CoWriter : Case Studies

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ABSTRACT

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Keywords

robot-supported educative activitiy, handwriting learning, learning by teaching

1. INTRODUCTION

2. THE COWRITER ACTIVITY

2.1 Children teach handwriting to the robot

2.2 Our approach

2.3 Learning and generating letters

2.4 robotic implementation

3. CASE 1 : DIEGO

3.1 Context

Diego is a five years old child. Her mother told us he had difficulties to learn writing at school, particulary in drawing cursive letters. Before experiments, she provided us with a homework of Diego to show explicitly his handrwiting level (fig).

From our perspective, Diego is shy and quiet. He suffers from a poor self-esteam much more than any actual trouble in writing.

3.2 Questions

The CoWriter activity needs a child engaged as interaction leader. In this study we consider the problem of long-term interactions : is it possible to sustain this engagement over several one-hour sessions?

3.3 Experimental settings

The experiment took place in our laboratory. Our goal was to figure out an environment in order to make Diego sustaining engagement over four sessions of one hour, one session per week. We decided to introduce an appealing scenario that justifyed to the child the activity where a robot wants to learn handwriting. We used two Nao robots : a blue one (called Mimi) and an orange one (called Clem). Mimi was away for a scientific mission, and the two robots had to communicate by mails. But they decided to do it "like humans", with handwritten messages. While Mimi was good in handwriting, Clem had strong difficulties and needed the help of Diego.

The mission of Mimi consisted in the exploration of a mysterious hidden base. Each week, just before the session, it was sending a postal mail contening a picture, a curious object it found and a few handwritten words about its discoveries. The pictures was representing itself exploring a dark room of the hidden base (that was actually our laboratory's workshop). The objects were 3D printed. In fact, there where puzzle pieces of a small 3D model of Nao robot but regarding them one by one, it was not easy to guess it.

During the three first session, Clem (the other robot) was waiting for Diego with the recieved mail. It let Diego take a look to the picture and the object, and then it asked him to read the message. Finaly, Diego figured out a response and helped the robot to write it.

The fourth and last session was set as a test: Mimi, the "explorer" robot, had come back from its mission and it actually challenged Clem in front of Diego: *"I don't believe you wrote yourself these nice letters that I received! Prove it to me by writing something in front of me!"* This situation was meant to evidence the Protégé effect: by judging the other robot's handwriting, Mimi would implicitly judge Diego's skills as teacher, and in turn, Diego's handwriting.

To complement the intrinsic motivation of helping a robot to communicate with another one, we gradually increased the complexity of Diego's task to keep it challenging and interesting (the first week: demonstration of single letters; the second week: short words; the third week: a full message – Figure **??**).

Diego had to tell the robot what to write with small plastic letters (visible behind the robot on Figure **??**). A third person was here to send the formed word to the robot via the computer.

3.4 Results

Overall, Vincent provided 154 demonstrations to the robot,

and he remained actively engaged over the four weeks. The story was well accepted by Vincent and he seriously engaged into the game. After the first week, he showed good confidence to play with the robot and he built affective bonds with the robot over the course of the study, as evidenced by some cries on the last session, and several letters sent by him to the robot *after* the end of the study (one of them 4 months later) to get news. This represents a promising initial result: we can effectively keep a child engaged with the robot for a relatively long period of time (about 5 hours).

No conclusion can be drawn in terms of actual handwriting remediation: we did not design this study to formally assess possible improvements.

However, as pictured on Figure **??**, Vincent was able to significantly improve the robot's skill, and he acknowledged that he had been able to help the robot: in that regard, Vincent convinced himself that he was "good enough" at writing to help someone else, and this is likely to have positively impacted his self-esteem.

4. CASE 2 : HENRY

4.1 Context

Henry, 5.5 years old child, is under the care of an occupational therapist. He has been diagnosed with visuo-constructive deficits. As an effect in writing activities, he was frequently performing random attempts and then was comparing with the provided template. What is more, Henry is strongly careless : he rarely payes attention to advices, even to what he is doing when he is currently drawing, and he is quickly shifting his attention from one activity to another.

Henry was working on number's allographs with his therapist. During a prior meeting, the therapist provided us with a sequence of numbers written by Henry **??**. Henry was sometime drawing horizontally-inverted allographs, mainly for "5".

4.2 Questions

This study focused technical adaptations of the CoWriter activity for a child diagnosed with real writing deficits. Our objective is to investigate small modifications of the activity adapted to the troubles of Henry (visuo-constructive deficits and inattention) in order to sustain him focused on the activity during forty-minutes session, and to make the robot evidently learning from his demonstrations.

4.3 Experimental settings

The experiment took place in the therapist's office. It was divided in four sessions. This time, we assumed that a scenario like the one we used for Vincent was no longer relevant with Henry. We just introduced the robot and quickly said that it was seeking help to train for a robot handwriting contest.

In order to better fit the work of the therapist, we decided to turn the CoWriter activity to teach numbers to the robot.

Since Henry was frequently drawing horizontally-inverted numbers, or even unrecognizable allographs, the learning algorithm of the robot was converging to meaningless scrawls. To fix this problem, we programmed the robot to refuse allographs that were too distant to a reference with a threshold we arbitrary fixed. In that way, the child was forced to take care on what he was providing to the robot as demonstration.

According to the therapist, it was easier for Henry to memorize the way to draw a number if it was allways done is the same order, *e.g.* if the "5" was allways drawn from the top-right tip up to bottom. Therefor we programmed the robot to refuse as well a good allographs drawn in a wrong order. But in order to reassure Henry about the right final allograph's shape, we made the robot able to recognize such a drawing, and, when it occured, to tell the child something like : *"Oh, this is exactly the shape of the number I want to learn, but can you show me how to draw it in the opposite order?"*

Also, to make sure the robot was going to improve its handwriting and to clearly show this improvement, we decided to make it starting from scratch : for all numbers, the first try of the robot resulted in a simple vertical stroke (see the first robot's try in **??**).

In this setup, we added a second tablet with one button per numbers. It was used by the child to chose a new number to teach to the robot. It also provided the possiblity to enter letters or words, and to switch to another activity (the robot telling a story).

4.4 Results

Despite his inattention, Henry was able to keep on the activity during more than forty minutes in each session. In total, 55 allographs out of 82 provided by the child as demonstration were acceptable by the robot (with a progressive improvement from 13 out of 28 in the first session up to 26 out of 29 in the last session).

As soon as Thomas understood that the robot was only accepting well-formed allographs, he started to focus on it and he would typically draw 5 or 6 times the number before actually sending to the robot (the tablet let the children clear their drawing and try again before sending it to the robot). According to the therapist, it was the first time that Thomas would correct himself in such a way, explicitly having to reflect on how *another agent* (the robot) would interpret and understand his writing. Figure **??** shows how he gradually improved his demonstrations for some numbers, according to the metric we used to make the robot accepting/refusing trials.

Since the robot's handwriting started from a simple primitive (a stroke), each time Thomas succeeded to have his demonstration accepted by it, the robot's improvement was clearly visible (as measured in Figure **??**). This led to a self-rewarding situation that effectively supported Thomas' engagement.

5. AUTOMATIC STUDIES

5.1 Context

5.2 Questions

5.3 Experimental settings

5.4 Results

6. DISCUSSION

child	demo	pos	neg	p-value (robot)	p-value (child)
valentine	127	24	6	6.454e-05	0.02286
enzo	223	20	9	0.1776	0.5780
matenzo	131	10	3	0.0001554	0.0006541
jonathan	98	10	5	0.1456	0.6640
nathan	115	16	4	3.660e-06	0.002705
alexandre	83	10	3	0.008527	1.288
adele	35	4	2	0.02145	0.01279
mona	40	5	1	1.138	0.2351

Table 1: results of gradings. demo : number of demonstrations provided by the child over all session. pos : number of positive grades provided by the child. neg : number of negative grades. p-value (robot) : how significant are the grades corresponding to robot's progression. p-value (child) : how significant are the grades corresponding to child's own progression.

7. CONCLUSIONS