

Students' Knowledge of Plant Cultivation Activities in Technology Education

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Abstract -- The purpose of this study was to investigate students' knowledge of plant cultivation activities in technology education at junior high school. We categorized free-form text comments of the students on knowledge of plant cultivation activities. As a result, students' comments were divided into 13 categories (K-1~13). They were classified into three types (C-1~3) through cluster analysis. Moreover, it was suggested that the knowledge of C-2 "Fertilizing, manuring and regulating of sunshine" for students was related to the pleasure of "Harvest, or gathering the seeds".

Keywords – Plant cultivation, Students' knowledge, Technology Education, Guidelines for teachers

I. INTRODUCTION

At junior high school level, the learning activity of plant cultivation mainly focuses on the technical field of the technology and home economics course in Japan. The aim of plant cultivation activities is to acquire the capability of managing the environment and appropriate intervention for growth of plants, as well as acquire the capability of planning for such activities.

The learning activity of plant cultivation is dealt with at elementary school level, or earlier. Therefore, at junior high school level, the teacher needs to draw up an educational guidance plan based on the knowledge acquired by students at elementary school level. In addition, although fish and shellfish farming may be included in cultivation activities, in this study, cultivation is defined as the learning activity used to cultivate plants.

There are some studies about plant cultivation activities at elementary school level. For example, Fujiwara and Noda [1] indicated the importance of making "comparison of" and "relating" performance in cultivation activities of elementary school first and second graders. Implementation involved putting a mark on one of the buds of a morning glory, to enable bud changes to be forecasted by first grader in an elementary school. When a teacher set up a subject so that "comparison" and "relating" may be performed spontaneously, it was reported that acquiring the capability to influence nature was promoted and the motivation for learning over cultivation activities also increased. Fujiwara-Noda research suggested that acquisition of capability in cultivation activities should be gradually performed via a subject at a level at which a student could tackle spontaneously.

There are some studies on early childhood education, about the stepwise acquisition of capability in cultivation activities. Suga [2] analyzed the inner view of small children (three and four year olds) in sweet potato cultivation activities at a kindergarten. As a result, it was considered that an understanding of the small child about a biological event shifts to the stage performed based on biological knowledge from the stage performed under the category of personification. Similarly, for a five-year-olds class at a kindergarten, Otani et al [3] analyzed a small child's recognition of the growth process in Kidney bean cultivation, and reported a shift to the stage of biological understanding from the stage of personification. Moreover, Toyama [4] investigated whether plants could be recognized as living things instead of inanimate objects by nursery school six-year olds who were performing cultivation activities daily. As a result, Toyama drew the conclusion that experience in cultivation of crops affected recognition of crops as living things.

Also, for plant cultivation in technology and home economics in Junior high school, the teachers should gradually set up training at an appropriate level, based on the student knowledge acquired in kindergarten and elementary school. For example, a noted problem has been that textbooks introduce the learning at a pace different to that of developmental stages [5]. Accordingly there is no established theory, at present, about the developmental stage for acquiring knowledge in plant cultivation activities at junior high school. In addition, there were indications that "horticulture as a hobby" was the main element of plant cultivation in relation to stimulation of students' aesthetic sensitivity, rather than "crop production" being the main element of plant cultivation [6]. Moreover, due to a lack of facilities and fixtures, some teachers had a negative attitude toward plant cultivation activities [7]. Consequently, the approach to implementation by teachers at junior high school is an issue.

In a previous study by one of the authors [8], the indication was that less than half of the students at junior high school took an interest in plant cultivation activities, which suggested that their past cultivation experience was the cause. Accordingly, it was assumed that there were many students who didn't have any interest in plant cultivation activities from the outset of study at junior high school. Such students would also be able to tackle plant cultivation activities smoothly if teachers could direct cultivation from a level that enabled the students to tackle tasks spontaneously so that knowledge could be acquired gradually.

The purpose of this study was to investigate students' knowledge of plant cultivation activities in the technology and home economics course at junior high school, and acquire useful knowledge for teachers to manage plant cultivation activities.

II. METHOD

A. Subjects –

A survey was conducted in February 2010 with 153 first graders in one junior high school. As the school was a private institution, target students had graduated from various elementary schools, such as ones in Osaka, Kyoto, and Hyogo Prefecture. The study revealed that not all the students had learned about plant cultivation at elementary level.

B. Construction of survey questionnaire –

In order to investigate student knowledge on plant cultivation activities, we included the following text in our questionnaire: "To enhance the evaluation process, please be specific in your answers about what you devised." Moreover, in order to analyze the relation between the knowledge and interest on plant cultivation activities, we prepared the following question sentence: "Was your experience of plant cultivation pleasant? Please give specific reasons." The students answered the questionnaire using free-form text comments.

III. RESULTS AND DISCUSSION

We categorized free-form text comments of the students on knowledge of plant cultivation activities. As a result, students' comments were divided into 13 categories (K-1~13). For students giving descriptions, student numbers are given for each category in Table 1. In addition, as some students' descriptions corresponded to two or more categories, these numbers were duplicated.

Table 1 shows that the majority of students' comments concerns K-1 "Sprinkling water" as knowledge in plant cultivation activities. Some 66.7% of all students mentioned "Sprinkling water". The necessity of "Sprinkling water" also was affirmed as a comparatively high rate in the studies conducted by Otani [3] on five-year olds, and that Toyama [4] conducted on six-year olds. It was suggested that the knowledge of "Sprinkling water" was acquired by many students in childhood. Accordingly, although the rate of the students who mentioned "Sprinkling water" was 66.7% in this study, it was considered that the other students had mentioned other knowledge on the premise that "sprinkling water" was important, rather than not knowing anything about "Sprinkling water."

Table -1 Students' knowledge of plant cultivation activities

	Boys N=61	Girls N=92	Total N=153	Boys—Girls χ^2
K-1 Sprinkling water	39 (63.9%)	63 (68.5%)	102 (66.7%)	0.341
K-2 Fertilizing, manuring	22 (36.1%)	19 (20.7%)	41 (26.8%)	4.442 *
K-3 Regulating of sunshine	15 (24.6%)	18 (19.6%)	33 (21.6%)	0.547
K-4 Observing, recording	4 (6.6%)	13 (14.1%)	17 (11.1%)	2.130
K-5 Weeding	5 (8.2%)	11 (12.0%)	16 (10.5%)	0.554
K-6 Take care against harmful insects and/or birds	4 (6.6%)	12 (13.0%)	16 (10.5%)	1.648
K-7 Working hard on plant cultivation	2 (3.3%)	10 (10.9%)	12 (7.8%)	2.924
K-8 Gathering information about cultivating plant	2 (3.3%)	10 (10.9%)	12 (7.8%)	2.924
K-9 Pruning leaves and side buds, etc.	4 (6.6%)	6 (6.5%)	10 (6.5%)	0.000
K-10 Keeping a distance on planting	1 (1.6%)	7 (7.6%)	8 (5.2%)	2.638
K-11 Conditioning and drawing soil, and plowing again	4 (6.6%)	3 (3.3%)	7 (4.6%)	0.913
K-12 Arranging harvest	3 (4.9%)	3 (3.3%)	6 (3.9%)	0.267
K-13 Guiding of stalks and branches	1 (1.6%)	4 (4.3%)	5 (3.3%)	0.851

Note: Rate shows percentage of students who mentioned the knowledge. * $p < .05$

Comparing reply tendency of boys and girls, the rate of boys in terms of numbers was significantly higher than that of girls' for K-2 "fertilizing and manuring" ($\chi^2(1)=4.442, p < .05$). Sasaki and Nishiuchi [9] investigated the numbers for experience and interest level on plant cultivation activities for elementary and junior high school students, and compared boys with girls. They reported that girls had more experience and interest than boys. Although, between boys and girls, it was surmised that a difference arises in the tendency of learning in plant cultivation activities, so attention will be given to this in a future study.

In each category, we computed the rate of disagreement with the responses of other categories, and standardized them (means=0, standard deviation=1) as distance scores. Cluster analysis was performed using the Ward method, based on these data. As a result, three clusters were formed at a semi-partial r-squared of 4.664 (C-1~3). The result of cluster analysis is shown in Figure 1.

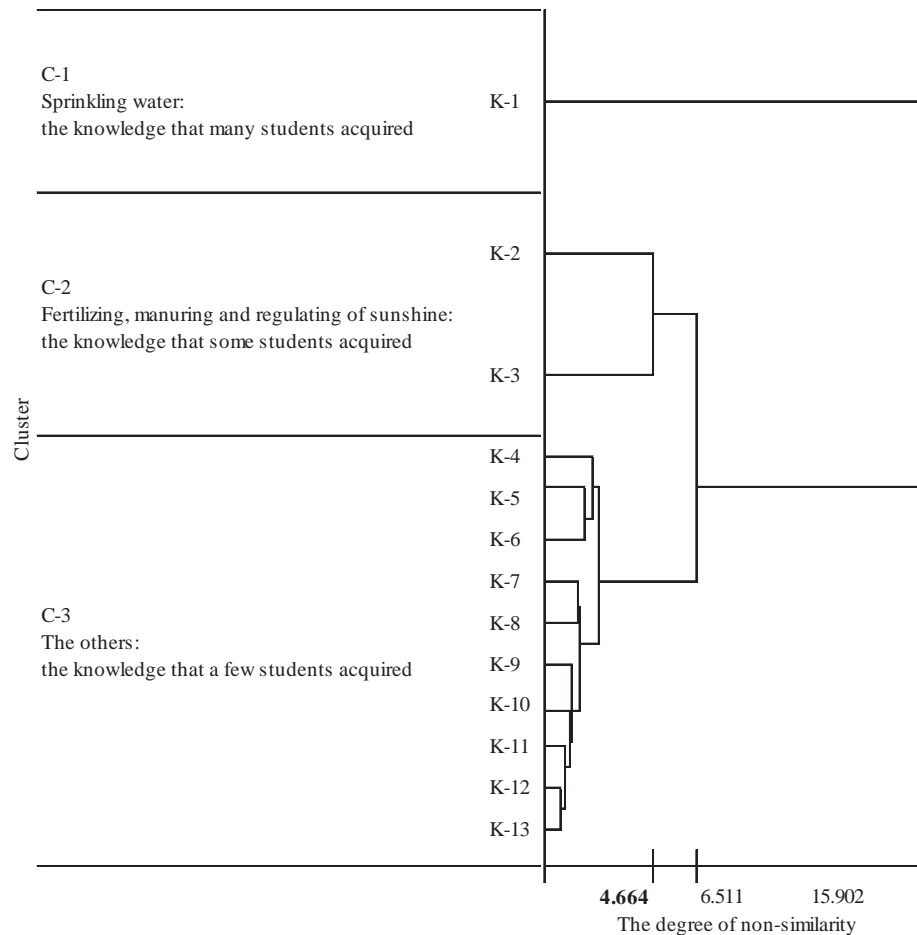


Figure 1. The tree diagram of students' knowledge of plant cultivation activities

Each cluster was named based on knowledge that the cluster included, and rate of the students' description of the knowledge. As a result, C-1 cluster was named "Sprinkling water: the knowledge that many students have acquired," C-2 cluster was named "Fertilizing, manuring and regulating of sunshine: the knowledge that some students acquired," and C-3 cluster named "The others: the knowledge that a few acquired." The knowledge that C-2 cluster included was mentioned by 21.6~26.8% of all students. Accordingly, it was suggested that the knowledge of C-2 played a role in mediating between the knowledge of C-1 and C-3.

We categorized the free-form text comments of the students on interest of plant cultivation activities. As a result, students' comments were divided into eight categories (P-1~8) on "Pleasure" and divided into seven categories (U-1~7) on "Unpleasantness." For every category, the number of students who mentioned the category is shown in Table 2 on "Pleasure," and Table 3 on "Unpleasantness."

Table -2 Pleasure that students found in past experience on plant cultivation

		Boys N=61	Girls N=92	Total N=153	Boys – Girls χ^2
P-1	Harvest, or gathering the seeds	22 (36.1%)	36 (39.1%)	58 (37.9%)	0.146
P-2	Real feeling on growth of plants	12 (19.7%)	41 (44.6%)	53 (34.6%)	10.039 **
P-3	Flowering	8 (13.1%)	25 (27.2%)	33 (21.6%)	4.286 *
P-4	An activity with friends	3 (4.9%)	9 (9.8%)	12 (7.8%)	1.201
P-5	New knowledge and experiences	3 (4.9%)	7 (7.6%)	10 (6.5%)	0.435
P-6	Being a worthwhile activity	4 (6.6%)	3 (3.3%)	7 (4.6%)	0.913
P-7	An activity accompanying plant cultivation	1 (1.6%)	5 (5.4%)	6 (3.9%)	1.402
P-8	Therapeutic value of tending plants	0 (0.0%)	3 (3.3%)	3 (2.0%)	2.029

Note: Rate shows percentage of students who mentioned the remembrance of pleasure in past experience of plant cultivation.

*p<.05 **p<.01

Table -3 Unpleasantness that students found in past experience on plant cultivation

		Boys N=61	Girls N=92	Total N=153	Boys – Girls χ^2
U-1	Tedious on a daily basis	17 (27.9%)	22 (23.9%)	39 (25.5%)	0.302
U-2	Plants tend to be underdeveloped	6 (9.8%)	16 (17.4%)	22 (14.4%)	1.701
U-3	Inept at dealing with insects	4 (6.6%)	12 (13.0%)	16 (10.5%)	1.648
U-4	Insufficient harvest	6 (9.8%)	5 (5.4%)	11 (7.2%)	1.065
U-5	Exhausted by cultivation work	2 (3.3%)	7 (7.6%)	9 (5.9%)	1.242
U-6	Indifferent to plant cultivation	2 (3.3%)	3 (3.3%)	5 (3.3%)	0.000
U-7	Uncooperative behavior by classmates or neighborhood	1 (1.6%)	2 (2.2%)	3 (2.0%)	0.055

Note: Rate shows percentage of students who mentioned the remembrance of unpleasantness in past experience of plant cultivation.

Table 2 shows that the students' comments about P-1 "Harvest, or gathering the seeds", P-2 "Real feelings on growth of plants" and P-3 "Flowering", on "Pleasure" of plant cultivation activities converts to a large proportion (21.6~37.9%) of all students; whereas, P-4 to P-8 reached less than 10% of all students. A comparison of reply tendency of boys and girls shows the rate for girls to be significantly higher than that for boys for P-2 "Real feelings on growth of plants" ($\chi^2(1)=10.039$, $p<.01$), and P-3 "Flowering" ($\chi^2(1)=4.286$, $p<.05$). It was surmised that the significant difference between boys and girls was linked with the content of above Sasaki and Nishiuchi [9] study.

Table 3 show that the students' description of U-1 "Tedious on a daily basis", U-2 "Plants tend to be underdeveloped" and U-3 "Inept at dealing with insects" on "Unpleasantness" of plant cultivation activities converts to a large proportion (10.5~25.5%) of all students; whereas, U-4 to U-7 were less than 10% of the whole. On "Unpleasantness," there was no difference between boys and girls.

The relationships between students' knowledge C-1~3, "Pleasure" and "Unpleasantness" on plant cultivation activities were examined. On "Pleasure" and "Unpleasantness," P-1~3 and U-1~3 occupied 10% or more of all comments made by students. Table 4 shows the results of computations in an ϕ coefficient [10] with regard to relationships between C-1~3, P-1~3 and U-1~3.

Table 4 shows that C-2 significantly correlated with P-1($\phi=.179$). This suggested that the knowledge of C-2 "Fertilizing, manuring and regulating of sunshine," for students, was related to the pleasure of P-1 "Harvest, or gathering the seeds." Some 21.6 to 26.8% of all students had knowledge of C-2. Consequently, to raise the rate of this knowledge, teachers should emphasize "Harvest, or gathering the seeds" in plant cultivation activities.

Table -4 The relationships between students' knowledge and pleasure, unpleasantness on plant cultivation activities

		Pleasure			Unpleasantness		
		P-1	P-2	P-3	U-1	U-2	U-3
Knowledge	C-1	n.s.	n.s.	n.s.	n.s.	n.s.	n.s.
	C-2	.179*	n.s.	n.s.	n.s.	n.s.	n.s.
	C-3	n.s.	n.s.	.232**	n.s.	n.s.	n.s.

Note. The value shows ϕ coefficient. * $p<.05$ ** $p<.01$

IV.CONCLUSION

The purpose of this study was to investigate students' knowledge of plant cultivation activities on technology and home economics course at junior high school, and acquire useful knowledge for teachers to manage plant cultivation activities. The results of this study were concluded as following:

- 1) Free-form text comments of the students on knowledge of plant cultivation activities were categorized. As a result, students' comments were divided into 13 categories (K-1~13). Moreover, they were classified into three types (C-1~3) through cluster analysis.
- 2) The knowledge of C-2 cluster was mentioned by 21.6~26.8% of all students. Accordingly, this suggests that C-2 knowledge played a role of mediating between the knowledge of C-1 and C-3.
- 3) Examination of relationships between students' knowledge and pleasure suggested that the knowledge of C-2 "Fertilizing, manuring and regulating of sunshine," for students, was related to the pleasure of P-1 "Harvest, or gathering the seeds."

Based on these results, our next study will aim at verifying data through practice of plant cultivation activities at junior high school technology and home economics course, and pursue improvements in the method of educational guidance.

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