Learning about Reflection Processes: An Analysis of Learners' Observation of Experts

Akio TAKASHIMA[a]
[a] *Shohoku College, Japan*
*akio.takashima.shohoku@gmail.com

Abstract: Both reflection-in-action and reflection-on-action are important, especially in creative design work. Although school curricula teach the technical side of design, they do not teach the psychological side, represented by the reflection process. The goal of this research is to support learners to understand experts' reflection processes in relation to design. This paper describes experts' reflection-in-/-on-action processes in design, and how learners observe this from video data on the design process, and on eye-tracking of an expert designer. The findings are helpful for designing environments that support students to learn about experts' reflection processes.

Keywords: reflection-in-action, reflection-on-action, design process, student learning, eye-tracking

1. Introduction

The goal of this research is to help learners understand experts' reflection processes in the context of design.

Schoen describes design as a reflective conversation with the material of a situation, and distinguishes two types of reflection: reflection-in-action and reflection-on-action (Schoen 1983). Reflection-in-action is the reflective process that takes place while externalizing representation, while reflection-on-action occurs when a designer views a result of representation. Both types of reflection are important, especially in creative design work.

Although school curricula teach the technical side of design, they do not teach its psychological aspects, which is represented by the reflection process. For this reason, the student has to establish his/her style over many long years, or has to learn it practically through on-the-job trainings of a company.

This paper describes experts' reflection-in-/-on-action processes in design, and how learners observe these processes from video data.

2. Reflection-in-/-on-Action in Design

In addition to physical sketches, supportive computer-based tools are useful to designers. Nakakoji et al. describe the approach of using two-dimensional spatial positioning of piece of document as a representation that is useful for reflection in the early design of documentation (Nakakoji et al. 2000). They argue that position as a state is closely related to reflection-on-action, while positioning as an action is closely related to reflection-in-action. In other words, reflection on the results of a previous action is regarded as reflection-on-action, and reflection while taking the action is regarded as reflection-in-action. The approach taken by Nakakoji et al. guides the present research.

3. Preliminary Study

For the purpose of examining students' interest in learning from experts' processes of creation, we used two tasks: we conducted a questionnaire survey and we asked the students to list their awareness of

expert behavior based on video viewing. The participants consisted of a total of 14 first- and second-grade college students. All participants were majoring in media design.

3.1 Questionnaire Survey

A questionnaire survey was conducted in order to examine students' interest in learning about media design. The questionnaire items are listed in Table 1, and the results relating to question 1 and question 2 are shown in Figure 1 and Figure 2, respectively. As shown in Figure 1, the students feel that watching video representations of the design process is an effective form of learning. Figure 2 indicates that all the students are interested in both the technical and psychological aspects of experts' creation processes.

Table 1: Question items for the survey

Q1	Which types of media are most effective in learning about experts' creation processes? <books, images, videos, Web, dialogue, others> (Multiple answers allowed)
Q2	What is your level of interest in the technical/psychological aspects of experts' creation processes? <None: 0 pt, Very little: 1 pt, Some: 2 pts, A great deal: 3 pts>

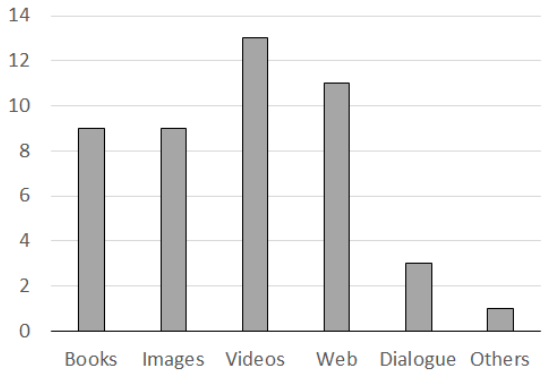

Figure 1. Results for Q1. Which types of media are most effective in learning about experts' creation processes? (N=14, multiple answers allowed)

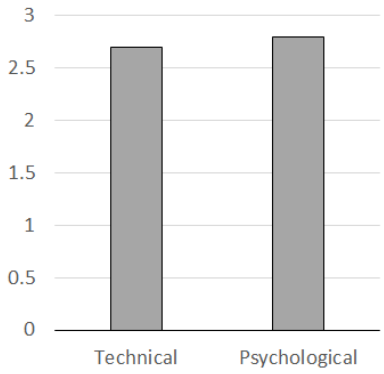

Figure 2. Average results for Q2. What is your level of interest in the technical/psychological aspects of experts' creation processes? (N=14)

3.2 Observation of Experts' Design Processes by Students

Based on the result of the questionnaire survey, a user study was conducted with the aim of revealing how learners observe experts' design processes. As a learning material, we used two video clips from a documentary film on the drawing processes of a famous manga artist, Inoue Takehiko (Inoue, 2006). The details of the videos are described as V1, V2 and typical behaviors considered as part of the reflection process are listed as R1, R2 and R3 in Table 2. The students were asked to report their awareness of the expert's technical and psychological aspects through watching the videos.

R2 was clearly regarded as a reflection-on-action process because the expert declared it to be so; however, it is not obvious that R1 and R3 are reflection processes because the artist did not mention them. R1 is likely to be reflection-in-action process, and R2 is unequivocally a reflection-on-action process.

As a result of the observation, the students reported their levels of awareness: 42.9%, 28.6% and 85.7% of the students mentioned R1, R2 and R3, respectively.

Table 2: Videos for the observation

V1	A documentary film focusing on Inoue's hand, which draws scenes from a very famous manga comic, *Vagabond*. 38 min.	
	R1	The expert said "Hmm..." while he was drawing the face of a character.
V2	A video that shows the drawing processes of other scenes from the same comic as that shown in V1. This includes dialogues between Inoue and an interviewer. 55 min.	
	R2	The expert reversed a sheet of paper in order to examine whether the body of a character is balanced well.
	R3	The expert corrected the eyes of a character using correction fluid.

4. Reflection-in-/-on-Action in Experts' Design Processes

4.1 Analysis of Results using the Retrospective Think Aloud Protocol

Since the target videos used for the preliminary study were in the commercial DVD (Inoue, 2006), the reflection processes were not immediately obvious. For the purpose of linking some of the artist's behaviors with reflections, an audio commentary of another expert's design process was recorded, along with eye-tracking data. The expert is a professional designer and also a part-time lecturer at several colleges. His work centers on logos, typefaces, posters, flyers, and so on. For this experiment, the artist was instructed to create a logo as part of a real logo design competition for a botanical garden in Japan. The tools he selected were Adobe Illustrator, Adobe Bridge, and Google Chrome. In order to track his eye movements, Tobii X2-30 Eye Tracker was used. This device can record eye-movement data without goggles. Figure 3 shows an image of the recording session.

The design process by the expert was initially recorded using his eye-tracking data (Figure 4 shows a screenshot of this data). The design was finished in three hours.

After the design process was complete, an audio commentary for the video containing the eye-tracking data was recorded through the Retrospective Think Aloud Protocol (Guan et al. 2006). Table 3 provides details on this video, and the behaviors that correspond to the reflection processes mentioned by the expert.

Figure 3. The environment during recording of the expert's design process

Figure 4. Eye-tracking data, which indicates that the expert was paying close attention to the character spacing

Table 3: Details on the audio commentary video and mentions of the reflection process

V3	An audio commentary video that includes eye-tracking data on designing a logo for a botanical garden in Japan. 170 min.	
	R4	The expert fine-tuned the position of the kanji characters using the arrow keys on the keyboard.
	R5	The expert fine-tuned the size of the leaves using the arrow keys on the keyboard.
	R6	The expert compared several logos made with different fonts.
	R7	The expert zoomed out and considered the logo for a while.

The reflection processes listed in Table 3 are all recognized as reflection activities by the expert. R4 and R5 can be regard as reflection-in-action processes, because the expert was reflecting while taking the action (i.e. fine-tuning using the arrow keys). On the other hand, R6 and R7 are reflection-on-action processes, because the artist was reflecting on the results of the previous action.

In addition to this awareness of reflections, the expert was surprised at his behavior because while he was adjusting the characters (R4) he paid close attention to the character spacing (Figure 4). This shows that even the expert himself could learn from his own design process. In other words, he "reflected on reflection-in-action".

4.2 Observation of Expert's Design Process by Students

In order to examine whether the college students were able to understand or learn about the expert's creation processes by just watching the audio commentary, an observation was conducted with the same student participants as in Section 3.

In focusing on the reflection processes, R4 and R5 did not capture the student's attention to the same degree as R6 and R7, which were recognized as meaningful behaviors by the expert. Only one student (7.1%) had some awareness of R4, and stated, "This manipulation is a delicate adjustment". A total of 14.3% of the students mentioned R5, for instance: "The expert is continuing to look for a satisfying size"; "it is not so easy for me to understand the slight differences...". In addition, 35.7% of the students showed some interest in the expert's comparison of several fonts (R6), stating, for example, "I cannot decide which is the best"; "Comparing a lot of fonts makes me confused…"; "This font is better"; and so on. R7 was recognized as a meaningful behavior by 28.6% of the students. Several comments, such as "I think that he is checking the arrangement"; and "Zooming in and out is important!" were received.

5. Conclusion and Future work

This paper describes experts' reflection-in-/-on-action processes in design, and how learners observe this from video data. Since the number of participants in these studies was small, the results from the quantitative data were limited; however, we discovered a new perspective from the students' written comments.

The findings from the observations and analysis are as follows:

- College students majoring in media design have an interest in both the technical and psychological aspects of the creative design process.
- Videos are preferred as learning materials related to the design process.
- Behaviors related to reflection-in-/-on-action were observed through the experts' design process.
- Reflection-on-action processes are relatively recognizable, whereas reflection-in-action processes are not.

How, then, can students learn about design processes used by experts? One key element is "reflection on reflection-in-/-on-action," as described in Section 4.1. Giving some cues that indicate instances of reflection-in-/-on-action during recorded design process would be useful in this regard, as would providing cues to indicate instances in which the expert is reflecting on their reflection processes. The fact that even experts continue to reflect on their behavior should enhance learners' interest in the reflection processes.

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