Supporting Zoo Visitors' Scientific Observations with a Mobile Guide

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Abstract: This study proposes an observation guide to support zoo visitors' scientific observation of animals in motion by providing viewpoints through animations. One of the difficulties that visitors experience when observing animals is that they do not sufficiently understand the functions and behavior of the body parts of the animal they are seeing. The guide aims to enhance visitors' understanding by resolving this issue through the use of animations of the functions and behaviors of parts of animals' bodies. To evaluate the guide, we had kindergarteners and elementary school students use its contents on seals while observing their hind flippers, noses, and claws at the Asahiyama Zoo. Our finding was that the guide was an effective means to enhance the children's understanding of the functions and behaviors of these parts of the body.

1 INTRODUCTION

Zoos serve as places for science education (Bell et al., 2009), as they allow children to observe the natural movement of animals directly and learn about the living environments and forms of animals through observation (Dierking et al., 2002). However, most children come to the zoo with their families for leisure, so they often do not seem to engage in focused observation of the living environments and forms of animals at the zoo (Patrick and Tunnicliffe, 2013), suggesting that they require educational support in this setting.

In a comment on observation among children, Eberbach and Crowley (2009) explained that scientific observation is a complex practice that requires the coordination of disciplinary knowledge of, for example, the living environments and forms of animals, and that children, with educational support, are capable of making a transition from everyday observations that focus only on obvious characteristics to scientific observations. Furthermore, they also noted that, during the shift between everyday observations and scientific observations, transitional observations take place that enable children to connect features to functions and behavior.

Previous studies have utilized mobile devices to enrich science education outside the classroom through learning from observation by effectively creating personalized learning environments (Traxler, 2005). Ohashi et al. (2008) developed a navigation system that offered audio and video guidance with an iPod. Furthermore, Jimenez Pazmino et al. (2013) designed technological supports for docents running an immersive, embodied-interaction with portable tablets and large fixed displays.

Following up on these studies, we developed a system to support observation among children to help them move to "transitional noticing," as Eberbach and Crowley (2009) explained in their study, which connects features to function and behavior. This system provides viewpoints for observation through animations that simulate animals' actual movements. We believe that these animations provide a more focused approach to observation so that children can easily understand functions and behaviors, which is something that still images alone were not able to do in the past.

This study proposes an observation guide that supports the observation of the function and behavior of each part of the body of an animal in motion. The purpose of this study was to ascertain whether the guide we developed, using content on seals, was effective in providing viewpoints on the

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function and behavior of the parts of the body.

2 SYSTEM OVERVIEW

2.1 Development Environment

HTML, CSS, JavaScript, and PHP5.3 were used to create the development environment of the server. The guide is Internet-based.

2.2 Flow of the Observation Guide

Figure 1 is a flowchart indicating the flow of the guide. The first page is for entering the child's name, and is followed by the homepage.

A prediction page (before) and a result page (after) are linked to each observation item. The child selects one of the animated choices given by these pages for each question related to the observation. The choices that he/she has made before and after the observation are then saved as a text file after the last observation page.

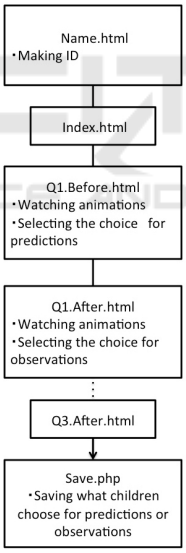

Figure 1: Flow of observation guide.

2.3 Pages

2.3.1 Prediction Page (before)

Figure 2 shows a prediction page, which gives four choices related to each observation item. Two buttons, "Watch Animation" and "Prediction," are displayed. When the child presses the "Watch Animation" button, the animation for each choice is activated. Figure 3 shows an example of an animation page for an observation item. The child can only select one choice among the predictions. Once the choice is made, the guide will move on to the observation page.

Figure 2: Prediction page.

Figure 3: Example of an animation page.

2.3.2 Result Page (after)

Figure 4 shows a result page. Here, the child is also given four choices, with the choice he/she made during the prediction phase indicated by the "My Prediction" graphic. On this page, two buttons, "Watch Animation" and "Result," are displayed. Similar to the prediction page, when the child

Figure 4: Result page/choices for hind flippers.

presses the "Watch Animation" button, the animation for each choice is activated. When the child presses the "Result" button, the choice after the observation is confirmed and the guide will move on to the next observation item.

3 RESEARCH METHOD AND DESIGN

3.1 Overview

The aim of this exercise was to facilitate observation of the features of seals while also examining their functions and behaviors. More specifically, the children were to observe the features and behaviors of seals' hind flippers, noses, and claws. There were four choices for each observation item. Figure 4 shows the choices for the hind flippers: 1. Swimming using hind flippers; 2. Catching something with hind flippers; 3. Swimming using fingers; and 4. Catching something with fingers. Figure 5 shows the choices for the nose: 1. Seals always open their noses and breathe above water; 2. Seals always open their noses and spray water on the water surface; 3. Seals close their noses underwater and open them to breathe above water; and 4. Seals close their noses underwater and open them to spray water on the water surface. Finally, Figure 6 shows the choices for the claws: 1. Walking with fore flippers without using claws; 2. Eating with fore flippers without using claws; 3. Walking with fore flippers using sharp claws; and 4. Eating with fore flippers using sharp claws.

Observation was carried out in the following steps. First, as shown in Figure 7, the children were presented with the questions and choices using images and the guide. They were then asked to predict the right answers from among the choices as shown in Figure 8. Finally, the children were asked to observe the behavior of the seals in the exhibit while using the guide and to select the answers from among the choices once again (Figure 9). After these steps, the right answers based on the observation were revealed and explained. The above steps were followed for each observation item, requiring approximately 15 minutes each time. After they had completed the observation of all the items, namely the hind flippers, nose, and claws, the children were interviewed for approximately 30 minutes (Figure 10).

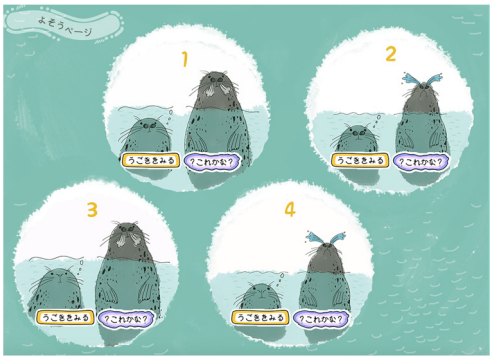

Figure 5: Choices for nose.

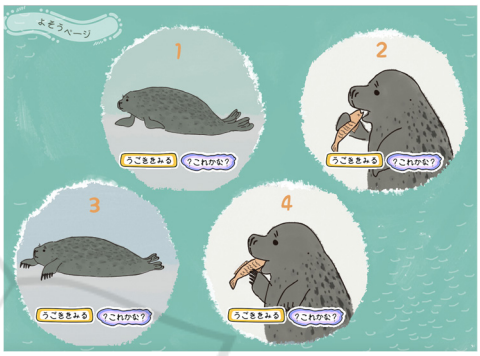

Figure 6: Choices for claws.

Figure 7: Staff members showing questions to the children.

Figure 8: A child watching an animation.

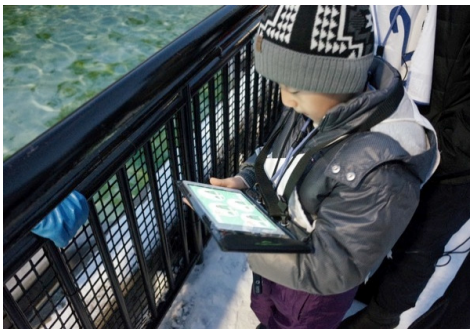

Figure 9: A child using his tablet during observation.

Figure 10: A child being interviewed.

3.2 Participants

The participants were 16 children chosen from the public; their mean age was 7.0 years (SD=2.0). One or two adults accompanied each child during the observation of the seals, and each child received a tablet to use for this exercise.

3.3 Zoo

The Asahiyama Zoo where this study was conducted is a pioneer in animal behavior exhibits and ranks high in the number of visitors among zoos around the world (Kosuge, 2006).

3.4 Data Source and Analysis

During this workshop, the verbal and non-verbal communication and behavior of the children were recorded using IC recorders and video cameras. For analysis, we used the interview research method to determine the children's assessments of the animations used during the observation of the hind flippers, nose, and claws, and, more specifically, whether the animations were useful and why.

4 RESULTS

4.1 Overall Trend

Table 1 shows the number of children who answered whether the animations were useful or not useful. Sixteen children stated that the animations for the hind flippers as well as the nose were useful. Fifteen children stated that the animations of the claws were useful while one stated that they were not.

Table 1: Number of children who answered whether these animations were useful.

	Useful	Not useful
Hind flippers	16	0
Nose	16	0
Claws	15	1

Note: N=16

4.2 Episodes

There are four episodes of the interview-based research. Episodes 1 and 2 show the children's statements about the usefulness of the animations on the Mobile Guide. Episode 3 shows a child's statement about the uselessness of one of the animations. Episode 4 shows a child's statement about the improvement of the animation.

4.2.1 Episode 1: Interview of B11 about Hind Flippers' Animation

Table 2 shows the episode with a five-year-old boy (B11). He says the animations of hind flippers are useful. He gives the reason, "When I forgot what I

Table 2: Episode 1: Interview of B11 about hind flippers' animation.

01I11v: Was the animation of hind flippers useful for observation?
02B11n: Nodding.
03I11v: Why?
04B11v: When I forgot what I had observed, I could confirm it with the tablet immediately.
05I11v: When you confirmed it, did you need the animation or just this still result page?
06B11v: I could do it just by the result page.
07I11v: How about the animation? Do you think the animation was not needed?
08B11v: I needed the animation. As the picture on the result page did not move, I could not understand how the seals use their hind flippers.

Note on transcription numbers: Consecutive numbers, B11: a 5-year-old boy, I11: an interviewer, v: verbal behavior, n: non-verbal behavior.

had observed, I could confirm it with the tablet immediately" (04B11v). To clarify the advantages of the animation, Interviewer 11 asks, "When you confirmed it, did you need the animation or just this still result page?" (05I11v). The child answers, "I needed the animation. As the picture on the result page did not move, I could not understand how seals use their hind flippers" (08B11v). Therefore, by using the animation, B11 can confirm how seals use their hind flippers.

4.2.2 Episode 2: Interview of G2 about the Nose's Animation

Table 3 shows the episode with a six-year-old girl (G2). She says the animation of the nose is useful, "Because I could understand how seals move" (04G2v). Interviewer 2 asks, "When you observed the seals, did you check the same motion?" (05I2v). She answers, "Yes" (06G2v). Therefore, G2 gets the viewpoint for observation of nose's function and behavior from the animation. Further, she can observe them.

Table 3: Episode 2: Interview of G2 about the nose's animation.

01I2v: Was the animation of nose useful for observation?
02G2v: It was useful.
03I2v: Why?
04G2v: Because I could understand how seals move.
05I2v: When you observed the seals, did you check the same motion?
06G2v: Yes.

Note on transcription numbers: Consecutive numbers, G2: a 6-year-old girl, I2: an interviewer, v: verbal behavior.

4.2.3 Episode 3: Interview of B1 about the Nose's and Claws' Animation

Table 4 shows the episode with a seven-year-old boy (B1). He says the animation of the nose is useful, but the animation of the claws is not useful. B1 explains that the animation of the nose is needed, "Because, for example, the air, then you can't see the air" (04B1v). However, he says the animation of claws is not needed, "Because, seal, seal, can eat, ah, you can see the food and the hunt" (08B1v).

Therefore, B1 thinks that the animation of the nose is useful because in the animation he can notice the air, which we cannot see otherwise. He can understand and observe how seals breathe on the water. On the other hand, he thinks that the animation of the claws is not useful because he can see the food and the hunt. This shows that the animation of the claws is not as useful for him as that of the nose.

Table 4: Episode 3: Interview of B1 about the nose's and claws' animation.

01I1v: Was the animation of nose needed or not?
02B1v: Needed.
03I1v: Why?
04B1v: Because, for example, the air, then you can't see the air.
…
05I1v: Was this animation needed or not?
06B1v: No need.
07I1v: Why?
08B1v: Because, seal, seal, can eat, ah, you can see the food and the hunt.

Note on transcription numbers: Consecutive numbers, B1: a 7-year-old boy, I1: an interviewer, v: verbal behavior.

4.2.4 Episode 4: Interview of G12 about the Nose's Animation

Table 5 shows the episode with an eleven-year-old girl (G12). She says that the animation of the nose should be improved. She explains, "For beginners, it looks misleading. In fact, seals open and close their noses when they are on the water" (02G12v). Interviewer 12 asks, "You think the animation is good but it should be improved, right?" (07I12v). She answers, "Yes" (08G12v). Therefore, G12 says that the animation is useful but it should be improved to represent the viewpoint of the nose's function and behavior more realistically.

Table 5: Episode 4: Interview of G12 about the nose's animation.

01I12v: Was the animation of nose useful for observation?
02G1v: For beginners, it seems misleading. In fact, seals open and close their nose when on the water.
03I12v: Seals also open and close their nose, so you think the animation should be improved, right?
04I12v: But, do you think this animation can show that seals close their nose under the water and open it on the water?
05G12v: Yes.
06I12v: You think the animation is good but it should be improved, right?
07G12v: Yes.

Note on transcription numbers: Consecutive numbers, G12: an 11-year-old girl, I12: an interviewer, v: verbal behavior.

5 CONCLUSION AND FUTURE WORKS

This study aimed to develop and assess an observation guide. We discovered that the vast majority of the children found this system useful during the observation and that the system helped the children understand the movements of the animal sufficiently to engage in prediction and observation. Our conclusion, therefore, is that this system was an effective tool for observing the functions and behaviors of parts of an animal's body. To identify the evidence that the system actually supports children's observation, we will examine how the children use the system by video research for future works.

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