Design of a web-based framework using XML and JavaScript

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Abstract: - In this paper the design and implementation of an automatic web-based framework, is shown. A template has been implemented using XML and JavaScript. The instantiation of this framework turn out different activities. The mains properties of this template are three: a) the result can be executed on web navigator; b) the programation is transparent to user. Only, the user has to fill the template and the activity is automatically generated. c) The student can interact with the system in different ways (click on an object; click and drag; select an area; answer by entering a text or a number; answer yes or no; answer multiple-choice questions). This tool is been used to create activities for the reinforcement of the addition operation.

Key-Words: - Man-Machine Interaction, Decision Support Systems, Multimedia

1 Introduction

This paper presents the architecture of a web-based framework which is used in the teaching of the addition operation in children with learning difficulties.

Teachers require resources in the classroom that can be applied towards the resolution of special situations, especially for children with special needs. Artificial Intelligence can be used to create intelligent tools that satisfy these needs.

In mathematics teaching the use of pedagogical methodologies is fundamental when the student begins to manipulate objects, especially in early ages. Graphic and symbolic representations can be worked starting with particular situations that allow mathematics relations to be found. For this reason, the use of computer programs must not be isolated from the rest of the teaching process that is followed for a particular concept [1].

In addition, different studies have proved that an animated pedagogical agent positively influences the way these children learn. Motivational aspects and the promotion of meaningful learning in particular have been studied. The effects produced by the interaction of learners with a personal agent show that they are more motivated, with greater interest and a greater transfer of knowledge is produced when the lesson is carried out by an agent than an isolated text on the screen. Effectiveness of teaching based on instructional conversations was also noted.

There are two fundamental aspects that need to be considered in mathematics teaching:

1. The use of pedagogical methodologies is fundamental when the student begins to manipulate objects, especially in early ages. Graphic and symbolic representations can be worked starting with particular situations that allow mathematics relations to be found. For this reason, the use of computer programs must not be isolated from the rest of the teaching process that is followed for a particular concept. It must be the only other didactic resource related with others materials used in the classroom and related at objective levels.

2. Mathematics software must consider their cognitive characteristics and use this profile in the teaching, as well as:

   - Include *activities related with experiences from their environmen*t, that is, be attractive and familiar;
   - Take into account their *lexical deficit*s, since these learners usually have difficulties in understanding the meaning of things and to incorporate it into their expressions;
   - *Avoid repetition of the same activity.* Offering a large number of distinct activities through a variety of presentations will result in the learner not taking refuge in repetitive behaviours and automatisms where their self-confidence grows.

This paper presents the domain, motivational techniques and the multimedia interface used in the implementation of the web-based framework. Finally, we are going to present the application of the web-based framework used in the teaching of the addition operation in children with learning difficulties that we have developed.

3 The domain

We have design a web-based framework as a tool for the reinforcement learning of the addition operation. The addition process consists of four phases: Phase 1 (logic), Phase 2 (numbers and operations with single digit numbers), Phase 3 (numbers and operations with double digit numbers without carrying) and Phase 4 (numbers and operations with double digit numbers involving carrying) (Figure 1).

The first phase consists of four objectives which are carried out in parallel and in a random manner. When the student performs the activity corresponding to each objective with an acceptable success rate, then he can proceed to the next phase. Phase 2 is characterized by another set of objectives, where the first two objectives (cardinality and order) are introduced first. Then the remaining topics in phase 2 are also chosen randomly. This is the only phase where randomly selected topics are not initially used. Again when these objectives have also been passed, the student advances to next phase, which is also defined by a specific set of objectives. If the student does not achieve a passing rate then a regression occurs. Phases 3 and 4 both work with double digit numbers.

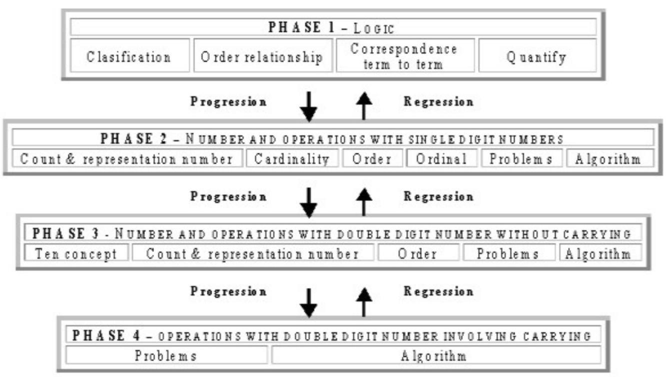

Figure 1. Phases in the addition operation

The activities to be carried out by the student in Phase 1 have been distributed in two difficulty levels, while the activities corresponding to the objectives in Phases 2, 3 and 4 have been organized in three difficulty levels. An activity set is available in each of the difficulty levels by objective and phase.

4 Motivational Techniques

Our model uses the following motivational technique [2]:

- A pedagogical agent explains the task to be carried out in each objective. This agent is chosen from an agent gallery given as a function of the cognitive and maturity levels of the student. Some examples are shown in Figures 2.a and 2.b [3].
- The process of individualized education consists of determining from the characteristics of each student which are the learning objectives. Different activities were then generated to be carried out by the student. These activities allow the student to learn the concepts which are determined by the objectives. We consider three students personalities:
    - o the student with fear of failure,
    - o the hyperactive student, and
    - o the motivated student who is unaffected by mistakes.

  The set of activities to be carried out by the student for each objective changes from one student to another since their personalities and characteristics differ.

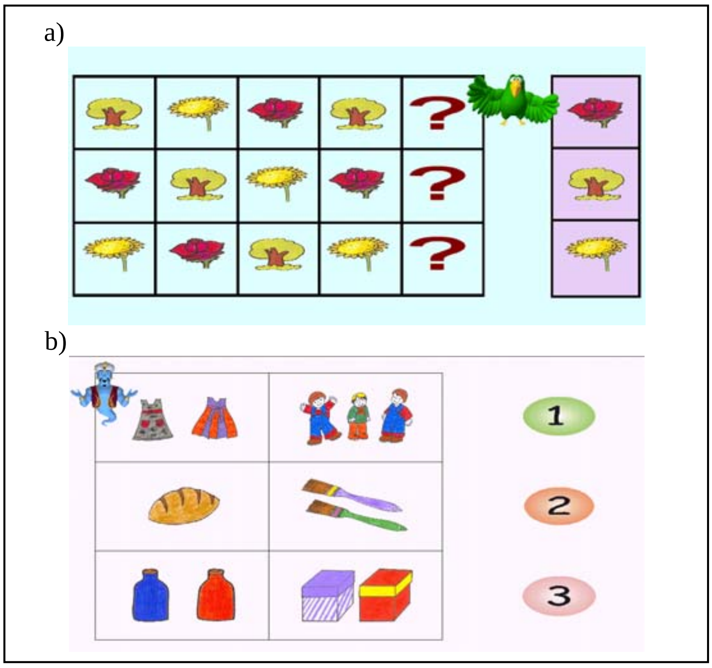

Figure. 2. a) Example of Order Relationship, high level (Phase 1). b) Example of Cardinality, low level (Phase 2).

In our case the pedagogical agent can move by the screen and make several gestures and actions. These can be for example:

- Greet: To salute when the session begins.
- Explain: To explain the exercise.
- Think: To think while the student is solving the activity.
- Congratulate: To congratulate the student when it solves the exercise correctly (positive feedback).
- Decline: To correct the student when it is mistaken (negative feedback).
- GestureAt: In order to indicate to some element or object of the screen.
- …

In principle we used text-to-speech for the voice of the agent in the tutorial, but once made a test with the children of the Association of Trisómicos 21 (ATT21) it was verified that the agent spoke too fast and who they did not understand to him well. As a result of this, we decided to record the voices corresponding to the agents and to reproduce them in format .wav during the execution of the web-based framework.

5 Multimedia Interface

An important function of multimedia interface is to attract and to maintain the student's attention. Furthermore, it has to create an appropriate learning environment. For this purpose, it must generate attractive screens which integrate text, figures, graphs, videos, audios, animations, and diagrams. The way these media are integrated depends on the student's personality and the activity. In this project we have used web-based technology where the activity to be carried out by the student is composed of a display which works with a navigator.

We have used XML to implement the interface framework [4][5] so that it may be used by any application domain. The multiple instantiations of this framework generate the activity set that is presented to the student. The manager communicates the specifications of the following activity to the interface and then the interface implements the Web page.

The student can interact with the system in different ways:

1. click on an object;
2. click and drag;
3. select an area;
4. answer by entering a text or a number;
5. answer yes or no;
6. answer multiple-choice questions.

We have implemented a template in XML for each type of interaction. This template is based on three main elements: the component *image*, where all the images which appear in the Web page are described; the component *agent*, which describes the pedagogical agent, and the component *web*, which indicates the next activity to present to the student after the current work has finished. The properties of each element are shown in fig. 1.

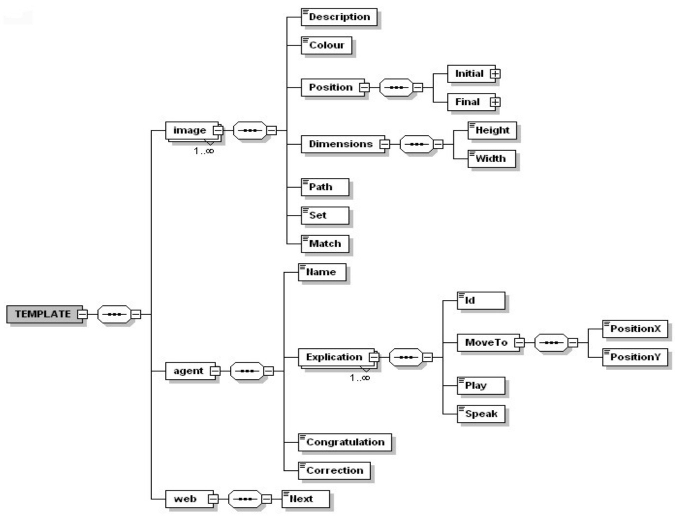

Figure 3. XML template

During the instantiation of the template an html file is generated using XSLT (Extensible Stylesheet Language Transformations) with JavaScript language. Figure 4 shows the pseudocode of this program.

6 Application

In this section we describe a click activity. The objective of this activity is to count the number of dinosaurs and click on the correct number. In the first time, the input data of the component image must be introduced. Each image of result web page is matched with a row in the table shown in figure 5.

The instantiation of the component *image* is based on to fill the following slots:

- *Description* is the name of the image (ex. one, dino1,…).
- *Colour* is the colour of the image for the automatic generation or for the recognition colour activities.
- *Initial Position* is the position on the screen where is place the image (including x e y coordinates).
- *Final Position* is the correct area where the student has to place the image in click and drag interaction (including x e y coordinates).
- *Dimensions* are the *width* and *height* of the image.
- *Path* of the image.
- *Set* is a slot which has two possible valours, true is this image is a correct result (ex. image name three) and false in other case.
- *Match* is a slot used only for matching up images activities.

The figure 7.a shows the place of each image of the figure 5.

The instantiation of the component *agent* (fig. 6) consist in:

- *Name* of the agent (with format .acs).
- *Explication* is a multiple slot that is made up of three elements:
  - o *MoveTo*, where the agent has to move;
  - o *Play*, action to release;
  - o *Speak*, text to explain the exercise.
- *Congratulation*, is the positive feedback.
- *Correction*, text to explain by the agent when the student makes a mistake.

The instantiation of the component *web* is only a slot (*Next*) with the following activity name (ex. Next.html).

When all dates of the template have been filled, they are used along with the translation leaf corresponding with the click interaction. This contains the code Javascript that it is used for generating the .html file. Figure 7.b shows the result of the example.

7 Conclusion

In this work we have presented the architecture design and the implementation of a web-based framework which has been defined to admit any domain. Furthermore, we have shown how this interface is connected with the architecture proposed. We have also presented the framework in XML which allows each element that is shown to the student to be modelled. Motivation must also be considered when working with children. The creation of attractive interfaces, the use of multimedia resources, the fact that the activities are shown as a game, and the use of a pedagogical animated agent for social interaction within the system are crucial. It has been tested on students of elementary school by a team of expert specialists in the teaching of mathematics with considerable success. Currently the web-based framework is being tested in collaboration with Asociación Tinerfeña de Trisómicos 21 (ATT21).

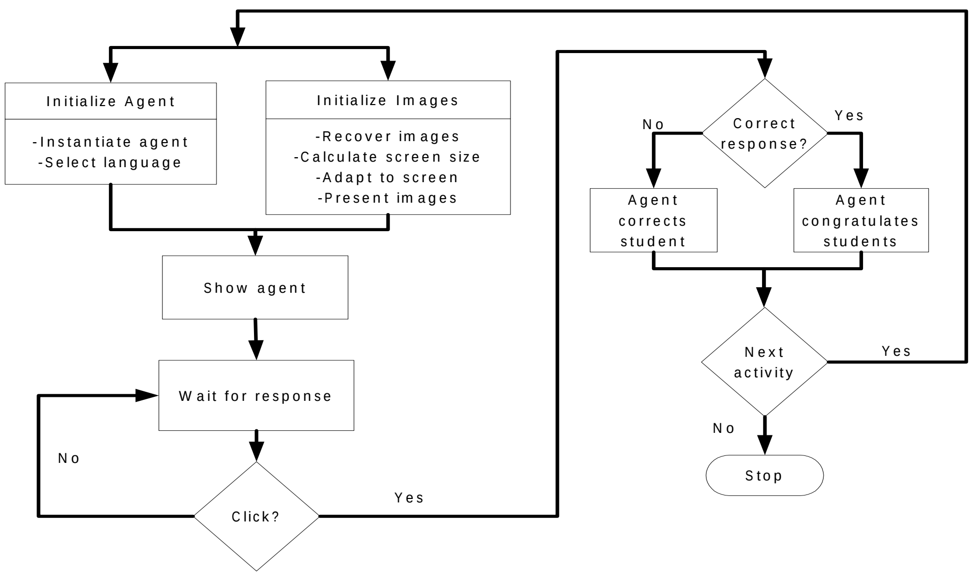

Figure 4.- Sequence of the script which generates a html file.

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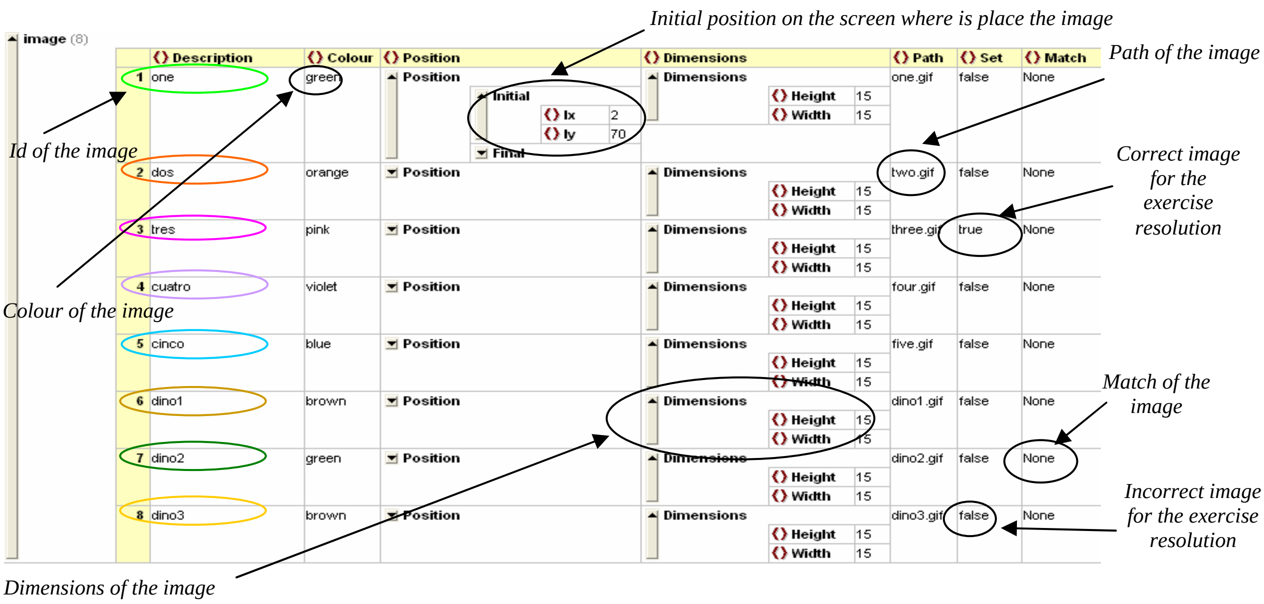


Figure 5.- Instantiation of the component image

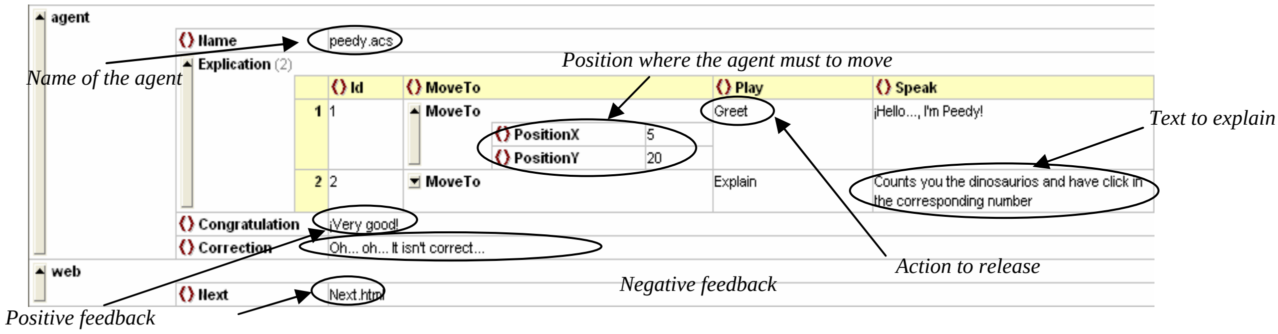
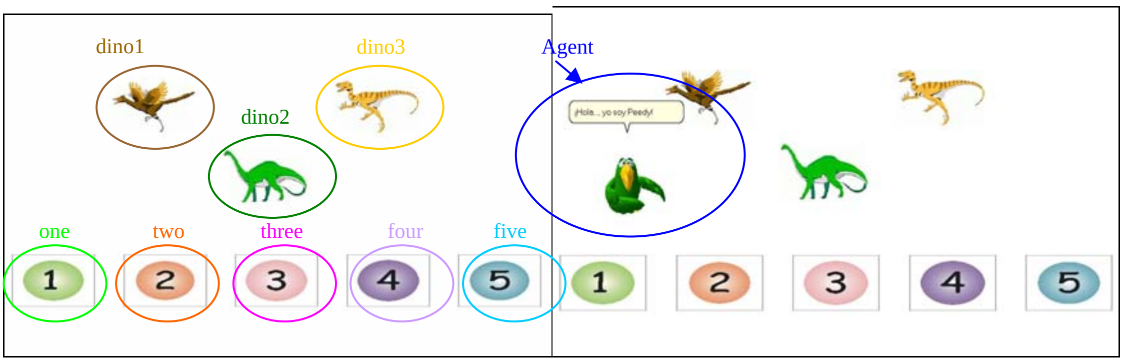


Figure 6.- Instantiation of components agent and web



(a) Location of each image. (b) Result of the example with agent.

Figure 7.-Visualization of the example with a navigator.