Use of the CANTOR System for Collaborative Learning in Medical Visual Object Recognition

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ABSTRACT

This paper reports from a user requirement, design and evaluation study on supporting collaborative learning by visual perception in the medical education domain. The CANTOR (Converging Agreement by Networking Telematics for Object Recognition) system can briefly be described as a tool that support collaborative consensus making when classifying sets of medical images or objects in medical images An evaluation experiment showed that using CANTOR seems to give a better learning effect than by using traditional methods.

Keywords

Visual Learning, Collaborative Medical Classification, Consensus Making

INTRODUCTION

As in many other domains learning in medicine is a life-long process. To specialize in pathology, for example, can last for up to ten years. Standardization of the learning processes is also needed to ensure a standardized high quality output of the medical work. In this paper we focus on the collaborative processes involved in learning to recognize, and to create consensus with respect to classifying, visual objects in medical images. Traditionally many of these processes have been of the master / student type. That is, the student learn how to classify under close supervision of an expert. This is a rather learning effective but costly educational activity and the level of expertise available may vary from place to place. The question is how better to support the collaborative learning processes and standardize the level of expertise within a group of students through training using the same system.

The CANTOR system support collaborative consensus making by letting a group of students view, share, compare, rank, and finally join individual and / or mutual classification results. In this way the system that stimulate learners to make maximum use of their cognitive potential (Scardamalia et al., 1989). CANTOR is based on the idea of self-regulated learning Schunk, 1989; Zimmermann, 1986) and it supports asynchronous distributed collaborative learning (Johansen, 1988).

EVALUATION EXPERIMENT

The objective of this experiment is to get a qualitative assessment of the usability of CANTOR for learning of 'students' within the domain of lung cancer histo-pathology. Six 'introductory doctors' from Denmark participated in the experiment. It is current practice to use a WHO booklet to learn how the different morphological features look like. The student can inspect sections of the book and compare the pictures with the microscopic image of the tissue to be classified.

The introductory doctors diagnosed individually 30 cases of lung cancer presented by slides as a base line test of their initial skill. After this introduction they were split into two groups, and they were allowed about two hours for training, one group using the CANTOR system and the other group using the standard WHO text book. Following this session they were all diagnosing 31 lung cancer cases. The improvement or deterioration for each participant was tested comparing the new success rate with the base line results. Since the two groups were small and the number of images shown limited, only qualitative results were obtained.

RESULTS

Figure 1 shows the average number and variation of correct pre-training and post-training diagnoses on person level approximated with normal distributions based on 30 and 31 classifications, respectively. If the increase in the mean value of correct diagnoses relative to the average of the variations before and after the training is taken as a measure of improvement, this value is about three times larger for the CANTOR training than for the textbook training. However, this is strongly influenced by the spreading of performance of the trainees, and this spreading is for the textbook trainees by chance nearly twice the magnitude of the CANTOR trainees. Furthermore, as indicated before, the two groups are too small to make any real quantitative significant conclusions from the results.

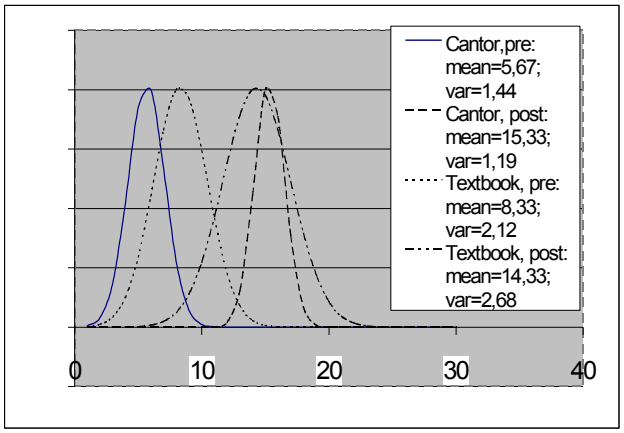

Figure 1 The correct diagnoses on person level approximated with a normal distribution regarding average and deviation. The scaling of the curves is arbitrary.

Following the session the group of physicians not using the CANTOR system were introduced to the system by their colleagues having used the system for a couple of hours. This introduction and the fact that all six physicians hereafter were able to benefit from the system by making diagnoses and making self control of these - by using the CANTOR tools - indicated the user friendliness of the system.

The session was concluded by a discussion concerning the usability and user friendliness of the CANTOR system for education and training of cancer diagnosis. Except for minor suggestions related to the user interface, the general opinion of the participating physicians was very positive. They found the system not only valuable, but also inspiring due to the tools allowing direct feedback of their performance as compared to the expert opinion, and allowing objective indication of personal improvement by the Kappa value.

In general the experiment indicates that CANTOR (still just seen as a qualitative indication) is just as good and may be even better than the textbook as an education tool, i.e., is has at least the same educational and training effect as textbooks. The scores provided by the students on a usability questionnaire indicated that the components of the CANTOR software that allow the classification of (objects in) images and for the comparison of classifications and the inspection of differences were well appreciated.

CONCLUSION

The experiment have shown that CANTOR is a valuable tool for learning and training. Using CANTOR seems to give a better learning effect than by using textbooks. The study are, however, limited since only six test persons were available. Using the CANTOR system in learning and training of medical persons could be more cost effective due to the increased computer supported collaborative learning effect replacing to a high degree the need for presence of real experts. Indeed, in front of a difficult diagnosis, a young isolated pathologist may greatly benefit from the CANTOR expert databases as well as the consolidation of the standards for disease classification.

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