Evaluation of the Effectiveness of a Digital Microscope System with Tabletop Interface in a Science Class

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Abstract: This study examined the effects of utilizing a digital microscope system with tabletop interface in an elementary school science class. The findings show that the equipment was more effective than optical microscopes for microscopic observation tasks such as finding, focusing, and sketching.

Keywords: Tabletop, Multi-touch, Microscope observation

1. Introduction

In science class, elementary students observe water microorganisms by taking turns using an optical microscope. However, it is difficult for them to observe and sketch the same object. In order to facilitate students' discussion and cooperation, a new tool for the observation of microorganisms is needed.

Kitahara et al. (2006) showed that a tabletop interface was effective in collaborative learning. Moreover, there are studies of observations using digital microscopes instead of optical microscopes (Tessmer et al., 2011; Dickerson et al., 2007; Van Scoter, 2004). Morita et al. (2013) developed a digital microscope system with tabletop interface and showed that microscopic observations using this system were useful for understanding water microorganisms. Therefore, this study examines the effects of utilizing this equipment for microorganism observation education.

2. Procedure

2.1 Digital Microscope System with Tabletop Interface

Figure 1 illustrates the digital microscope system with tabletop interface (MT-SCOPE). MT-SCOPE consists of a multi-touch screen and digital microscope. The multi-touch screen has infrared LEDs, an acrylic sheet, a tracing paper, and an infrared camera. The system is capable of scaling, rotating, and moving microscope photos and videos through multi-touch operation.

2.2 Subjective Assessment by Survey

A total of 33 elementary school students participated in this study. After operating both types of equipment (optical microscope, MT-SCOPE), they responded to nine questions by selecting from the following four responses: Strongly Agree, Agree, Disagree, and Strongly Disagree. The positive (Strongly Agree and Agree) and negative (Disagree and Strongly Disagree) responses were totaled for each item and compared using Fisher's exact test.

(Sketching microorganisms)

(Observing microorganisms with multi-touch)

Students using MT-SCOPE

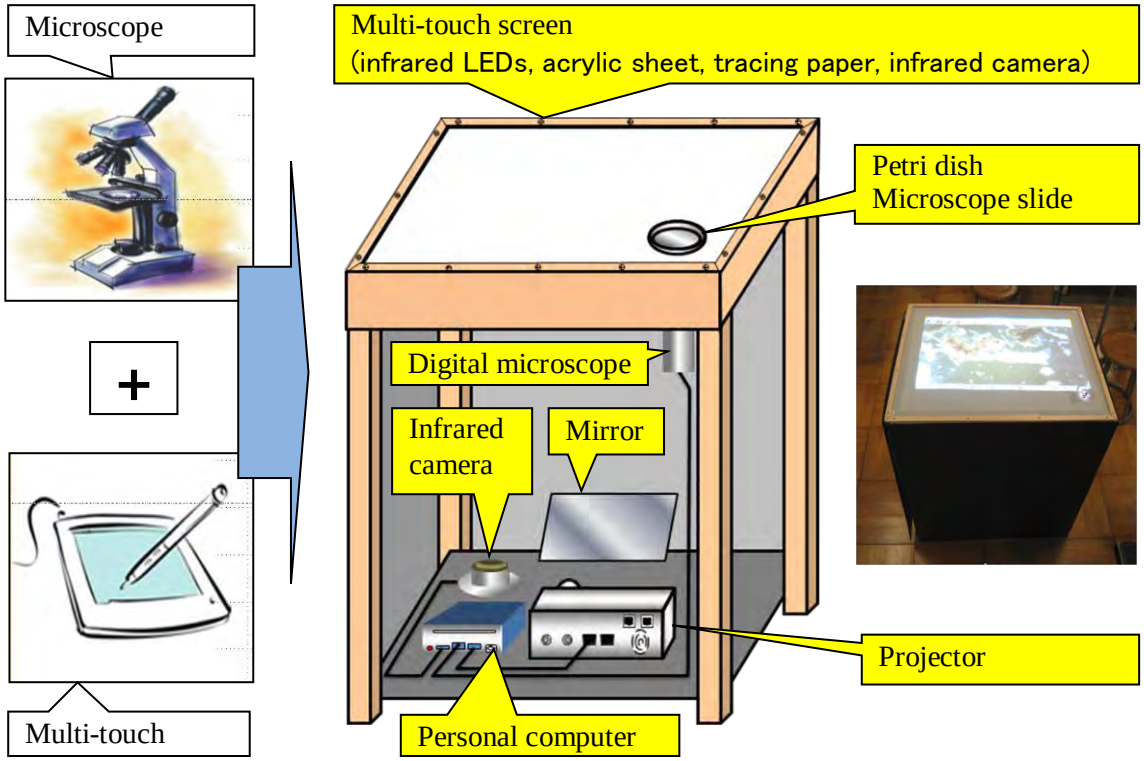

Figure 1. The Digital Microscope System with a Tabletop Interface for Microscope Observation.

3. Results and Discussion

Table 1 shows the results of Fisher's exact test. All the students responded in the affirmative to the statements "It was easy for me to find the water microorganisms" ($p < .01$) and "It was easy for me to adjust the focus" ($p < .01$). Moreover, there were many affirmative replies for "It was easy for me to sketch the water microorganisms" ($p < .01$) and "I found the water microorganisms" ($p < .05$). The results suggest that MT-SCOPE was more effective than optical microscopes for microscopic observation.

Conversely, there were a number of negative replies for "I discussed the water microorganisms with my group members" (*n.s.*). This seems to indicate that the design of observation lessons needs to be improved in the future.

Table 1: Results of the subjective assessment.

Question Categories	Equipment	Positive		Negative		Fisher's Exact Test
		Strongly Agree	Agree	Disagree	Strongly Disagree	
It was easy for me to find the water microorganisms.	MS	15	12	4	2	**
	MT	19	13	1	0	
It was easy for me to adjust the focus.	MS	5	10	16	2	**
	MT	16	14	3	0	
It was easy for me to sketch the water microorganisms.	MS	10	11	10	2	**
	MT	17	15	1	0	
I found the water microorganisms.	MS	15	12	4	2	*
	MT	31	2	0	0	
I observed the water microorganisms.	MS	19	10	2	2	*n.s.*
	MT	31	1	1	0	
I discussed the water microorganisms with my group members.	MS	9	15	5	4	*n.s.*
	MT	15	10	6	2	
After taking the practical class, I have become eager to learn more about water microorganisms.	MS	20	8	1	4	*n.s.*
	MT	22	7	2	2	
After taking the practical class, I have become eager to learn more about other microorganisms.	MS	23	5	2	3	*n.s.*
	MT	24	7	1	1	
I enjoyed this microscope observation lesson.	MS	25	5	2	1	*n.s.*
	MT	30	2	1	0	

MS: Optical microscope, MT: MT-SCOPE, $^{**}p < .01$, $^{*}p < .05$, *n.s.*: not significant.

4. Conclusion

This study examined the effects of utilizing MT-SCOPE in an elementary school science class. The findings show that the equipment was more effective than optical microscopes for microscopic observation tasks such as finding, focusing, and sketching. Using the data from this study, future research should focus on improving MT-SCOPE and examining its effective practical uses in elementary schools.

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