

Title	切り絵初心者の上達を目的とする タブレットを用いた 切り絵練習帳に関する研究
Author(s)	東, 孝文
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A supporting system for practicing paper cutout using a tablet computer

Takafumi Higashi

School of Knowledge Science,
Japan Advanced Institute of Science and Technology
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In recent years, 3D printer and CAD (Computer-Aided Design) can support creator's efforts in making easily and highly accurate things. On the other hand, there is a field "Craft art" to make things by hand in trial and error. In the craft art, it is not easy for novices to make what they would like to create.

In this research, we focus on "Paper Cutout" as one of craft art. The paper cutout is a form of a painting art using black paper that is cut out into various kinds of pictures. In the paper cutout, you put the cutout paper over a white paper so that you can see a picture in white and black. For novices in paper cutout, there are some difficult points based on irreversibility of process of paper cutout. For example, you cannot undo the failure to cut paper.

In this paper, we propose a supporting system for practicing paper cutout using tablet computer stylus for novices. The system provides users with expert's knowledge how to make paper cutout. The users can repeat practice and review of information on user's hand movements and handling of materials: a utility knife and papers. Thus, the system assists progressing efficiently paper cutout for novices.

We conduct experiments to investigate the differences between novices and experts, and compared "Completion time", "Frequency of usage of a utility knife" and "Frequency of retried cutting".

At the experiments, with regard to “Completion time,” the novices finished 60 minutes later or more than experts. The novices tended to struggle against sequence of cutting all the time. The experts could cut without trouble. With regard to “Frequency of usage of a utility knife,” the frequency of the novices is 100 counts more than that of the experts. With regard to “Frequency of retried cutting,” the novices tended to repeat to cut a paper at the same location. The cutting pressure of the novices is weaker than that of the experts. The cutting pressure is stable while the experts cut a paper. Moreover, The novices tended to cut a paper by hand when the parts of paper cutout are separated from the paper. From the above results, we find out some significant differences between the novices and experts, namely, “Order to cut”, “Pressure” and “Action of tearing out”.

From the preliminary experiment, a supporting system should have three functions of practicing for novices: (i) The function of displaying the order to cut, (ii) The function of displaying the handwriting by changed color depending on pressure, and (iii) The function of displaying line at the start and end.

In order to investigate the effect of individual functions in the system, we conduct five types of user experiments: the only function (i) is activated (Type-1), the only function (ii) is activated (Type-2), the only function (iii) is activated (Type-3), the all functions are activated (Type-4) and the all functions are not activated (Type-5). In Type-1, 2, 3 and 4, subjects make paper cutout at the first, after that they use the system and finally, they make paper cutout again. In Type-5, subjects make paper cutout three times.

As a result, in Type-1, “Order to cut” of subjects modified like that of experts. In Type-2, “Completion time” and “Frequency of usage of a utility knife” reduced substantially. In Type-3, the frequency of action of tearing out reduced. In Type-4, the subjects tended to improve operations like Type1, 2 and 3. In Type-5, the subjects improved only slightly in “Completion time” and “Frequency of usage of a utility knife” and they did not improve “order to cut”.

We developed a system that assists progressing efficiently paper cutout for novices. In the future, we will conduct more experiments to validate the effect of the system.