Comparison of Braiding Skills Between Expert and Non-experts by Eye's Movement Measurement

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Abstract. A braiding rope is the Japanese traditional rope that a quality and beauty of them have depended on the skill and experience of a braider. In this research, the skill of a expert and two non-experts who practice the braiding everyday and every week, respectively were measured and compared through the eye's movement measurement and observed the braiding rope quality. The measurement was carried out every month for three times. It was found that the expert show the constant of eye's focus at the center of marudai plate and reveled a complete pattern of braiding rope. For two non-experts, their eye's movement wobbled around marudai plate for all trials. However, the braiding speed and quality were developed by the regular training. There are no the defects in the ropes in the trial 2 and 3.

Keywords: Braiding · Kumihimo · Eye's movement measurement · Braiding skill

1 Introduction

Kumihimo is a traditional Japanese braiding technique that is used for making of long decorative rope. In that past, kimihimo is the important accessories for Japanese kimono and samurai armor. The styles and uses for the braids have changed over time. Nowadays, these braiding ropes are used in a variety of decorative ways. Some people wear them as bracelets or necklaces. In general silk was used as a braiding material due to its beauty and strength. However, many types of fiber can be used to braid kumihimo such as cotton floss or pearl cotton even metallic thread is used also. Because the beauty of the braid is accomplished by the color of threads. For the processing, the Japanese braiding technique is braided by specialized stands. The most common pattern of kumihimo is carried out on the

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marudai, which means round stand. The braiding is done on top of the marudai plate and the finished braid goes down the center of the plate. The sequence of moving the treads creates the shape. The initial placement of the colors will create a repeating pattern. The shape is usually round. However, there are many shapes that can created from the different specialized stand such as square shape, which is braided from kakudai or square stand.

In this research, the comparison of braiding skill between the expert and non-experts were carried out by using the common method as a marudai. In order to study the basic braiding skill, The braiding speed is the first parameter that was investigated in this experiment. The eye's movement measurement was selected to study and explain the concentration position of braider's eyes during the process. The braiding ropes were observed and measured the diameter to evaluate the quality of ropes.

2 Braiding Method

The cotton strands and marudai stand were prepared for braiding experiment. The first braiding step start by gathering all eight strands and tie a knot at one end (Fig. 1(a)). And then drop the knotted end into the center hole on the marudai (Fig. 1(b)). Next separate the strands out into four groups with two strands each and lay them over the marudai (Fig. 1(c)). After that reel strands around the bobbins tightly as shown in Fig. 1(d).

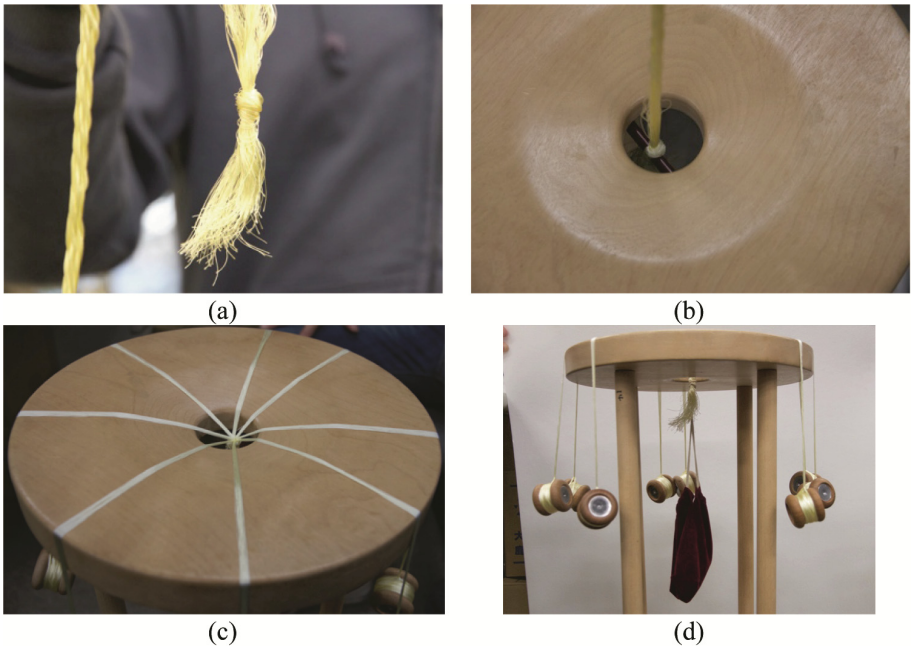


Fig. 1. Strand and marudai stand preparation

The braiding method is shown in Fig. 2. First step, start by moving the strand A across strand B and strand E across strand F. After that move strand C across strand D and strand G across strand H. Next the strands are braided anticlockwise. Start by moving the strand F across strand C and strand B across strand G. Finally move strand D across strand A and strand H across strand E. Continue the braiding from first step until finish.

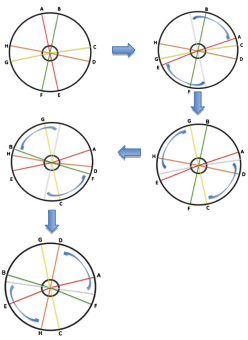


Fig. 2. Braiding method

3 Experiments

An expert and two non-experts were measured theirs braiding skill by eye's movement analysis. Before started the experiment, two non-experts studied a braided method from the expert. After braiding class, non-expert 1 practiced his braided skill everyday. Whereas non-expert 2 practice his braided skill only once time per week. For eye's movement analysis, the expert and non-experts were measured their eye's movement once time per month for 3 times. The first measurement was conducted on the first day that non-experts studied the braiding technique. The second and third times were conducted after 1 month and 2 month, respectively. During the experiment, the eyes of the expert and non-experts were detected their movement by eye mark recorder as shown in Fig. 3 and the braiding process was recorded by video camera.

A braiding speed was calculated follow Eq. (1) as show below.

$$Braiding\ speed = \frac{Braid\ length\ (cm)}{Braiding\ time\ (min)} \tag{1}$$

The braided rope position in the marudai hole during braiding process was measured to investigate the tension of each thread. Those positions were determined from each cycle of braiding process. Finally the final products of the expert and non-experts were observed and detected the defects. The braiding ropes were measured the diameter and the regularity of rope diameter was determined by standard deviation (S.D.) values.

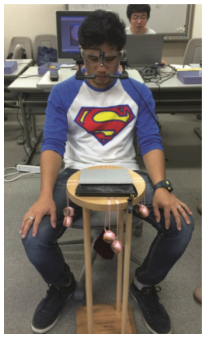


Fig. 3. Eye's movement experiment

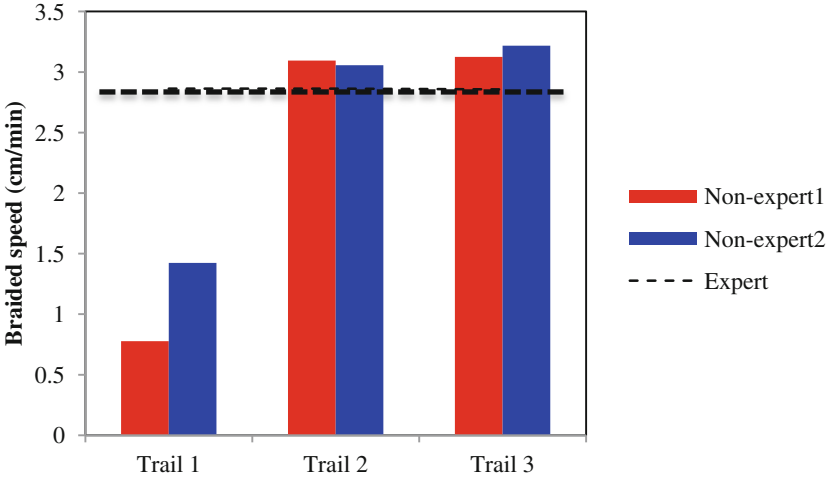


Fig. 4. Comparison of braiding speed between expert and non-experts

4 Results and Discussion

4.1 Comparison of Braiding Speed between the Expert and Non-experts

The braiding speed of expert and non-expert are compared as shown in Fig. 4. For the first braiding trial, the braiding speed of the expert show significantly higher speed than both non-expert samples. This is due to the difference of the experience and skill between expert and non-experts. However after non-expert samples have already understood the braiding process, the braiding speed in the second and third trials of non-expert samples obviously increase when compared with the first trial.

4.2 Eye's Movement Analysis of the Expert and Non-experts

The details of the different braiding skill between expert and non-expert are evaluated by the determination of eye`s movement during braiding. The comparison of the

movement of eyes between expert and non-experts are shown in Figs. 5, 6 and 7. The origin point of the plot is based on the center of the hole of the marudai. The movement of eyes of expert mainly changes in the horizontal direction. In addition, during the braiding process an expert focused on the center position of the marudai plate as the eyes movement data clustering in the center area. In the case of non-expert, both non-expert samples show the higher scattering data and the vertical movement of eyes during the first trail of braiding process (Fig. 5).

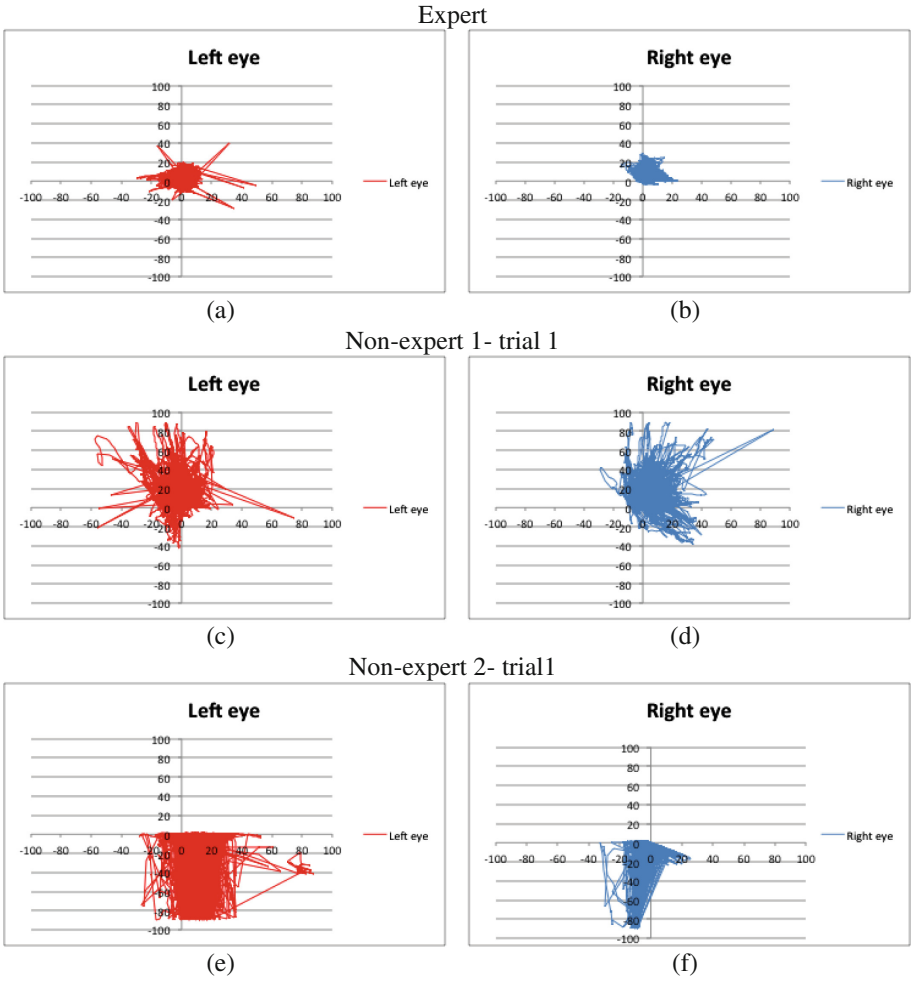


Fig. 5. Eye's movement direction of trial 1 (a) Expert – left eye, (b) Expert – right eye, (c) Non-expert 1 – left eye, (d) Non-expert 1 – right eye, (e) Non-expert 2 – left eye and (f) Non-expert 2 – right eye.

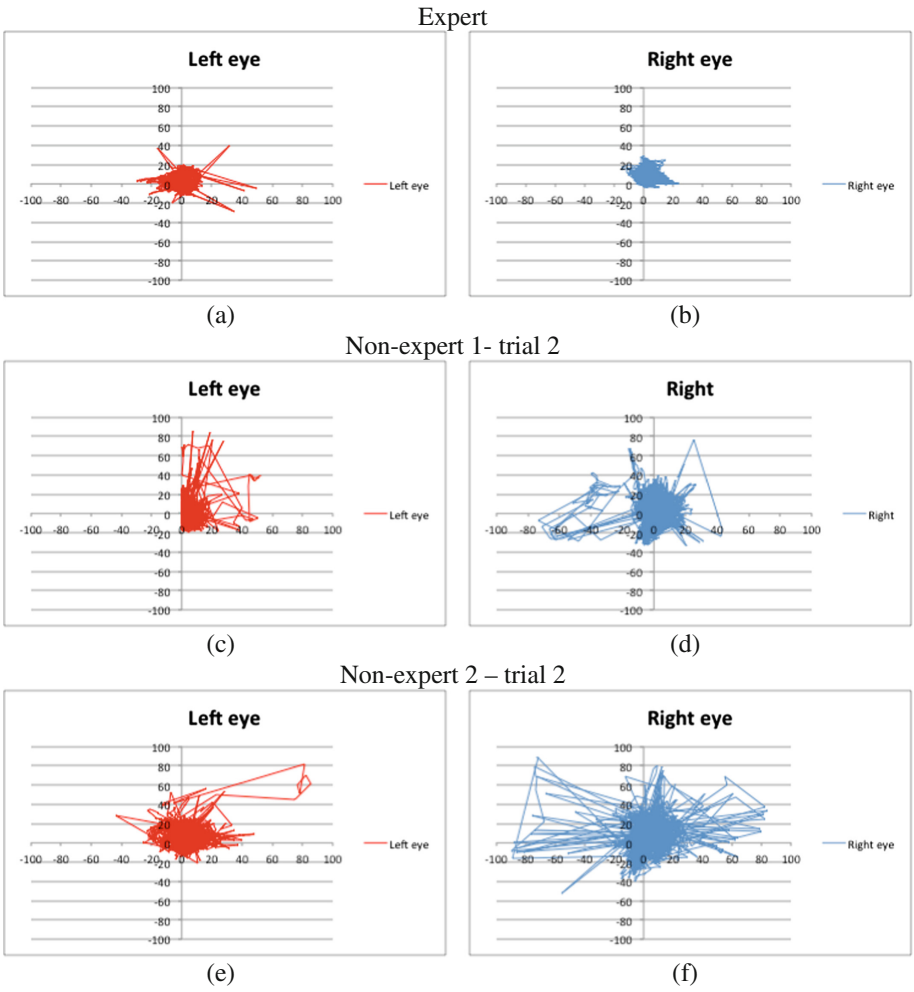


Fig. 6. Eye's movement direction of trial 2 (a) Expert – left eye, (b) Expert – right eye, (c) Non-expert 1 – left eye, (d) Non-expert 1 – right eye, (e) Non-expert 2 – left eye and (f) Non-expert 2 – right eye

After non-expert samples experienced the braiding technique, the eyes's movement in the second and third braiding trials changes from vertical movement to more horizontal direction as shown in Figs. 6 and 7. This is due to the non-expert samples' eyes are focused on the movement of the thread during braiding.

4.3 Braiding Rope Position

Figure 8(a)–(b) shows the position of the braided rope during braiding process. The position of the rope is directly influenced by the tension of each thread. The braided rope positions of an expert scatter around the center of the marudai while the non-experts

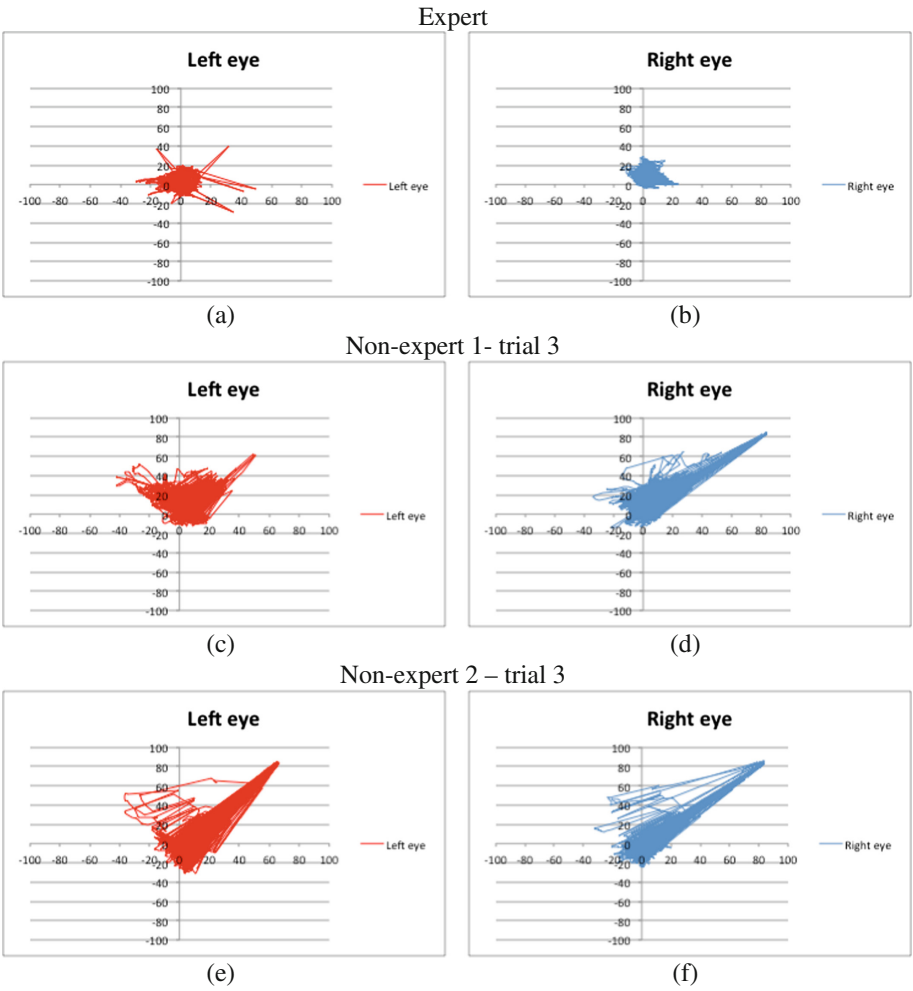
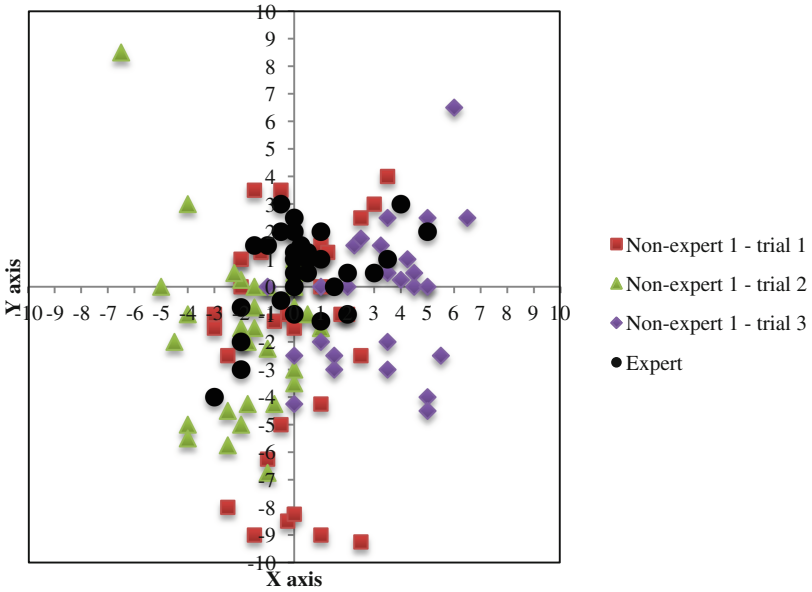


Fig. 7. Eye's movement direction of trial 3 (a) Expert – left eye, (b) Expert – right eye, (c) Non-expert 1 – left eye, (d) Non-expert 1 – right eye, (e) Non-expert 2 – left eye and (f) Non-expert 2 – right eye

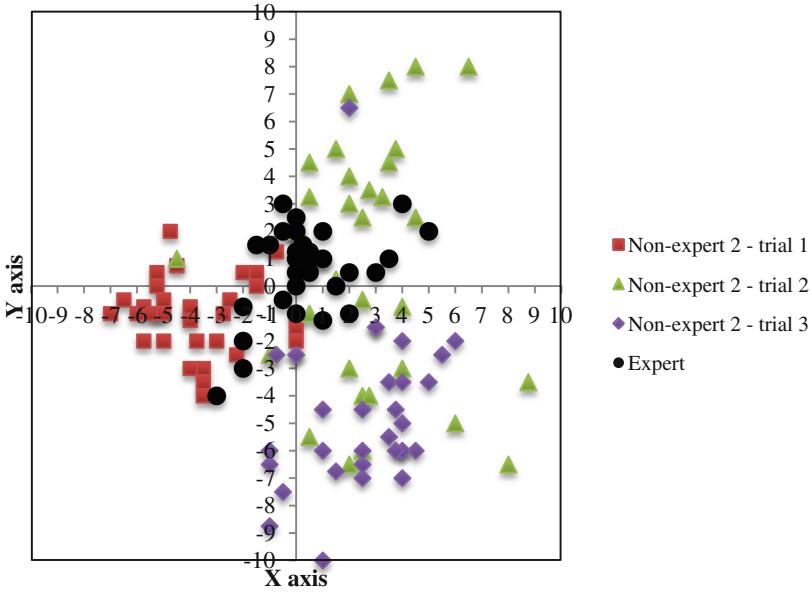
show the unsymmetrical scattering of the rope positions. The unsymmetrical distribution of the rope position is caused by the instability of the tension of the thread during braiding process.

4.4 Comparison of Braiding Rope Quality

A quality and beauty of braiding rope of the expert and non-experts were observed. The photographs of braiding ropes were shown in Fig. 9. A braiding rope of the expert shows the complete braiding pattern along a rope. The quality of braiding ropes that were fabricated by non-expert at the first trial shows the defects due to the incorrect pattern.



(a)



(b)

Fig. 8. Braiding rope position (a) Non-expert 1 and (b) Non-expert 2

However, the everyday practice of braiding for one month of non-expert 1 led to the development of braiding speed as mentioned and a beauty of braiding rope. There is no the defects of the incorrect pattern both of trial 2 and 3. For the braiding rope quality of non-expert 2, they are not show the defect in the braiding ropes in trial 2 and 3 too.

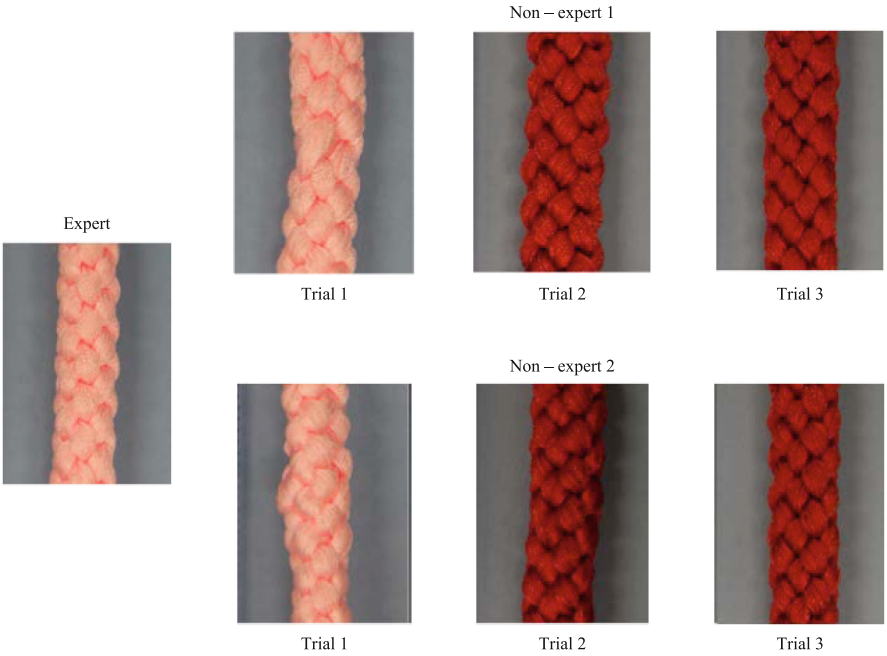


Fig. 9. Final braiding products of the expert and non-experts

The braiding rope diameter also was measured along the rope as shown in Fig. 10. The average value of expert's rope is 0.54 cm. Her rope diameter shows a very small S.D. value. That may cause of the concentration at the center of her eyes and the tension balance of threads during the braiding impacted on the diameter of braiding rope. In the case of non-expert 1 and 2, their ropes diameters increase after all of them have an experience on the braiding technique. However, the diameter along the ropes are not constant obviously as indicated. That relate the eye's movement direction and the braiding rope position. The results of Both non-experts do not show the concentration at the same position with the expert. The lost focusing of non-experts affect the controllable braiding rope diameter.

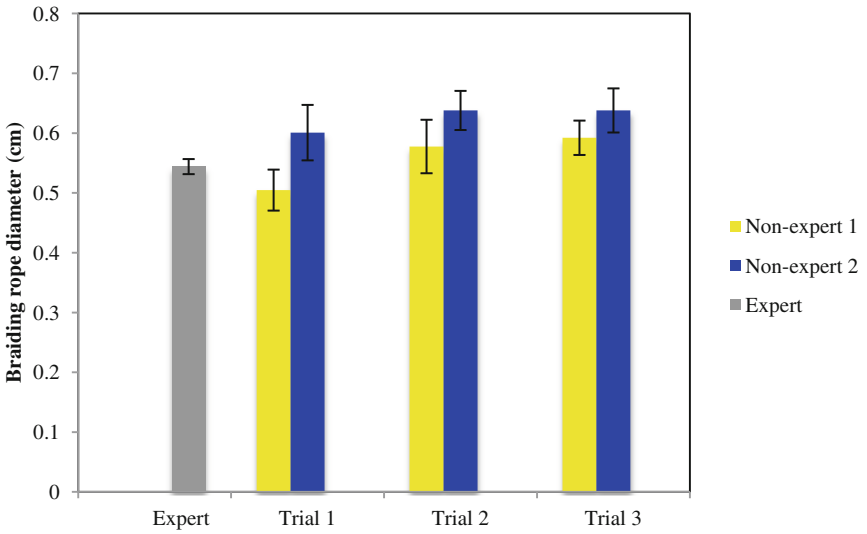


Fig. 10. Braiding rope diameter of the expert and non-experts

5 Conclusion

The expert shows the high performance and constant of braiding skill. Her eye's movement focused at the center of marudai plate that accorded with the braiding rope position. The expert can balance the rope tension during the braiding process well. Whereas the eye's movement of non-experts did not relate with the braiding rope position. However, the braiding experience of non-experts led to the increasing on their braiding speed and a quality of braiding ropes.

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