Data Model and Smartphone App in an Observational Research Social Network

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Abstract: Children observation is a time consuming and complex process that involves time and knowledge. However, when performed adequately, it is fundamental for both child and professionals development, allowing a sound basis for reflection and action around learning experiences and teaching environments. Following specific guidelines and programs can help the teachers reduce inherent subjectivity. The EEL/DQP was developed to evaluate and improve quality in preschool education. This program is enhanced by using a rigorous observation process of children and adults. In this paper we propose an unified data model to structure the information from the thirteen steps of the EEL/DQP. Moreover, we also describe a smartphone application to assist the observer, recording notes, sound, photos and video.

1 INTRODUCTION

Children observation is a time consuming and complex process that involves time and knowledge. However, it provides a valuable tool to support both child and professionals development, allowing a sound basis for reflection and action around learning experiences and teaching environments (Belfield et al., 2006; Schweinhart and Weikart, 1997).

There are several programs in which observations are used to assess children physical, emotional, social, and intellectual development. Well-planned observations can give us important information about specific areas, such as social interaction, learning experiences, space management and creations, and others. Observation can also help to better understand how different areas of development are interrelated, as well as helping recognizing what behaviors are typical of various age groups. In turn, this understanding will help the teacher to improve as a person and as a professional.

Specific and well-known guidelines allows the teacher to be more focused in the observation and to make more objective interpretations. Some initiatives and projects that provide such guidelines have been implemented, such as Effective Early Learning (EEL) (Bertram and Pascal, 2004), known in Portugal under the designation *Desenvolvendo Qualidade em Parceria* – DQP (Bertram and Pascal, 2009). These initiatives define a systematic and rigorous four stage process of Evaluation and Development Framework (Pascal et al., 1997).

This four staged framework includes the Evaluation of Quality of early learning, followed by Action Planning. In this step, priorities are identified and an action plan is generated. The Development phase follows, during which the quality improvement action plan is implemented and, finally, the Reflection phase, focusing on reviewing the impact of the former.

In this paper we propose using a smartphone based application to record the observation materials directly in the device. The application is already implemented and fully working, according to the following sections. This allows recording videos, photos and sounds, with the possibility of exporting to a specific social network for observational research (Lopes and Mesquita-Pires, 2014). This online, web-based, regulated community, provides a central and secure repository of observation data, results and annotations that, together with the smartphone application, mediates communication between participants and maintains a memory of observational data.

The next section describes the observation process as described in the EEL/DQP initiative. It proceeds with the design of the smartphone application, namely the user interface, data model and user input approach, in section 3. Section 4 closes the paper with some conclusions.

2 EVALUATION PROCESS IN EEL/DQP

The evaluation of quality of early learning in the scope of EEL/DQP requires obtaining a considerable amount of data through several techniques, including detailed observations of children and adults, interviewing parents, practitioners and children, documentary analysis and others. This complex and somewhat subjective process requires well-trained teachers and researchers. In particular, the EEL/DQP initiative defines a four phase/thirteen steps procedure, comprising:

1. Evaluation

 1.1. Initial preparation

 1.2. Initial data gathering

 1.3. Interviews

 1.4. Child Tracking Observation Schedule

 1.5. Child Involvement Scale

 1.6. Adult Engagement Scale

 1.7. Development of evaluation report

2. Action planning

 2.1. Development of the action plan

3. Development

 3.1. Document and support the implementation of the action plan

 3.2. Child Involvement Scale, following the same procedure from 1.5

 3.3. Adult Engagement Scale, following the same procedure from 1.6

4. Reflection

 4.1. Reflection on the impact of the plan in the future

 4.2. Final report

Data is gathered and systematically organized in research portfolios, that will be used in a cyclic process of thinking-do-thinking to research and create change (Mesquita-Pires, 2012). This process is enhanced by the utilization of observation techniques which measure the effectiveness of the learning and teaching processes, such as the Child Tracking Observation Schedule (step 1.4), to gain a snapshot of the childs day and providing information of learning experiences (Bertram and Pascal, 2006), the Child Involvement Scale (step 1.5), an observation technique which measures the level of a childs involvement in an activity, the Adult Engagement Scale (step 1.6), to evaluate the interaction between the practitioner and the child (Laevers, 1994).

2.1 EEL/DQP Procedure

The EEL/DQP overall procedure follows the four phases described above. It starts by an initial orientation of the work to be performed, in which all the process is prepared and all the participants informed in detail. Initial data gathering follows, where the institution is characterized, including the interior and exterior spaces, its education philosophy, the different learning activities, and others.

The third step includes performing interviews with the dean, staff (about 50 %), children (20%), and parents (20%). It is very important that all the stakeholders are well informed and have a full understanding of the process. The teacher records the interviews and take notes of key phrases, to support the written report. In the end, access to interview transcripts must be given to participants.

2.1.1 Child Tracking Observation Schedule

The fourth step requires an observation process, using the Child Tracking Observation Schedule (CTOS), with the main purpose of understanding the child's daily routine. This technique gives information about the learning experiences, the level of choice, child involvement, the group organization and interaction with adults.

In broad terms, this step starts by choosing a set of children, considering gender, ethnicity, age, and others. Each child is observed two sets of two times, with each session in a different day. In other words, each child is observed four times, where each observation should not last longer than 5 minutes. The details are registered in a specific form (Figure 1).

2.1.2 Child Involvement Scale

The Child Involvement Scale (CIS) seeks to understand the learning outcomes and the underlying processes. Essentially, it gathers information about the participation in activities and projects, thus giving indicators of concentration and motivation as well as of satisfaction.

High levels of motivation reveals that the children are truly interested and driven to engage in the activity. The impressions and experiences obtained by a motivated child are very strong, assuming an influence that will not occur otherwise. High level of involvement also results in a high level of satisfaction. Children spontaneously take initiatives to get into this particular state. This is also achieved through the interest that the children have to discover or explore.

The concept of involvement refers to the human quality (visible in children and adults) characterized

Project: Effective Early Learning/Desenvolvendo a Qualidade em Parceria
Child Tracking Observation Schedule

School: _____ Observer: _____
Date: _____ Child: _____ Sex: _____ Age: _____

Schedule description – 5m each (M) Morning / (A) Afternoon Time: _____ Total Children: _____ Present children: _____ Total adults: _____	Initiative	Group	Interaction	Involvement level	Learning experiences
	1	GG	CA<-->A CA<-->C CA<-->GC	1	FPS
					EP
	2	PG	CA->A CA->C CA->GC	2	ED
					EMus
	3	P		3	LiNG
			A->CA C->CA GC->CA		MAT
	4	I		4	CM
			->CA<- CA	5	EMot

Figure 1: Child Tracking Observation Schedule.

by intense involvement in activities, being considered as a necessary condition to carry out a deeper level of learning and development (Laevers, 2005). Involvement contributes for a deeper way to learn. When lacking, chances are that the children development will stagnate, and all the actors in the education process should do everything in order to create an environment in which children can engage in a wide variety of activities.

Under the EEL/DQP this step requires to select 50% of the 3, 4 and 5 years old up to a maximum of 12 children. Each child is observed three times, with each session in a different day. In other words, each child is observed in a total of six times, where each observation should not last longer than 2 minutes. The details are registered in a specific form (Figure 2).

Project: Effective Early Learning/Desenvolvendo a Qualidade em Parceria
Child Involvement Scale

School: _____
Observer: _____
Date: _____ SED: _____
Child: _____ Sex: _____ Age: _____
Total Children: _____ Total Adults: _____

2m periods	Involvement Level					Learning Experiences							
	5	4	3	2	1	FPS	EM	ED	EP	Emus	LAE	MAT	CM
Time													

Figure 2: Child Involvement Scale.

2.1.3 Adult Engagement Scale

The Adult Engagement Scale (AES) evaluates the interaction between the practitioner and the child (Laev-

ers, 1994). It targets the effectiveness of the teaching-learning process through observation of adult-child interaction. The quality of the adult's intervention is a critical factor for the child's knowledge building.

Up to a maximum of 5 adults should be observed, paying special attention to the sensibility, stimulation and autonomy categories. Each adult is observed twice, with each session in a different day. Each session should include five observations of 2 minutes each, in a total of 10 minutes. In other words, each adult is observed four times, 40 minutes total. The details are registered in a specific form (Figure 3).

Project: Effective Early Learning/Desenvolvendo a Qualidade em Parceria
Adult Engagement Scale

School: _____
Observer: _____
Date: _____
Adult _____ Sex: ____
Total Children: _____ Total SED: _____ Total Adults: _____

2m periods	Points					
Time	5	4	3	2	1	ND
Sensibility						
Stimulation						
Autonomy						

Figure 3: Adult Engagement Scale.

The observation process is translated into an evaluation report, to be used in the following (2-4) phases.

2.2 Challenges

The EEL/DQP process is heavily structured around paper based forms and reports. In this approach, many details are usually over summarized or even lost. This also prevents broader studies from being made, such as inter-school or inter-country assess-

ment, unless the notes and observation portfolios are physically shared.

In this paper we propose the design and development of an online, web-based, regulated community, providing a central and secure repository of observation data, results and annotations. This service allows each teacher to manage each observation process, sharing information with authorized colleagues and improving their experience and knowledge. It is complemented with the tools to generate PDF reports and spreadsheet either for individual as for collective studies.

We also propose using a smartphone based application to record the observation materials directly in the device. This allows storing a portfolio of observations in a single device, as well as recording videos, photos and sounds together with written annotations.

3 SMARTPHONE APPLICATION

Smartphones present a set of restrictions that are necessary to consider when developing applications for these kind of devices. Although processing power, battery and memory are potentially limiting issues, the most important aspect to consider is, probably, the display size. It is used both to present information to the user and to collect input from him. This characteristic influences the user interface, designed around sequences of pages, switched (or flipped) according to the context.

In the previous section we presented an overview of the process for quality enhancement in preschool education, comprising several paper-based forms and specific observation techniques. The form occupies all the available paper space, allowing the observer to immediately see the whole picture. If the data grows, it is necessary to move to an additional sheet of paper. Moreover, each observation is registered in an individual sheet, being necessary to organize and archive all the sheets in a portfolio.

Another limitation of the paper based form is that it does not allow to record photos, sounds or other media, requiring additional tools, such as video-camera or digital sound recorder. The process also requires that the observer pay rigorous attention to the time through a stop watch, for example (Mesquita-Pires and Lopes, 2013; Mesquita and Lopes, 2013).

3.1 User Interface

The design of the user interface has to incorporate all these aspects, in a small touch screen. Each form is accessible through a tabbed panel, allowing switching between forms with a single touch (Figure 4). The main panel allows the user to switch to the Child Tracking Observation Schedule (CTOS), the Adult Engagement Scale (AES), the Child Involvement Scale (CIS), and the synchronization tool (Sync).
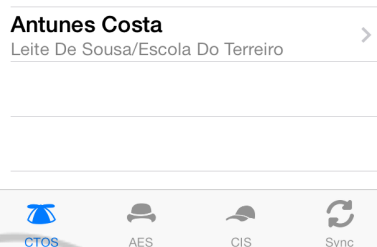

Figure 4: Tabbed panel, allowing access to other forms.

In each form, the master-detail interface paradigm is used to present a tree of contexts and associated data. This allows organizing all the portfolios and observations in a drill-down navigation model, in a comfortable to use approach (Figure 5).
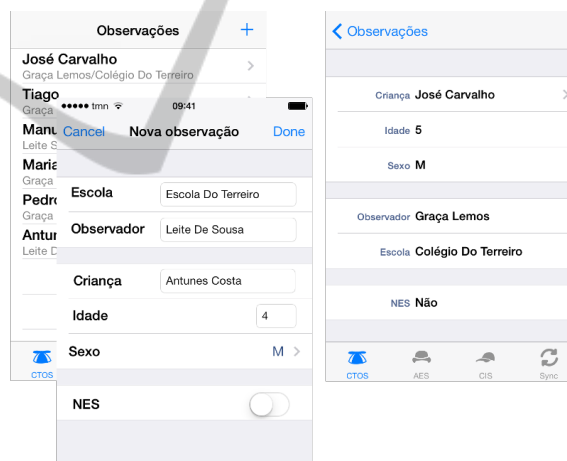

Figure 5: Observation views: listing, adding and details.

The user creates a child's portfolio by touching the '+' button, in the screen's upper right corner. A new view is shown to allow entering the observation details. Each entry in the main list shows the child's name, in bold, and, below, the observer's and institution's name. Touching an element in this list, will push a new view with the remaining details. Touching the child's name, will advance to the sessions section. The same paradigm is used throughout the application.

Just as in the previous case, the main view presents the list of sessions, identified by the date. Below the date, the number of children adults is shown (Figure 6).
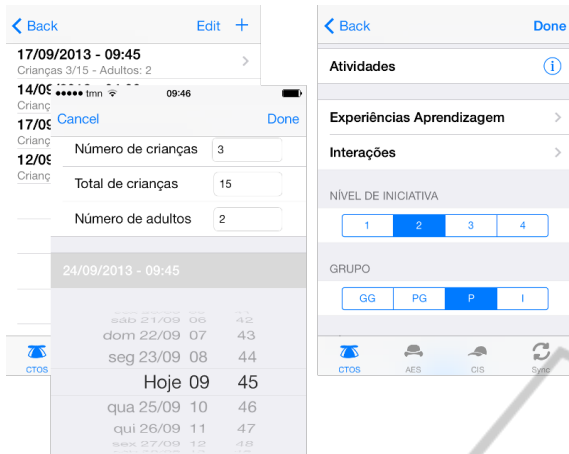
Figure 6: Session views: listing, adding and details.

By touching the '+' button, the user will be able to create new sessions. When selecting a session from the list, the view is replaced by the session details, to allow entering the related information. The initiative level, the predominant group and the involvement level is entered by selecting the corresponding button. The interactions and learning experiences will present a new view to the user where he will be able to select from a list of choices.

3.2 Data Model

As mentioned above, the observation process in the EEL/DQP project is implemented in three procedures: the Child Tracking Observation Schedule, the Child Involvement Scale and the Adult Engagement Scale. Each observation detail are registered in paper based forms (Figure 1, 2 and 3).

The CTOS form starts by identifying the institution and the observer name, the date, time, and the child's name, sex and age. In addition it also records the number of children and adults present during the session. It also registers the child's level of initiative (1 to 4), learning experiences, predominant group, involvement (1 to 5) and interaction, either verbal or non-verbal (Table 1).

There are four levels of child's initiative:

Level 1. No possibility of choice is given to the child performing the activity

Level 2. A limited number of possibilities of choice is offered to the child

Level 3. Some activities are not allowed to be chosen by the child

Level 4. The child has total freedom of choice

Table 1: Child Tracking Observation Schedule interaction.

CA $\longleftrightarrow$ A	Balanced interaction between target child and adult
CA $\longleftrightarrow$ C	Balanced interaction between target child and child
CA $\rightarrow$ A	Target child interacts with adult
CA $\rightarrow$ C	Target child interacts with child
CA $\rightarrow$ GC	Target child interacts with group of children
A $\rightarrow$ CA	Adult interacts with target child
C $\rightarrow$ CA	Child interacts with target child
$\rightarrow$ CA $\leftarrow$	Target child talks to himself
CA	No interaction
GC $\rightarrow$ CA	Group of children interacts with target child
CA $\longleftrightarrow$ GC	Balanced interaction between target child and group of children

The predominant group situation is registered as follows: Large Group (GG), Small Group (PG), Pair (P), Individual (I). Learning experiences fall under: Personal and Social Education (FPS), Physical Expression (EMot), Representation and Dramatical Expression (ED), Artistic Expression (EP), Musical Expression (EMus), Oral Language and Approach to Writing (LING), Mathematics (MAT), Knowledge of the World (CM).

Children involvement follows five levels:

Level 1. Absence of activity

Level 2. Activity frequently interrupted

Level 3. Activity almost continuous

Level 4. Activity with intense moments

Level 5. Maintained intense activity

The CIS form uses the same values from the involvement level and the learning experiences, changing the way the observations are made. This allows us to simplify the data model, by reusing the same entities defined for the CTOS module.

The Adult Engagement Scale has a different header as well as focus. It defines three sub-scales, measured from 1 to 5:

Sensibility: the attention and care the adult demonstrates towards the feelings and enotional well being of the child. It also considers the honesty, empathy and affection;

Stimulation: the way as the adult fulfills the learning process and the content of the intervention;

Authonomy: the degree of freedom the adult concedes the child to experiment, judge, choose learning activities and express ideas and opinions.

Using the paper based forms as a starting point, all fields are collected and corresponding data types identified (Table 2). The fields from the CIS form is clearly a subset of the CTOS form, allowing some simplification to the data model. On the other hand, the AES form introduces different fields, that must be considered.

Table 2: Data fields and corresponding data type.

Data Type	Field Name	Forms		
		CTOS	CIS	AES
String	school	X	X	X
String	observer	X	X	X
Date	date	X	X	X
String	childName	X	X	
Number	childAge	X	X	
String	childSex	X	X	
Boolean	nes	X	X	
Number	nChildren	X		
Number	nTotalAdults	X	X	X
Number	nTotalChildren	X	X	X
Number	involvementLevel	X	X	
Number	initiativeZone	X		
String[]	learningExperiences	X	X	
String	group	X		
String[]	interaction	X		
String	adultName			X
String	adultSex			X
Number	nTotalNes			X
Number	sensibilityLevel			X
Number	stimulationLevel			X
Number	autonomyLevel			X

In complement to the information from the paper-based forms, we also want to record different media, such as text, photos, sound and videos. This data is associated to each observation, so we have to specify additional data names and types (Table 3). The fields are common to all the observations, regardless of the form structure.

Table 3: Additional fields and corresponding data type.

Data Type	Field Name	Forms		
		CTOS	CIS	AES
Date	timestamp	X	X	X
ActivityType	type	X	X	X
String	descr	X	X	X
Blob	activity	X	X	X

The resulting data is structured in two conceptual groups, one for the fields from the CTOS and CIS forms and the other for the fields specified in the AES form. Each group will have two one-to-many associations, starting with the Observation (AESObservation for AES) entity for it is the most generic. Each Observation has many Sessions (AESSession for AES). In turn, each Session

records the child's behavior acting on a set of Activities (Figure 7).
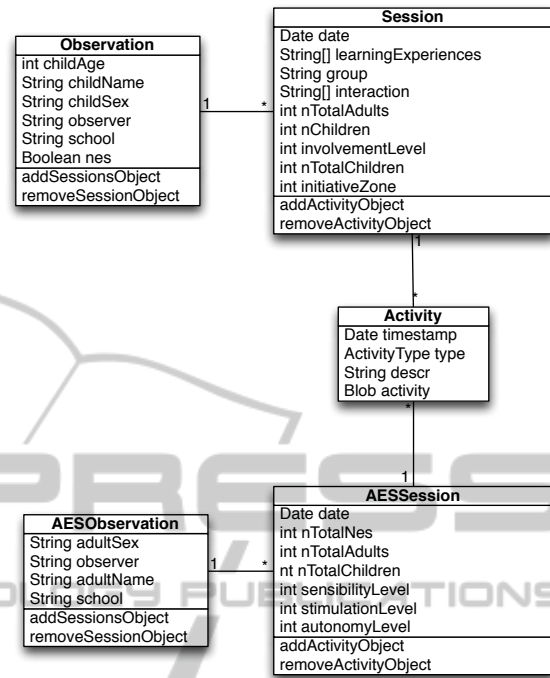

Figure 7: Entity diagram.

The Observation stores general information about each target child, namely, the institution's name (school), the observer's name (observer), the child's name (childName), sex (childSex) and age (childAge). It also registers if the target child requires Special Education Needs (nes). Objects of this type are the umbrella to all the information about a single target child.

The AESObservation stores general information about each adult, namely, the institution's name (school), the observer's name (observer), the adult's name (adultName) and sex (adultSex).

Session entities registers each observation. Remember that the procedure require four total sessions per child (six for CIS). Objects of this type store the summary of the observation details, such as the date the session took place (date), the set of learning experiences (learningExperiences), the predominant group (group), the set of interaction indicators (interaction), the involvement level (involvementLevel), the initiative zone (initiativeZone). Each session starts by registering the number of children in the group (nChildren) and in the room (nTotalChildren) and the number of adults (nAdults).

AESession entities registers each observation to an adult. Remember that the procedure require

four total sessions per adult. Objects of this type store the summary of the observation details, such as the date the session took place (`date`), the sensibility level (`sensibilityLevel`), the stimulation level (`stimulationLevel`) and autonomy level (`autonomyLevel`). Each session starts by registering the total number of children with special education needs in the group (`nTotalNes`), the total number of children (`nTotalChildren`) and the number of adults (`nTotalAdults`).

Each `Observation` has multiple `Sessions` which, in turn, can have several `Activity`. The latter represent all the media than can be registered, such as text notes, audio, photos and video. The remaining `AESObservation` and `AESSession` are specific of the Adult Engagement Scale. The `Activity` is the same format, since the type of media does not change.

3.3 User Input

In the paper form, each activity is described textually by the observer. We tried to maintain the same approach although allowing the user to take pictures, make videos and record sounds from the observation (Figure 8). The combination of photos, videos and text allow associating the observation to the opinion of the observer for latter assessment. It also can be used to train new observers.
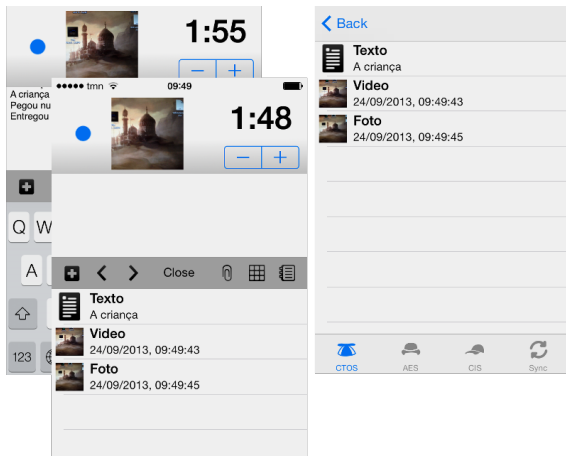

Figure 8: Activities: listing, adding and removing.

This is the view that the observer will depend the most. During the observation session, the user will write in the smartphone, take pictures and, eventually, make videos of all or pieces of the session. All these information is associated to the session that, in turn, is under an observation, thus organizing the data in an easy to browse, top-down approach – from the more general information to the more specific.

The top of the screen show a record button, to start and stop recording the video, previewed in the small window besides it. When clicking in the preview image, a photo is taken and added to the list of activities. Further to the right, there is a timer, to allow observers to keep track of the time at the same time they are paying attention to the child or adult. We added a timer (countdown) that can be set between 1 and 5 minutes. It is always visible, thus allowing for better time and observation control.

Moreover, there is also the possibility for the observer to select template phrases, thus reducing the effort of typing in the smartphone screen. The user can customize template phrases and add placeholders, to quickly type one or two words. A template phrase has the following structure:

`The child walked to the ### and grabbed the ###.`

The user can jump between placeholders (###) and type, transforming the template phrase into something like:

`The child walked to the table and grabbed the book.`

Template phrases are appended to the text area by touching it. The text is added to the activity list after pressing the '+' sign in the tool bar (Figure 9).
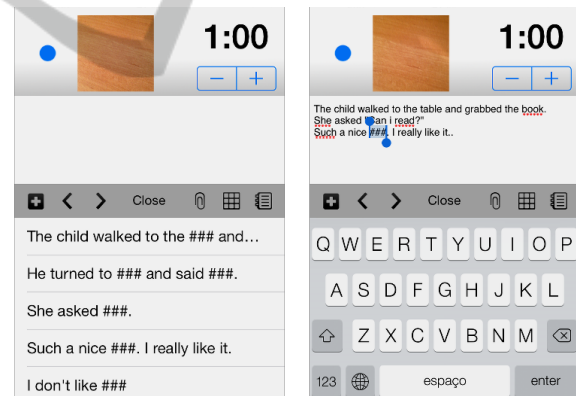

Figure 9: List and usage of template phrases.

The other tabs, in the main screen, allow the user to use different observation forms, as well as synchronizing with his area on the server. The data is stored and cyphered, so that it is protected at all times.

4 CONCLUSIONS

Observational research is a non-experimental research method in which the ongoing behavior is observed. This allows for a high degree of flexibility, because the subjects are in their natural setting. Careful and rigorous observation procedures can provide

valuable data to assess and improve quality in the processes at hand. In particular, the area of preschool education allow the professionals to improve the intentionality of their actions, the learning experiences of children and, consequently, the whole pedagogical process.

In this paper we described the adaptation of paper-based forms and methodologies to electronic format. The form fields are translated into a data model, structuring an electronic observation record. We also described a smartphone application to be constantly accessible to the professional to quickly make a note or to register a video or even photos. This data is stored in a tree structure and is later used to build observation reports.

The data can also be exported to the user personal area in a specific social network, fostering the participation of members and the maintenance of previous knowledge, that can be used for training and further studies.

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