CoWriting Kazakh: Towards Cognitive Learning of a New Script

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Abstract. In the Republic of Kazakhstan, the transition from Cyrillic towards Latin alphabet raises challenges to teach the whole population a new script. This paper presents a CoWriting Kazakh system that aims to implement an autonomous behavior of a social robot that would assist children in transition from old Cyrillic alphabet to new Latin alphabet. Considering the fact that the current generation of primary school children have to be fluent in both Kazakh scripts, this exploratory study aims to investigate which learning strategy provides better learning effect. Participants were asked to teach a humanoid robot NAO how to write Kazakh words using one of the scripts, Latin vs Cyrillic. We hypothesize that it is more effective when a child mentally converts the word to Latin in comparison to having the robot perform conversion itself. The findings support this hypothesis for female participants while male participants had an opposite trend though not significant. Further studies are needed to explore other strategies to find the most effective way of practicing a new script.

Keywords: Human-Robot Interaction · Child learning · Language learning · Social Robot

1 Introduction

Kazakhstan has recently adopted a state program for the development and functioning of languages for 2011-2020. This new trilingual education policy aimed at development among the Kazakhs of fluency in three languages: Kazakh, Russian and English. Additionally, a recent decision on the transfer of Kazakh language from Cyrillic into the Latin alphabet was approved by the Kazakh authorities in October 2017 [1]. While there are clear reasons for these reforms, there are numerous risks facing the transfer, including risks to cause disinterest and lack of motivation to learn to write and read the Latin-based Kazakh among children and adults.

A substantial increase in social robots in various areas of applications raises the importance of human-robot interaction research, especially in the application of education [5]. Recent years have seen the increase in the amount of work investigating the topic of language learning using social robots [8], [6].

Since 2014, the CoWriter project has explored how robotic technologies can help children with the training of handwriting via an original paradigm known as learning by teaching (LbT) [2] [3][4]. Since the children act as the teachers who help the robot to learn handwriting, the children practice their handwriting even without noticing it and stay committed to the success of the robot via the Protége effect. Previous research have shown the motivational aspect of the LbT with a robot for handwriting [3]. We believe that the CoWriter activity has the required innovative aspect to it and, hence, it can boost the childrens self-esteem and motivation to learn the Latin-based Kazakh alphabet and its handwriting. This paper presents the CoWriting Kazakh project that aims to benefit from the new language planning in Kazakhstan in order to address challenges of training and motivating children to learn and use a new alphabet.

In the CoWriting Kazakh system, the NAO robot is introduced to a child as a native English speaker that needs child's help in learning new vocabulary in Kazakh language. The robot asks the child to translate simple words from English to Kazakh (e.g. "hello") and to demonstrate how to write them using Latin script so that the robot can read it. To investigate whether this approach would cause children learn more letters in Latin-based Kazakh, we conducted an exploratory study with 48 children in primary school in Kazakhstan. Children were asked to complete a pre-test, robot interaction, and a post-test to evaluate the number of learned letters in Latin-based Kazakh. Children interacted with the robot in one of the conditions where they had to demonstrate how to write Kazakh words using either a Cyrillic script or a Latin script. The robot then had to repeat child's demonstration using only Latin script that was a correct spelling of the words so that the child could see the right spelling in Latin script and learn from his/her mistakes. We hypothesize that Latin demonstration by the child (in contrast to Cyrillic demonstration) is more effective for learning a new script.

In addition, this paper presents a discussion of other scenarios that might be more effective at learning a new script. Thus, the CoWriting Kazakh learning activity aims to look into existing theories in multiple research domains such as education, linguistics, cognitive science, etc. Since the CoWriter Kazakh learning activity relies on multidisciplinary approach including education, linguistics, and cognitive science, there is a need to explore and compare other theories to find alternative learning scenarios that might maximize childrens learning gains. To this end, this paper presents a case study that aims to investigate various possibilities for integrating a social robot into a new script handwriting acquisition and measure its impact on childrens learning process. Through human-robot interaction user studies the CoWriting Kazakh activity will follow an incremental evolution of the research.

2 HRI System

Since the project is motivated by the recent decision of Kazakh authorities to transition from Cyrillic to Latin script, we aim to train students of a new script

in a handwriting learning scenario with a social robot. In contrast to original CoWriter's LbT paradigm where robot's handwriting improved gradually via several demonstrations by the child, the CoWriting Kazakh does not have a handwriting improvement component. In the presented system, the robot and a child engage in a co-operative learning where the robot learns from the child the new vocabulary in Kazakh while the child learns from the robot the spelling in new script. Thus, they take turns in writing words in Kazakh (see Figure 1).

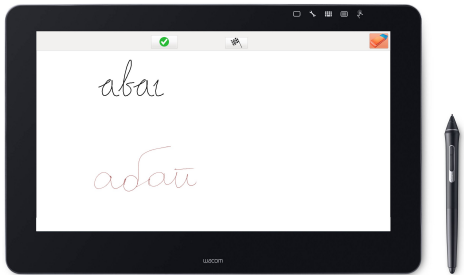

Fig. 1. Screenshot of a Wacom tablet demonstrating Cyrillic-to-Latin condition

2.1 Robot Role

In this scenario the NAO robot plays a role of a peer. The robot is introduced to a child as a native English speaker of approximately his or her age who wants to learn Kazakh. The robot asks the children for help, especially, to demonstrate how to write Kazakh words using the new Latin alphabet because that is convenient for the robot to read. In a control condition, the robot does not ask to write explicitly in Latin script, so the child writes words in their preferred script which is Cyrillic script as that is what they are used to.

The child is told that the robot does not understand Kazakh or Russian language, so children have to understand what the robot says. The reason is the absence of the child voices in Kazakh text-to-speech engine. It was important to compose simple robot speech utterances for the children to understand. We developed these utterances and then verified them with the help of the English teacher.

2.2 Dialogue

Interaction with the child consists of several stages during which the robot sustains the interaction: greets the child in the beginning, provides instructions in the form of the questions, and says goodbye at the end.

NAO: -Hello. I am a robot. My name is Mimi. [Waves his hand]
Child: -...

NAO: -I study Kazakh language. Can you help me?
Child: -...
NAO: -How do you say “Hello” in Kazakh?
Child: -Sálem
NAO: - How do you write it? [In Latin-to-Latin case: Please write it using Latin letters so that I can read it.]
Child: -[Writes on a tablet the word in one of the scripts]
NAO: -Let me try to write it too [gesticulates]. This is a correct writing using Latin letters.

NAO: -How do you say “thank you” in Kazakh?
Child: -Rahmet
NAO: -How do you write it? [In Latin-to-Latin case: Please write it using Latin letters so that I can read it.]
Child: -[Writes on a tablet the word in one of the scripts]
NAO: -Let me try to write it too [gesticulates] This is a correct writing using Latin letters.

... repeated for another 10 words

NAO: - You are a great teacher. Thank you very much! Goodbye! [waves]

2.3 Software and Hardware components

The Wacom Cintiq Pro tablet is a graphics tablet which can display the monitor of the computer, serving as the second monitor. Its pen has 8,192 levels of pressure sensitivity and tilt recognition. This allows to acquire not only the trajectory of the handwriting, but also the pressure and tilt at every point.

A humanoid robot NAO is a programmable autonomous robot developed by SoftBank Robotics. It is widely used in human-robot interaction research, in particular, educational and robot-assisted therapy applications. A humanoid robot's height is 58 cm which makes it comfortable to transport, also its appearance is appealing for children. Furthermore, it has 25 degrees of freedom and 7 tactile sensors. We extended the original CoWriter project[1].

2.4 Conditions

In order to investigate whether it is more effective for the child to perform conversion mentally and observe correctly written Latin spelling by the robot, we distinguish two conditions that are different in who performs the conversion:

- Latin-to-Latin: the child does the conversion mentally and writes directly in Latin.
- Cyrillic-to-Latin: the robot does the conversion. The child writes in Cyrillic and observes the Latin writing provided by the robot.

[1] https://github.com/chili-epfl/cowriter

During the interaction we did not help children in writing and did not correct their mistakes. We would only help them in case they did not understand or hear the robot.

3 HRI Study

3.1 Recruitment

This research was approved by the Ethical committee of Nazarbayev University. We commenced an introductory sessions with two classes of different age groups where we gave a brief description of the research. Assent and consent forms were distributed and children were able to ask questions. Teachers then collected assent and consent forms for us in the next few days.

3.2 Procedure

The procedure of the experiment had the following parts: pre-test, pre-interaction survey (further pre-survey), learning activity, post-interaction survey (further post-survey) and post-test. Overall procedure for one child lasted approximately 20 minutes.

3.3 Pre-test and Post-test

The next phase is pre-test, where a child is given a printed table with 42 Cyrillic letters and were asked to try to convert them to Latin script. The pre-test is needed in order to determine child's level of knowledge of Latin script. It should be noted that children study English a few hours per week and are familiar with Latin letters that are shared with English. None of the children had any training using new Kazakh script. Pre-test was followed by the intervention with the robot that was then followed by the post-test.

Children were presented with the new printed table of the Kazakh Cyrillic alphabet to write Kazakh letters in Latin script again. The post-test is needed in order to determine the number of the learned letters. After the test, children received a book for participation.

4 Results

There were 67 children (32 females) aged 8-11 years old. Exactly half of the participants had Latin-to-Latin case which were selected randomly and counterbalanced for gender and age groups. In general, children improved their knowledge of Latin alphabet during the experiment. The average number of new learned letters is 4.35 (SD = 3.7, Max = 18, Min = 0).

A series of one-way ANOVA tests was conducted to determine if there was any difference in learning. It revealed a non-significant difference in the number of learned letters between different robot conditions, which rejects our hypothesis

that Latin-to-Latin condition is more effective in the current learning scenario. Children did not have significant differences neither in learning gains, nor in pre-tests or post-tests. Boys learned 4.32 ± 3.14 while girls learned 4.39 ± 4.33 letters. Girls scored slightly better in a pre-test (14.25 ± 5.98 vs 12.69 ± 6.22) and in a post-test (18.26 ± 5.8 vs 16.85 ± 6.05), though not significant.

A two-way ANOVA was conducted that examined the effect of gender and robot condition on a number of learned letters. There was a statistically significant interaction between the effects of gender and robot condition, F (1, 64) = 6.17, p = .016. Males learned more in Cyrillic-to-Latin condition (5.06 ± 3.28 vs 3.59 ± 2.89) while females learned more in Latin-to-Latin condition (3.00 ± 2.87 vs 6.07 ± 5.31). A separate one-way ANOVA was conducted for female participants only: F (1, 29) = 4.017, p = 0.05. Thus, the learning strategy of performing mental conversion themselves was more effective for girls, in contrast to boys who learned more when the robot performed the conversion for them (5.06 ± 3.29 vs 3.29 ± 2.89 in Cyrillic-to-Latin and Latin-to-Latin respectively), though not significant (F = 1, 33) = 1.916, p = 0.17).

5 Discussion

It is an interesting finding that children's learning gains were significantly different in two robot conditions for males and females. Further data analysis is needed to understand what caused this difference. All participants were from the same school and we can not generalize to confidently say that the same result will be valid in other schools in Kazakhstan.

We plan to further refine the scenarios in search for the best strategies for learning a new script. It might be effective to enable children to use their knowledge of foreign language vocabulary to advance their foreign script learning. Contrary to this strategy, it might be more effective to use unknown/non-existing words in languages children know in order to avoid confusions with prior knowledge. We believe that it is important to study various strategies to find the most effective cognitive learning scenario as the robot is situated in the physical world, interactions with a social robot can be multimodal (verbal, visual, and tactile) and be adapted according to all perceptual modalities including events on the tablet, its stylus data and child's feedback.

6 Conclusion

This paper describes an exploratory study that aimed to investigate whether children need to try to perform conversion of the letters themselves and then see the results in comparison to having conversion performed by the robot. Future work will include creating and refining learning scenarios so that the child can choose which words to teach the robot himself/herself. Also, it could be worth integrating original CoWriter's handwriting learning to be able to have several demonstrations of the same word to the robot to focus on long-term commitment to an interaction.

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