profile.

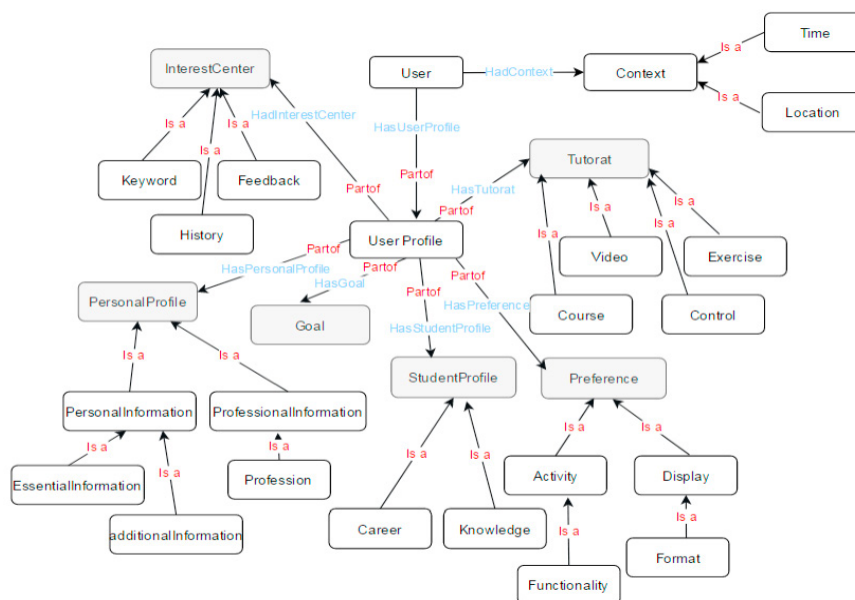


Fig. 3. The conceptual model of the user model

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