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A model of learners profiles management process

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Abstract. Our research concerns teaching assistant systems. It deals with the question of reuse and exploitation of learners profiles by the different actors of the learning situation; teacher, learner, families, institution or scientist. This paper first describes the difficulties linked to the reuse of heterogeneous existing learners profiles. Then, REPro, a learners profiles management model is proposed. The deployment of this process within a computerized environment is presented as well as the results of first experiments.

keywords. human learning, learner models, teaching assistant, learner follow-up, model of learners profiles management process.

Context

The national and international educational institutions are looking for common representations of data concerning learning activities. This is shown through numerous initiatives around skills frameworks, standardization works [1] or portfolio [2][3]. Some ILE (Intelligent Learning Environments) collect learning information in order to customize the system, help the teacher or tutor in his follow-up task or deliver a reflexive learning report to the learner. The teacher collects information to evaluate the learner, to propose individualized activities or to provide a view of the learning process to the learning situation actors. These various needs lead to different models of the individual information related to the learning. We call these models “learners profiles”.

Currently, ILE designers and teachers make learners profiles in the aim of specific exploitations. There is no generic method allowing to reuse existing profiles – created by other systems, human or not – in different contexts or practices. Our work aims to fill this gap.

To carry out this research, we have collaborated with seven teachers covering several levels from primary school to university. Four of them took part in our final experimentation.

This paper first gives an overview on the issue of reusing heterogeneous profiles. Then the learners profiles process management model REPro is proposed. The deployment of this process into a computerized environment is presented as well as the results of our first experiments. Finally, the implication of our contribution and the new perspectives opened by this work are discussed.

1 Reuse of heterogeneous profiles

In ILE research domain, the more general term to speak about personal information on a learner is “learner model”. However, in our work, we prefer to use “learner profile” in the same sense than [4], [5] or [6]. We define a learner profile as *information concerning a learner or a group of learners, collected or deduced from one or several pedagogical activities, computerized or not. Information contained in the learner profile can concern his knowledge, abilities, conceptions or his behaviour* [7].

The heterogeneity of existing profiles – both structure and content wise – makes difficult their reuse in various contexts.

One way of solving the heterogeneity problem consists in defining a priori a set of information about a given learner. Normalization works have chosen this approach, like PAPI [8], IMS-RDCEO, or IMS-LIP [1]. However, these standards do not provide necessary details describing the information about the learner's knowledge. Moreover, existing standards are focused on storage and exchange of data in order to help in managing educational institutions. This explains why standards are not precise enough for learning data [4]. Finally, these information are stored as free text strings of characters, which makes them hard to reuse by a computer system [4]. This is a major limitation in our context of profiles reusing.

Another approach (as followed in this paper) consists in reusing external profiles within a common computer framework by rewriting them according to an internal formalism. ViSMod [9] and DynMap systems [10] allow the reuse of learners profiles coming from an ILE and based on an overlay model. They rewrite on one hand the domain-centric data, on the other hand the specific learner data. [10] is focused on activity with the description of the educational tools required by this activity and its specific evaluation criteria. The approach by [9] requires first the description of the Bayesian network by the teacher.

None of these systems totally fulfills the need of reusing existing learners profiles. The teacher himself has to be the major contributor to the profiles reuse and exploitation, so that he integrates learners profiles in his practice. This requires that the teacher could associate his profiles to profiles contributed by other teachers or coming from ILEs. Moreover, such approach has to be built around knowledge and skills instead of being centered on activities. By reproducing domain specific data, the previous systems don't allow to represent some information existing in learner profiles, such as free text (ie: a commentary), graphs with values suited to the links, or

distribution lists [11]. Therefore the REPro model is proposed in order to fulfill the previously identified requirements.

2 REPro: a model of learners profiles management process

The REPro (Reuse of External Profiles) model is shown in Figure 1. It represents all necessary stages between the generation of profiles and their exploitation by the various actors of the learning situation.

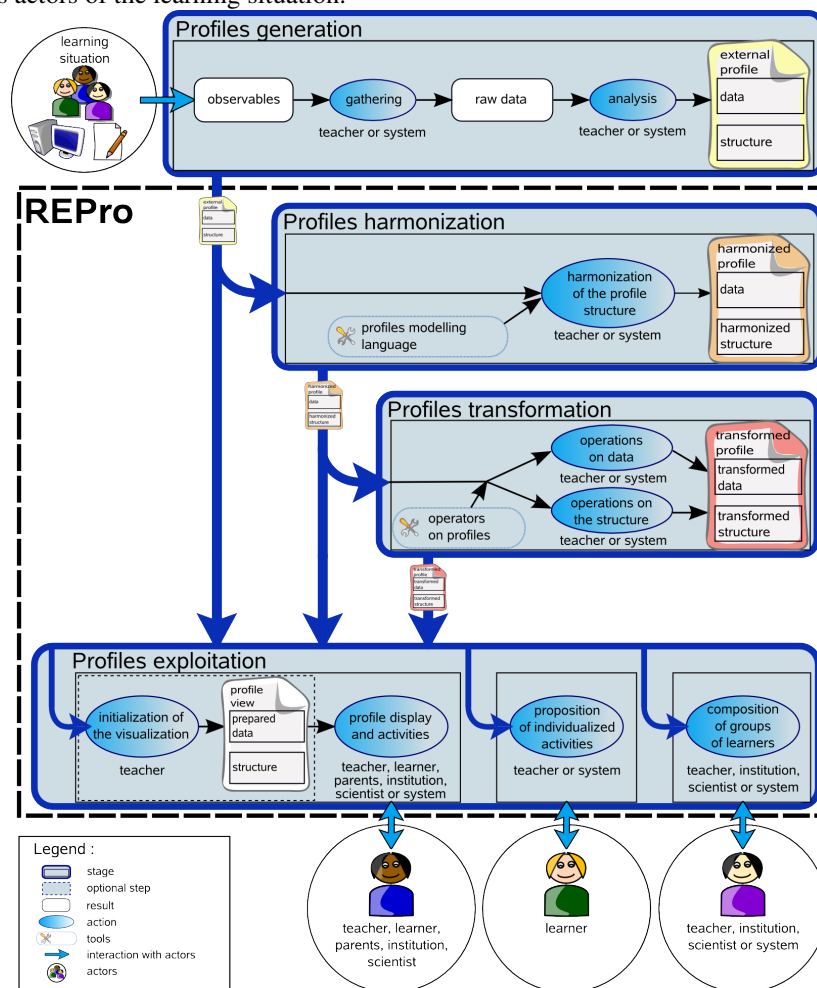


Figure 1. REPro, a model of learners profiles management process

The *profiles generation* precedes the REPro model. This preliminary stage consists in generating profiles by computer systems or teachers from a given learning situation. This situation can be either in-class learning or e-learning, using computers or not, including individual or collaborative activities. Some *observables* exist in any situation: the oral or written outputs of the learner, the time it takes him to complete the

activity, his attitude... They can be observed and collected by humans (teacher or observer during an experiment), internal digital device (log file) or outside digital device (camera, microphones). This initial set of *raw data* has to be converted into higher level data through a diagnosis carried by a teacher or through a computer system. This produces a set of interpreted and analyzed data about the learning process of a given learner. We call this set an *external profile* since it is created outside REPro. In our perspective, a profile is made of two categories of information: the *data* and their *structure*.

For example, a part of an external profile is presented figure 2: MoreMaths profile [12]. It is generated by the MoreMaths system and is directly exploited – visualized by the learner – in the same system.

In the context of reusing existing profiles, it is not possible to go directly from the profile generation stage to the profile exploitation stage: the nature of the collected information as well as their structure and formalism is not known. It is therefore necessary to go through an *harmonization* stage to rewrite these profiles according to an internal formalism. This stage can read an *external profile* already digitized or not. The harmonization consists in rewriting the *structure* in a *profile modeling language*. We propose such a language, named PMDL (Profiles MoDeling Language), defined in [11]. At this stage, only the structure is altered. The harmonization can be carried out by a computer system or manually by the teacher. Following this stage, the harmonized profile can be transformed or directly forwarded to the exploitation stage.

Figure 3 presents the MoreMaths profile rewritten according to the PMDL formalism. This profile can then be easily reused by another system in the aim of transforming or exploiting it.

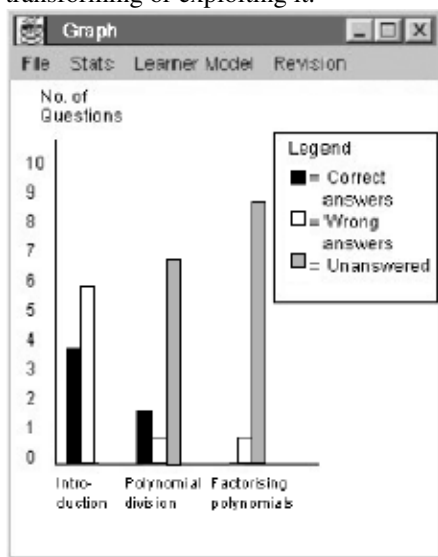


Figure 2: A part of MoreMaths profile [12]

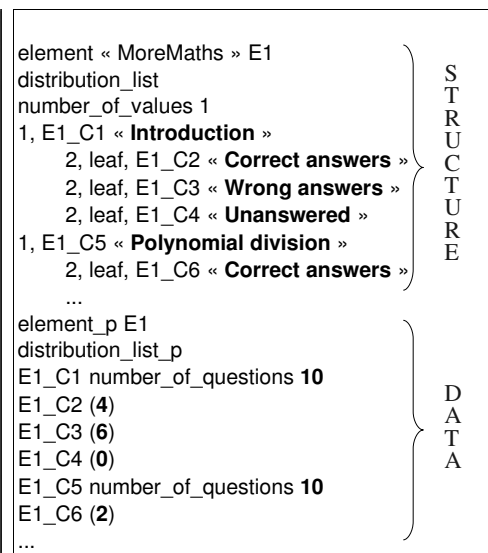


Figure 3: MoreMaths profile rewritten in PMDL

The *profiles transformation* stage consists in transforming harmonized profiles. This is required by the teacher to make his profiles compatible with his expectations

and usages. Some of the operators available at this stage operate on the data and others on the profiles structure. For example, the teacher can then filter information, concatenate two subsets of initial profiles or build a profile of a group, which is based on individualized profiles (we propose some examples of operators in [11]). These operations are performed by the teacher or the system and output a *transformed profile*, in which the *structure* and/or the *data* have been transformed.

For example, the teacher can add to the profile shown in figure 3 a part of a learner profile generated by himself dealing with polynomial knowledge (this profile must also be written according to PMDL). He can also suppress the component named “Introduction” and its related data.

Last stage of the REPro model is made of the *profiles exploitation* by the various actors. Three major exploitation scenarios emerge from literature and teachers' practice. Profile visualization is used by the teacher, the learner, the parents, the institution and scientists. The visualization can be associated with reflective activities on the profile for the learner (a topology of activities is proposed in [11]). It can be preceded by an optional preparation step, in which the teacher can adapt the visualization to the receiver. The teacher can – for example – only show a subset of his profile to the learner in order to avoid a negative perception, rephrase the information to adapt it to the receiver, choose the most appropriate representation (bar plot, progress bar...). Another possible exploitation is proposing personalized activities according to the learner profile. These activities can be digital (through the use of an ILE) or not and can be proposed by the system and/or the teacher. Finally, the last major application is to set up groups according to individual profiles. The actors can be for example the teacher in order to set up work groups, the institution to set up classes, the scientist to build statistical analyses or the system to arrange collaborative activities.

In the usual case, the exploitation of a profile is handled by the system that created it (e.g. MoreMaths, figure 2). In the case of an external profile rewritten according to a generic formalism like PMDL (e.g. MoreMaths, figure 3), its exploitation may be handled by any system that understands the formalism. Such a system can then propose various and numerous exploitations reusing external profiles.

3 Deployment of the REPro model of process

The aim of PERLEA project is to study the reuse of existing profiles by different actors of the learning situation [7]. The ILE EPROFILEA (Exploitation of PROFILES by tEachers and leArners) is developed within the framework of PERLEA project. This environment implements REPro, the model of process presented earlier.

Actors who are most concerned by this environment are teachers who have different profiles for each of their pupils and want to reuse and exploit them. But it is also interesting for various actors of the learning situation, such as learners themselves, institutions, families or scientists [7].

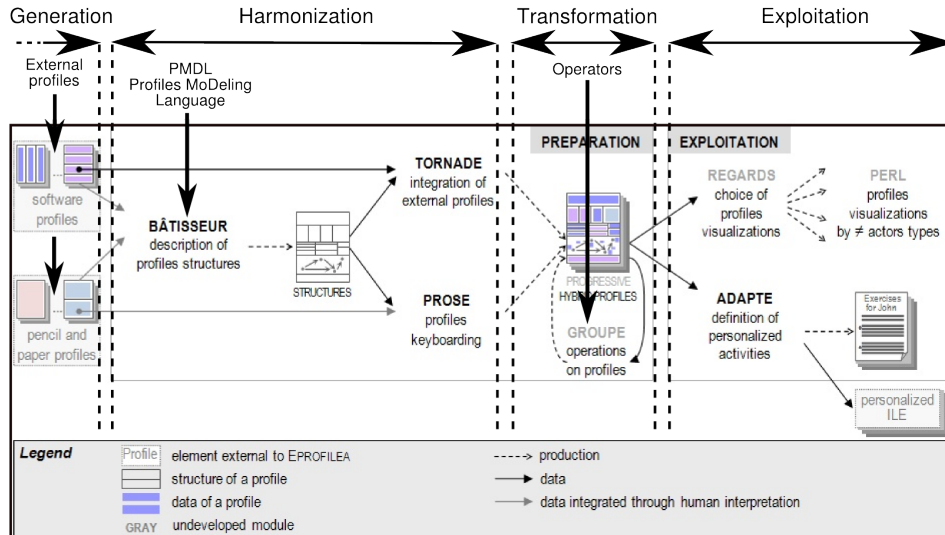


Figure 4: Deployment of the REPro model into EPROFILEA environment

The environment EPROFILEA consists of two stages, the *preparation* of the profiles and their *exploitation*. Figure 4 presents the architecture of EPROFILEA with the different elements of the REPro model.

First EPROFILEA stage brings together the REPro model *harmonization* stage and *transformation* stage. Through the *Bâtisseur* module, the teacher describes the *structure* of the *external profiles* he wants to reuse, coming from an ILE or not. This description uses the *Profiles MoDelling Language* PMDL. The integration of the learners' personal data is either automatic when data comes from an ILE – through the *Tornado* module – or manual, when data comes from a pencil and paper profile – through the *Prose* module [7]. The teacher can create hybrid profiles, in which some data come from ILEs and the other ones come from pencil and paper profiles. At the end of this stage, the teacher will be able to use some operators to transform the profiles through the *Group* module.

The second stage of EPROFILEA consists in the exploitation of the prepared personal profiles. In the REPro model, these profiles are named *harmonized profiles* or *transformed profiles*. The first exploitation available in EPROFILEA consists of the profiles visualization by the different actors of the learning situation and some activities proposed to the learners on their own profiles. Through the *Regards* module, the teacher will be able to create a view of the profile adapted to each actor – content, vocabulary, or display. The user will be able to visualize this view through the *Perl* module. The second exploitation available in EPROFILEA consists of the proposition of activities adapted to the learner profile through the *Adapte* module. The activities are generated automatically by the system according to criteria that are defined on the profiles by the teacher. These activities can consist of the configuration of an ILE according to the learner profile or of a pencil and paper activities adapted to this profile [13].

4 Evaluation

Throughout this research, we have collaborated with seven teachers, coming from primary school to university and continuing education. The aims of this collaboration are numerous: to collect learners profiles coming from teachers practices, to identify the context of the profiles use and the concerned actors, to consider teachers needs and practices in our propositions in order to be close to the reality, and finally to evaluate our propositions. For this last point, we first evaluated the understanding of the concepts of 'profile' and 'profiles structure' with all of the seven teachers. Then, we tested the use of the EPROFILEA modules with four teachers. These “partner teachers” were implicated in the design of several EPROFILEA modules and took part in their experimentation. Two of them were coming from primary school, one from junior high school and the last one from secondary school.

These experimentations consisted in semi-directive interviews without specific use of computer, except for tests of EPROFILEA modules. Most of meetings took place in research laboratory with one interviewer, who was sometimes assisted by someone in charge of taking notes. The two primary school teachers were mostly met together in order to compare their point of views. There were two types of guidelines for interviews: one for teachers practices gathering and another for software tests. First software tests meetings were devoted to presentation of EPROFILEA modules to get teachers feedback. Following meetings consisted in observing how teachers were using the software without giving them instruction.

First results are promising. First, the concepts of 'profile' and 'profiles structure' are easy to understand and to use for six teachers over seven. These teachers usually use skills frameworks. The seventh teacher – coming from secondary school – doesn't use skills frameworks or learner profiles in his practice. He needed some reminders about the concept of 'structure of profile' during the first interviews.

Nowadays, a first prototype of each EPROFILEA module has been developed, except for the Group module. During first experiments of EPROFILEA, “partner teachers” doubted whether it was possible to use such a device in their practice due to a lack of time. These doubts have been reduced throughout our meetings with them. First, the environment became more familiar for the teachers and so, easier to use and to understand the succession of the modules. Then, they compared this environment with the J'ADE software [14]. Indeed, teachers have to use J'ADE each year in primary and secondary school in France to enter the results of each of their learners. According to the teachers, the time devoted to the use of J'ADE is significant but the exploitation of this work is too poor in their practices. They were very interested by the connection between EPROFILEA and J'ADE which allows to reuse the profiles of their learners. In the opinion of these teachers, the exploitations proposed by EPROFILEA are especially rich and some of them are currently impossible to do in their classroom. According to them, this richness justifies the time required. They also insisted on the fact that they wanted to keep control on learners data. They want to choose which data to show and to who to show them. Finally, the teachers realized that a big part of the work – such as the creation of the profiles structure – is made only once for a long-term exploitation.

5 Conclusion

Many human actors and systems produce information about learning. However reusing heterogeneous data in various situations is currently difficult. The REPro model proposes a process of management and reuse of learners profiles. This model, independent of any technical framework, can be reused – partially or completely – in various contexts. At the end of this proposal, an implementation of this model in an operational environment has been proposed.

Results of first experimentations are promising but require to be completed by others. Most of the profiles used in first studies come from the community of open learner models [15]. It's necessary to experiment our work with other profiles. The environment is planned to be experimented in real situation with teachers who have not been involved in our work. This experimentation will permit to assess working and cognitive load as well as understanding of concepts by teachers. Finally, the question of using such a device by numerous teachers will be studied.

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