Edushare, a step beyond learning platforms

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Abstract. This papers presents Edushare, a web-based learning environment that has been designed for cognitive remediation applied to autistic children. While existing learning platforms integrate various services in a web-based environment, they meet limitation where specific software must be integrated. Their role is then mostly confined to hosting the external software, without deep integration. Therefore, *Edushare* a service-rich integration platform, was created. It consists in centralizing within the platform a series of services shared by many educational softwares. These services include data logging, logs visualization, media management or parameterization. As a result, software development benefits from these services and focuses on its core goal, learning activities. This approach is described with a case study concerning facial emotion recognition in autistic children.

Keywords: learning platforms, service-rich integration platforms, special education, cognitive remediation, educational technologies, learning software.

1 Introduction

1.1 Context

This research project is concerned with helping autistic children through the use of educational software. These children are part of a special education program in Geneva, Switzerland. During the day, they attend a specialized institution with only eight children, where they are followed by psychologists and educators. The children are severely autistic persons, with an I.Q. below 80.

The goal of the project is to develop training software based on *Cognitive Remediation* for the children. Cognitive remediation consists in training a specific basic skill via repeated exposition of stimuli, hypothesizing that such a remediation have a more global impact on the everyday behavior of the subject. Cognitive remediation has been used successfully with people with disabilities including ADHD [1][2], schizophrenia [3] and age related cognitive impairments [4].

Cognitive remediation is advantageously administrated via computerized exercises, which allows both a precise timing of activities and an automatic reporting of the patient activity (as far as the keyboard/mouse activity is concerned). The use of

virtual environments of learning and practicing living skills has been the central point of several projects [5][6]. Furthermore, many other benefits have been observed when autistic people get trained with computers, such as the safety and predictability of the environment or the control of the interactions (see [7] pp. 91-101).

Specific software for psychological experimentation built on top of *E-Prime* [8] for example, is used in laboratory settings. But in a real context, the deployment of such software is not easy. Therefore, the first requirement was to implement the cognitive remediation activities via Internet. In this way, there is no need to install software at each institution interested in the cognitive remediation activities.

Since several institutions in Geneva are potentially interested in implementing the activities, it is particularly relevant to allow psychologists and researchers involved in the program who are not based in the institutions to follow the progression of the children via Internet. Communication among all the actors of the project is also needed in order to better accompany each child following the program.

Furthermore, it is desirable that some parameters and data in the activities could be modifiable by non-programmers (researchers, educators, teachers, etc.), such as stimuli/media (e.g. images, sounds) used in the experiments.

These initial requirements have naturally led us to examine learning platforms, which gather several functionalities for on line teaching and learning.

1.2 What platforms do, what they do not do

Existing learning platforms, such as Moodle [9], Dokeos [10] or Claroline [11] provide various services for distance learning with the following functions [12][13][14]:

- Information exchange: page display, download and upload of any file (usually a document)
- Communication (synchronous and asynchronous): forums, chat
- Collaboration: wiki
- Management: learner management, activity management, usage logging, time management (deadlines, calendar)

Given the above initial requirements, learning platforms and content management systems (CMS) could be used in two ways:

- activities fit into an existing authoring tool. For example, if the activities only contain simple quizzes to answer, the eXe editor [15] could be used in conjunction with Moodle, because eXe products can be integrated in Moodle as a learning object. However, content management (media modification) is restricted to people who know how to use eXe tool. Furthermore, the logs retrieved from the activities would be limited to the SCORM [16] standard. Another option consists in developing a plugin for a platform such as LAMS [14], but this requires a high degree of programming expertise.
- activities constitute a separate executable file, which is downloaded from the platform, as in the *abuledu* website [17]. In that case, the activity developers have total freedom in their design, but the trace of their activity cannot be easily uploaded to other actors. The log file must be manually sent back to the platform for further processing. Furthermore, content management tools must be

developed specifically for each software, and the content management itself cannot be performed on the platform. A variant of this solution consists in using a web-based development tool, such as Adobe Flash, in which case the activity is still separate but integrated within the web browser. See as an example the *paraschool* website [18]

It results from the above analysis that existing platforms appear insufficient to both:

– host activities that go beyond simple e-learning functions, that is beyond material presentation and quizzes,
– allow various actors to "get inside" these activities, either in terms of content management or data log processing.

Therefore, we chose to overcome these limitations by developing our own learning environment, that we named *Edushare*.

1.3 The concept of a "service-rich integration platform"

In order to combine the ease of use of classical e-learning platform in terms of course preparation and the richness of a specific software development, a different concept of platform needs to be invented.

This new concept is illustrated in Fig. 1. While a platform, as its name suggests, hosts autonomous complete software for activities (as an independent file), the idea is to host partial software, which reuses standard services provided by the platform. Typically, all cognitive remediation exercises need media (content), that should not be hard-coded into the software. Developing a content management interface is always a time consuming task, which is remote from the core role of the software, namely the pedagogical/educational components. It is proposed that the software delegate the content management to the platform. Similarly, other common functionalities lie inside the platform (see Section 2).

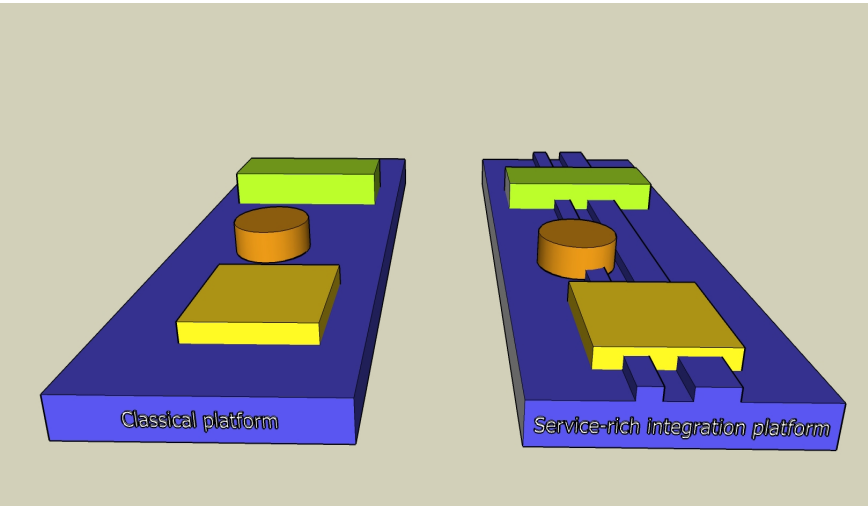

Fig. 1: General principle of Edushare. Instead of hosting fully autonomous external software (left), the new platform contains some services, represented by rails, which complete the external software (right).

Technically, each module is developed in a development language chosen according to the specific needs of the exercises and the expertise of the development team. It can be Flash, Java, Authorware, provided that the two following conditions are met:

– the software produced by the language/tool can be played on a browser (possibly with a plugin),
– the software can connect to a MySql database, either directly or by calling php functions.

Within the software, developed in a suitable language, calls to the database allow to access to the various services provided to the software. Platform's services consist in recurrent components in educational software that are not specific to the learning task. Most of these services (detailed below) benefit from the networking characteristics of the platform.

Edushare can be called a “service-rich integration platform”, even if, in a way, it is no longer a platform, since it does not only *host* documents and exercises but provides them with common *services* that would otherwise be part of the software. At the same time, the goal is not to impose a specific language or tool, for the development itself, beside the conditions mentioned above. It is interesting to compare Edushare with the Educlasse website [19], which enables advanced integration features such as media management or logging of learning activities, but does not provide the means for an independent developer to add a new exercises in the website.

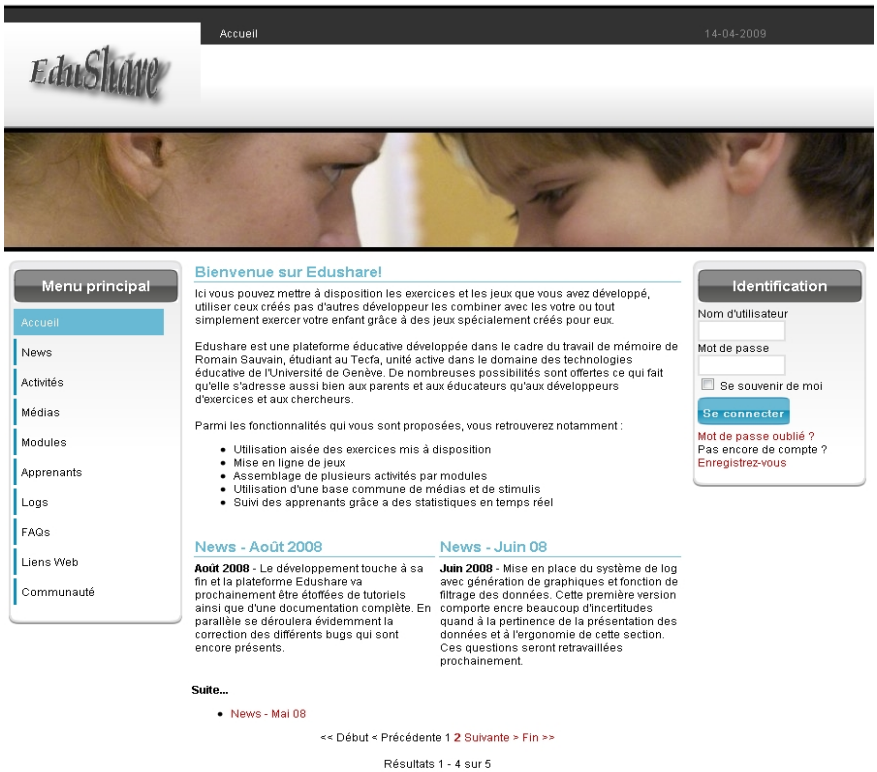

Fig. 2: Overview of the home page of the "Edushare" environment

Note that while Edushare is devoted to special education and autism treatment via cognitive remediation, it can be used for various educational needs.

2. Functionalities

Before listing the functionalities implemented within Edushare, it is relevant to identify the various roles related to the use of such an environment. In our context, 5 roles can be distinguished:

- Learners: they are the final users, faced with the educational content. In our case, they are the autistic children. A particularity of Edushare, compared to classical platforms, is that these users do not directly log in (see below).
- Accompaniers: They are the people next to the student, who are responsible for the proper execution of the learning session. They log in the platform and specify the identity of the learner. They might contribute to the session actively, either during the exercises or after, for reporting. Accompanier could be educators, psychologist, or members of the family.
- Program director: It is the person who is in charge of the learners and is responsible of their progress. She/He knows the learners outside of the computer-based learning program.
- Developers: They are the people who create new exercises. They should be proficient in the development language or authoring tool they decide to use.
- Distant analysts: They are interested in analyzing the efficiency of the exercises. Typically, psychologists who prescribed the exercises are interested in evaluating them, in terms of learner's progresses, time of usage, etc. Researchers in cognitive remediation also play this role, as they want to gather data to evaluate statically the effect of the activities.

These different roles correspond various functionalities that have been implemented within Edushare:

For the learner:

- Execution of the activities for learning and remediation. During the execution, detailed logs are stored.

For the Accompanier:

- Login and learners management: As in any platform, it is possible to create accounts for each user of the environment. Specific admin accounts are created for this purpose. More specific to Edushare is the possibility to create for each learner an identity, that is automatically attached to the corresponding logs. This identity does not correspond to a login account, since learners are not autonomous.
- Comments writing: The accompanier (as well as other actors other than the learners) can attach comments to a learning session. This allows in particular the accompanier to provide information that is more qualitative regarding the performance and related to the global context of the learner. It includes the attitude of the learner, the progress (or regression) perceived by the accompanier, information on activities outside Edushare, etc.

For the program director:

- Modules and activities management: The atomic exercise in Edushare is an *activity*. Activities are stored within Edushare and can be combined together to build *modules*. Furthermore, several modes of sequencing are proposed: fixed sequencing of activities or free sequencing (order chosen during interaction). This parametrization is performed on the platform by the person who wants to build a specific learning/training program. This allows some flexibility in the design of a specific course.
- Content Management: A main originality of Edushare is that the media are not stored and managed within the exercises but in the database included in the platform. In this way, the program director can upload new media or assets (pictures, images, sounds etc.) and assign them to activities. Note that one asset can be shared by several activities. Content management allows an activity to be modified/customized by non technical people.
- Parametrization: variables are attached to activities and media. They can be modified outside the software, on the platform. As for content management, this allows more flexibility for non programmers. Note that parametrization and Content Management have been implemented with generic educational games [20], to enable teachers to make their own games.
- Off line communication: a simple forum has been added to the platform, to organize the communication between the program director, the accompaniers, the analysts.

For developers:

- Development: This activity is performed outside the platform. This strong choice gives developers a maximum of freedom, rather than forcing them into a specific language or approach. However, this freedom is limited by two constraints: (1) use an appropriate development language, (2) use specific functions for accessing Edushare's functionalities: data logging, media storage and parameterizable variables.

For distant analyzers:

- Log visualization: This allows to produce visual logs of the learners activity: It is detailed in Section 4.
- Log export: For statistical analysis, it makes more sense to export raw logs, and use specialized software such as SPSS or Statistica.

3. Technical development and architecture

Edushare is a Web-based platform and is built with the most popular technologies currently used on the Internet. Php 5 is in the center of the technical development with Html, the predominant markup language for Web pages. In addition to these core technologies, we find other standards such as : CSS (Cascading Style Sheets) to provide more flexibility and control in the specification of presentation characteristics; Javascript, scripting language used for the development of dynamic, real-time functionalities; Ajax (Asynchronous Javascript and XML) that allows to retrieve data from the server asynchronously in the background without interfering

with the display and behavior of the existing page; as well as MySql, the relational database management system used to store all the data.

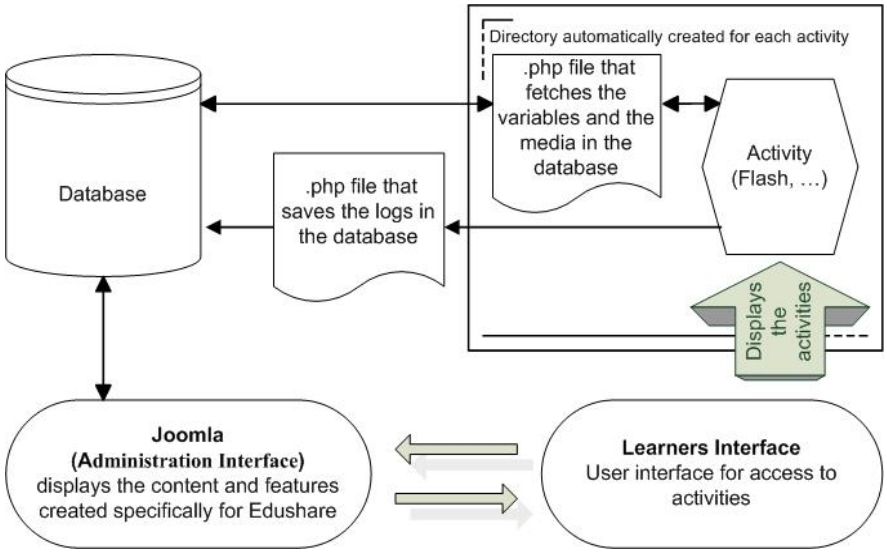

Fig. 3: General outline of the organization of the platform

Depending on the type of user visiting Edushare, two distinct parts are available (Fig. 3). Specially designed for learners, a simplified interface allows them to select and execute the existing exercises easily. We name this side of the platform the "Learner Interface". The extreme simplicity of the design is important to avoid any source of distraction during the execution of activities, especially for learners who have difficulties such as autistic children.

The other side is much more complete and includes most functionalities. This "administration interface" is built with Joomla [21], an Open Source content management system, and offers users like developers, educators and psychologist to upload new activities, change the images and medias used in the exercises or monitor the progress of learners.

Several data models have been established in order to maximize the flexibility of the tool. Activities, medias, modules and learners are the entities in the database offered by Edushare to advanced users.

The "activity" entity is the one used to create a new exercise and upload / modify the needed files. As shown in Fig. 3, each time a new exercise is uploaded on Edushare, a new directory is created to store the needed files. The platform automatically proposes the newly created activity in the list of all available activities and allows learners to directly access to it.

Furthermore, with the "media" entity, Edushare proposes a complete system to manage the data used in the exercises. A *.php* file interacts with the database to get those information and transmits them to the current activity. This system allows to manage directly on the platform which images or texts will be used in the exercise

without any modification of the exercise files. An educator, for example, will be able to adapt a stimulus for a child without knowing anything about programming and without modifying the files of the exercise.

The purpose of the "module" entity is to combine several activities. One module contains one or more activities that can be displayed either as a unordered pack of activities or as a sequence of activities. In the latter case, each activity is assigned with a rank by the user (see Fig. 4). For example, this feature allows a psychologist to propose sessions with a steady progression. Finally, the "learner" entity is necessary to follow the evolution of the learners on the platform.

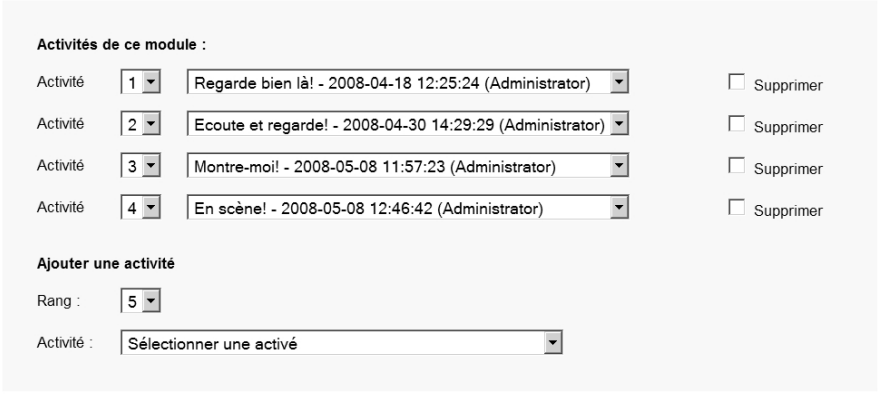

Fig. 4: Management of the sequencing of activities within a module

As a final point on the technical side, the opportunity to make comments should be described. From both interfaces, users can write comments about a learner, an activity or a module at any time. These comments will appear on the management section of the entity, but also directly on the home page of the administration interface for each person involved with the entity in question. For example, the user who created an activity will see the comment saying "This exercise has been appreciated by the learner but could offer several levels of difficulty" and can reply directly by writing another comment.

This technical overview highlights the fact that Edushare is more than a simple platform where you can only host exercises. We would like to further illustrate this point by describing in detail one of the main feature of Edushare, the ability to manage logs.

4. Log management

As presented before, an important feature offered by Edushare is a complete management of logs. When a learner executes an exercise, "session" logs are automatically saved in the database. Information such as the current learner, the date and time, the module and the activity are stored. In addition to these general data, the activity creators can include a simple call to a *.php* file that will save any desired variables and link them directly with the session logs. The following programming

example works for an exercise created with Macromedia Flash 8 and stores two variables: the correct answer and the execution time of the activity.

```
loadVariablesNum("../../scripts/logs.php?correct_answer
="+correct_answer_value+"&execution_time="+execution_ti
me_value, 0, "POST");
```

This call to the *logs.php* file must be sent each time a learner gives an answer or finishes an exercise. Of course there is no limit to the number of variables saved as logs, but we consider that a small selection of pertinent data is better than a large amount of useless information in which it will be difficult to make a precise analysis.

Beyond the mere storing of this information, Edushare offers the possibility to extract and view them. For this purpose, a complete section of the platform is dedicated to data analysis. An extensive study was conducted during the creation of the platform to propose an optimized tool to the user. Indeed, user accesses pre-processed data that are more relevant than raw data.

A form allows selecting precisely the desired logs with parameters such as learners, modules, activities, variables, dates or sessions. After the validation of these settings, a new window appears containing the results of the query. A table containing all the data as well as a button to export them as *.xls* file are present, but Edushare offers directly basic analysis without using an external tool.

Depending on the type and amount of data to display, different visualization modes are offered. In case of multiple variables, a time line is generated and shows only the repartition of the sessions for each learner. Figure 5 brings out the sessions made by three learners during one month.

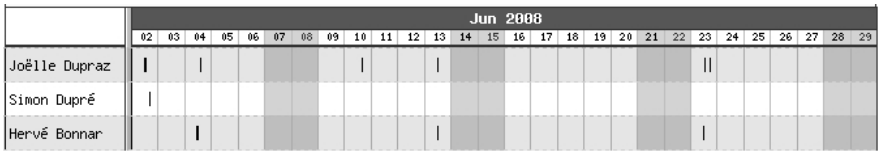

Fig. 5: Example of time table generated for a multiple variable analysis. Each vertical bar indicates that a session has occurred.

In case of a single variable, a table and a graph are generated in real time. They display the first analysis for the data (Fig. 6). If the variable is a numeric one, the mean value and the distribution are calculated automatically for each learner and are presented in the table. The graph that accompanies the table is very useful since it allows to visualize quickly the evolution of the learners over the multiple trainings and tests they have performed.

Joëlle Dupraz	Mean = 2.2	0.9 = 16.7% / 1 = 16.7% / 2.5 = 16.7% / 3 = 16.7% / 6 = 16.7%
Simon Dupré	Mean = 1	0.7 = 33.3% / 1.3 = 33.3% / 1 = 33.3%
Hervé Bonnar	Mean = 2.8	1.2 = 16.7% / 2.5 = 33.3% / 2.9 = 16.7% / 3.7 = 16.7% / 4 = 16.7%

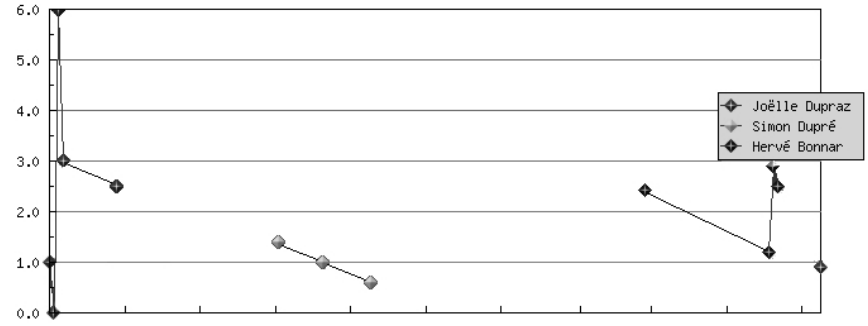

Fig. 6: Example of table and graph generated for a numeric single variable analysis

The last possible case, corresponding to a single non-numeric variable, generates a table containing the distribution of the values for each learner and a bar graph that visually represents this distribution (Fig. 7).

Joëlle Dupraz	colère = 66.7% / peur = 33.3%
Simon Dupré	colère = 33.3% / peur = 66.7%
Hervé Bonnar	colère = 33.3% / joie = 16.7% / peur = 50%

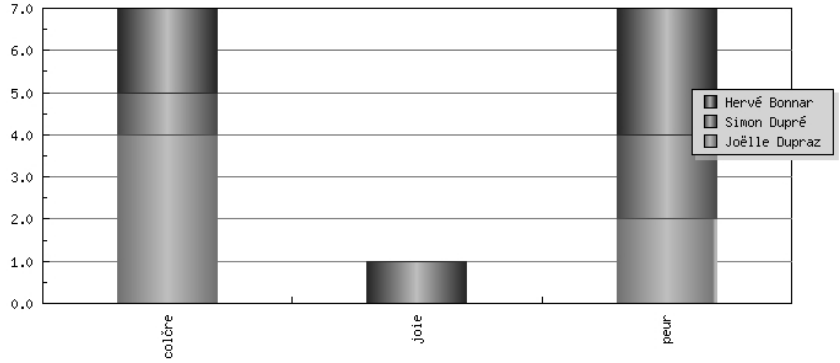

Fig. 7: Example of table and graph generated for a non-numeric single variable analysis

Only after this first step, for checking the quality of data, should the user use external tools to perform further analysis. We think that getting a quick overview of the logs will gain time and will be appreciated by users.

5. Example: Facial emotion recognition

As stated in introduction, Edushare was designed in the context of cognitive remediation for autistic children. The first phase of the project focused on the content hosted and managed by Edushare. This content consists in educational software for people with learning difficulties. In this framework, a software called "*Remédion*" was created, a Macromedia Flash program connected to a MySql database for media management. The purpose of this application was to exercise autistic children in order to improve their recognition of facial emotions. In collaboration with the *Service Médico-Pédagogique* of Geneva (SMP), medicinal and psychological research center, and the *Centre des Amandiers* (CA), center for diseased children, we have been able to study the kind of exercises suitable for those children and how these activities should be presented. Tests were then conducted and the positive feedback of educators on the children's behavior with *Remédion* allowed us to proceed to following step: the Edushare platform itself. Starting from this software, we had to create a platform to host it, to offer the management of the medias used by the exercises and to log the results, as seen in chapters 2 to 4.

The platform is now fully functional and it hosts the *Remédion* software, a module that contains four distinct activities. The testing of this module within the full version of Edushare is underway. In parallel, another module has been implemented (for memory training) and partially integrated within Edushare.

In the following paragraphs, we will outline a few possible routes for users of the platform who are researcher from SMP, educators from CA and the autistic children.

For a full access to different topics and to take full advantage of features offered by Edushare, it is necessary to get logged in. Users, researchers and educators but not the children, need an account in order to have the basic rights. It is necessary to complete the provided form to register and to use the link in the e-mail automatically sent by the platform to confirm the registration. Once registered, many options offered by the platform are available.

One of the common use of the platform for an accompanying person is to record learners they are in charge of and help them practicing with activities. For that, the educator starts by creating a new entity in the "Learners" topic of the administration part for the child to whom he wants to propose exercises. Once this first stage is completed, he should go to the learner interface dedicated to the use of activities, which proposes various modules currently available in the platform. The educator selects "Remedion" in the list of existing modules. This module is made of four cognitive remediation activities dedicated to facial emotion recognition (Fig. 8). He will now let the child try the exercises itself, while providing assistance and support as the children received by the center are severe autistic children and are not autonomous.

At any moment during the training, the educator can make a comment about the current module, activity or learner simply by clicking on the corresponding button located on the top left corner. This whole process is described in Fig. 9.

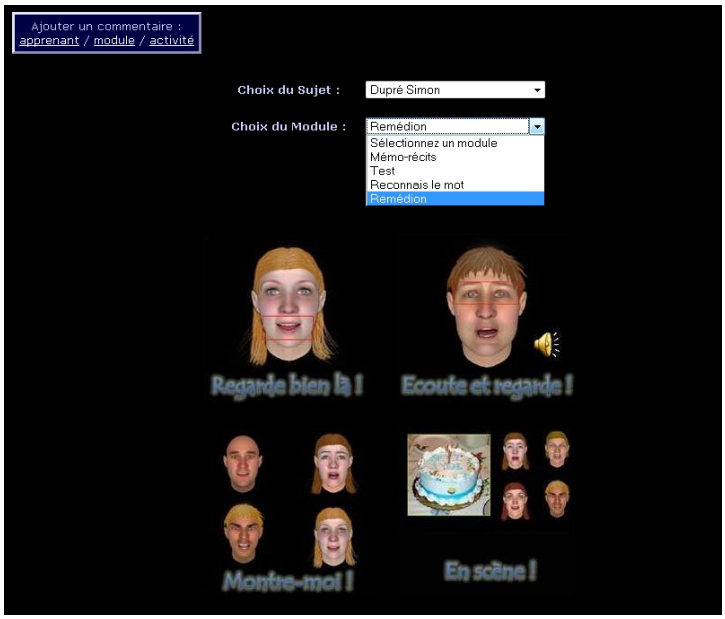

Fig. 8: Selecting the facial emotion recognition module (Remedion)

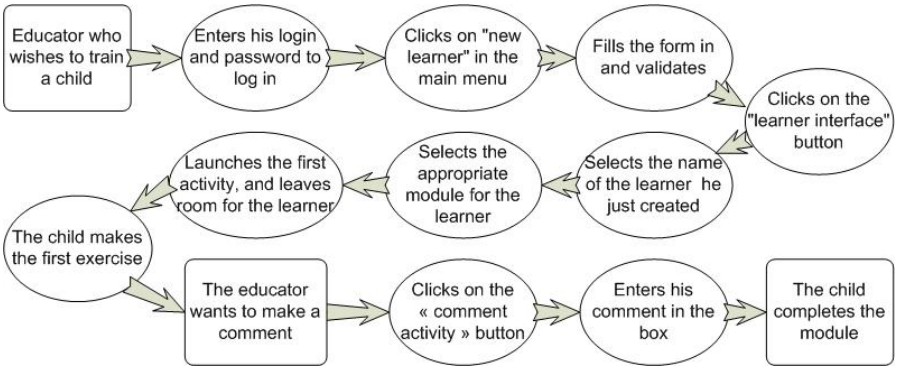

Fig. 9: Steps for creating a new learner and starting the activities with him

Logs have been automatically generated during the use of the activities by the child. Let us consider the case of a psychological researcher of SMP who wishes to examine them in order to monitor the progress of a child. After logging in, he will go to the section dedicated to the extraction and visualization of logs and select the options corresponding to the logs he wants to extract. The first possible parameter will certainly be the name of the specific child he wants to follow. Then he can be interested in choosing an activity built for a special purpose (Fig. 11), like *Remédion* for facial recognition. Defining a start and end date could be relevant too, in order to view the results starting from the last check (Fig. 12). Having validated the selection,

the results window opens, showing precisely the logs for this child, following one activity between the selected dates. The diagram below (Fig. 10) details each step in order to select and visualize logs using the platform's user interface.

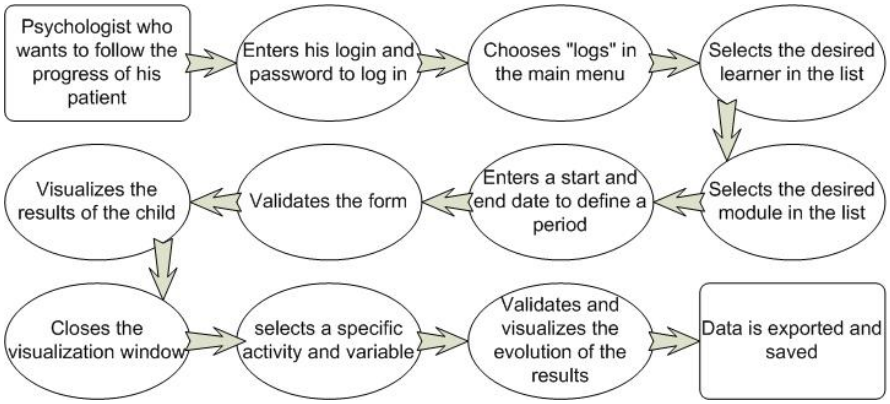

Fig. 10: Steps for selecting and visualizing logs

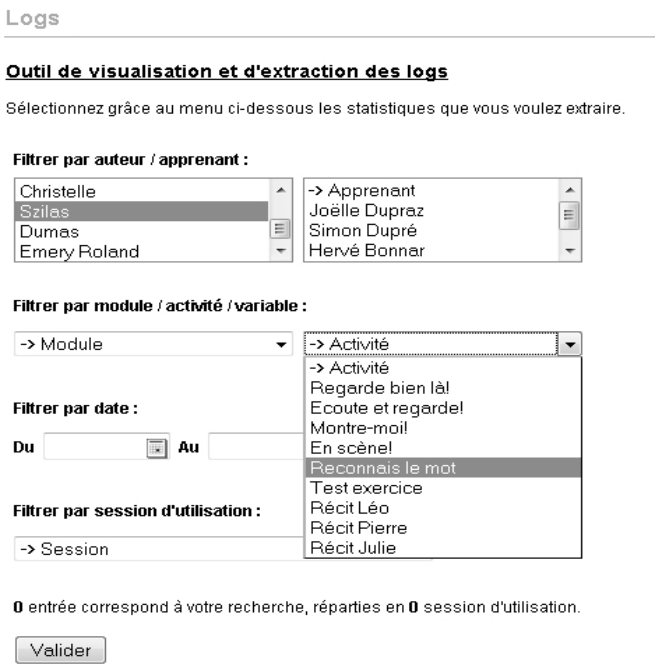

Fig. 11: Overview of the logs form, selection of an activity

The use of Edushare within this context was appreciated by educators and cognitive remediation researchers, particularly the ability to change the media and

log comments. But a full experiment with the platform is still to be performed to systematically assess its strengths and weaknesses.

6 Conclusion and future work

We have proposed a novel approach for combining the flexibility of specific educational software development with the advantages of learning platforms in terms of integration and communication. In the current implementation, services performed by the platform include user management, data logging management, media management and simple parameterization.

Among these services, much effort has been put on data logging because it moves educational software towards more openness. Indeed, if laboratory initiated cognitive remediation activities obviously logs the learner activity, it is far from being the case for other educational software. Typically, learning and edutainment products are usually designed as "black boxes": the learner uses them but the other actors – the parents, the teachers – have a quite limited feedback on what has happened, beyond the mere percentage of completion of the software. We believe that this closeness is one of the reasons for their limited usage. Adapting such software to be used within a service-rich integration platform such as Edushare should increase the usage of the software.

Other services could be developed to help integration and openness of educational software. We will mention here two of them. Firstly, in case of a complex software (for example a learning game), it is not easy for the potential user (a teacher) to get a clear view on the content of the software, in terms of both general learning goals and specific pedagogical strategies used within the software. We are considering adding this feature to the platform, that is letting the possibility for a software developer to make a "detailed overview" of his/her product, without executing the whole product, similar to the walkthrough available (often via "cheat codes") in some video games. Secondly, the current parameterization capability offered by the platform is limited to modifying variables. We would like to extend this to advanced parameterization interfaces that would allow a non programmer to gain more authorial control of the final educational activity. The platform would make available templates of parameterization graphical user interfaces that could be used by developers to make their product more visible.

Given its current and future possibilities, it appears that Edushare and its underlying approach, initially designed for special education and cognitive remediation, could be of interest for a much wider population, in terms of both learners and trainers.

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