

# Study on the Fostering of Creativity in Technology Education

## — Comparison of Average Scores between Male and Female Students —

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### 1. Introduction

Instruction processes in technology education can be classified into lessons focusing on sedentary learning (hereinafter called “sedentary learning”) and those focusing on productive practices (hereinafter called “productive practices”), and the latter productive practices are considered to be an especially important instruction process for achieving the fostering of creativity, one of the objectives of Industrial Arts and Homemaking course<sup>1)2)</sup>.

In this study, the creativity in technology education is considered to be “an ability and attitude toward creating the ever most valuable thing, concept and solving method for the individual for solving technological problems”<sup>3)4)5)</sup>, the productive practices as a process in the whole instruction plan of the “Woodworking” area are taken up and clarification of relations between these productive practices and the fostering of creativity is aimed at as the purpose of the study.

### 2. Method of study

For understanding concretely the conditions of the fostering of creativity, we have examined the structures of the fostering of creativity in technology education in view of the formation of creativity based on a general educational concept and the objectives and contents of Industrial Arts and Homemaking course, set up the structures and components shown in Figure 1<sup>4)5)</sup> and made the creativity diagnosis tests in Figure 2<sup>4)5)</sup>. In making the creativity diagnosis tests, we have set up, in principle, 3 questions each for one component, 9 and 5 questions respectively for components “expression” and “planning” and thus made 50 questions in total, in order to understand easily the conditions of creative activities for each content of learning. The reason why the number of questions for “expression” and “planning” is increased to in that we have considered these 2 components particularly important for the contents of learning to work materials in order to complete the product just in line with the expected conception. Evaluation for each question is made in 4 stages of A (4 points), B (3 points), C (2 points) and D (1 point). This study intended to examine the conditions of fostering creativity in the productive practices by using these creativity diagnosis tests.

Lessons for which the creativity diagnosis tests were conducted were productive practices in the “Woodworking” area for 57 male students, 46 female students and 103 students in total in 1-3 classes of the first grade in Satsukino Junior High School, Osaka Prefecture. The total instruction plan (of 35 hours in total) for them is indicated in Table 1<sup>5)</sup>. As shown in the table, the 1st through the 19th hours are for sedentary learning, the 20th through the 34th hours are for productive practices and the 35th hour is for sedentary learning. The creativity diagnosis tests were conducted immediately before the productive practices (immediately before the start of the 20th hour) and immediately after them (immediately after the end of the 34th hour).

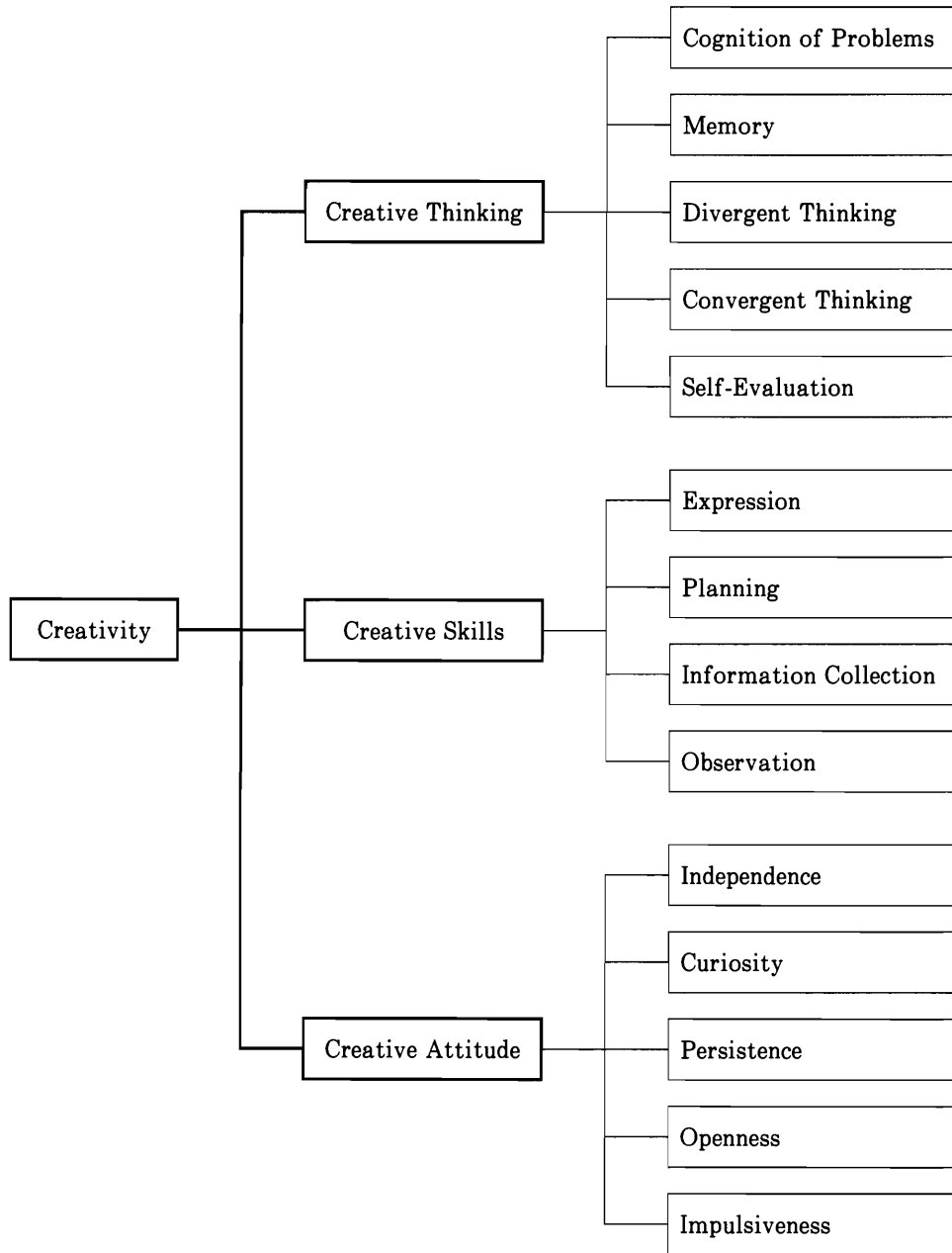


Figure 1. The structures and components of “Creativity” in Technology Education.

## Let us Look Back our Learning in the Lessons of Teconology Education

Grade \_\_\_\_\_, Class \_\_\_\_\_, No. \_\_\_\_\_ Name: \_\_\_\_\_ (male, female)

This survey does not have any relation with your achievements. Please select the answers which hold the most true of yourself at present.

According to the meaning of the following indications A, B, C and D, put the mark ○ around the relevant indication. (Example: A (B) C D)

A: It holds sufficiently true.

B: It holds rather true.

C: It does not hold true to some extent.

D: It does not hold true completely.

Questions	Judgment			
1. In the lessons, I try to make efforts in my way with some interest.	A	B	C	D
2. In the lessons, I make efforts by always making clear what I have to do.	A	B	C	D
3. In the lessons, I am always careful of whether there is any hint around myself.	A	B	C	D
4. I try to master as far as possible the things I learn anew in a lesson.	A	B	C	D
5. Sometimes I try to study more thoroughly the things which I have learned in a lesson.	A	B	C	D
6. In the lessons, I try to absorb something useful from other persons' ideas and practices.	A	B	C	D
7. When I devise something, a plenty of various ideas come to mind.	A	B	C	D
8. In the lessons, I very often think about whether I can devise anything in my way.	A	B	C	D
9. I try to think about thoroughly even a problem which seems difficult how to answer it.	A	B	C	D
10. I can think about a thing systematically, by making reasoning.	A	B	C	D
11. I am good at combining some things and applying them.	A	B	C	D
12. I don't mind solving anything unclear or complicated problems.	A	B	C	D
13. In the lessons, I can myself understand precisely the progress of the learning.	A	B	C	D
14. About my achievements of learning, I can say clearly what I have done well and what I have done insufficient.	A	B	C	D
15. About my achievements of learning, I can myself evaluate them without comparing them with other persons' achievements.	A	B	C	D
16. I am strong in expressing what I have thought of or learned with figures, tables and graphs.	A	B	C	D
17. I can bring the cube to mind by looking at a figure.	A	B	C	D
18. I don't mind drawing figures and graphs precisely.	A	B	C	D
19. I can express well a product devised myself with a conceptional figure or an assembling figure.	A	B	C	D
20. I can bring the product to mind by looking at a conceptional figure or an assembling figure drawn by other person.	A	B	C	D
21. I can draw precisely and finely assembling figures and figures of parts.	A	B	C	D
22. I can very often think of measures for well coping with unexpected problems which have occurred on the way of productive practices.	A	B	C	D

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|---|---|---|---|---|
| 23. I always work while thinking about what tools and how to use them for conducting precise work.                      | A | B | C | D |
| 24. I can work while inspecting and adjusting myself the preciseness of parts and the progress of work.                 | A | B | C | D |
| 25. I can make myself plans of learning and the progress of work.   | A | B | C | D |
| 26. I can advance learning and work just in accordance with the plans made myself.                                      | A | B | C | D |
| 27. I can modify my schedules myself when I confront unexpected affairs on the way of learning and work.                | A | B | C | D |
| 28. I can make a process table while imaging tools to be used and variations of materials.                              | A | B | C | D |
| 29. I rather expect in advance likely difficulties in production and consider measures for that.                        | A | B | C | D |
| 30. I can collect myself necessary information in accordance with the purpose of my learning.                           | A | B | C | D |
| 31. When I confront an understandable thing in my learning and work, I try to investigate it myself as far as possible. | A | B | C | D |
| 32. When I find a thing to know or a question in my learning and work, I have some ways to deal with it.                | A | B | C | D |
| 33. When I cannot advance my learning of work by any means, I can re-examine it from various view points.               | A | B | C | D |
| 34. When I confront difficulties in learning and work, I can clarify myself the course of them.                         | A | B | C | D |
| 35. I adopt and implement myself what is useful in other persons' ways of learning and work.                            | A | B | C | D |
| 36. Whenever doing things, I try to achieve everything myself alone.  | A | B | C | D |
| 37. When making something, I will not rather be satisfied if I do not make any device myself.                           | A | B | C | D |
| 38. I try to challenge the problem which I find myself rather than to perform a given assignment as it is.              | A | B | C | D |
| 39. In the lessons, I try to look for if there something new or curious.  | A | B | C | D |
| 40. I try to challenge something incomplete or imperfect by being charmed with it.                                      | A | B | C | D |
| 41. I try to transform an already existing thing completely anew.   | A | B | C | D |
| 42. I try to continue further a thing even though satisfactory results of it do not seem to be obtained.                | A | B | C | D |
| 43. I try to carry a thing through just in the way I think correct, whatever objection is raised by other persons.      | A | B | C | D |
| 44. I try to do thoroughly with conviction what I have thought out.   | A | B | C | D |
| 45. I try to accept positively any good viewpoint, conception, etc. of other persons.                                   | A | B | C | D |
| 46. I try to absorb one after another everything new and curious.   | A | B | C | D |
| 47. I try to have or do myself any experience or work whatsoever.   | A | B | C | D |
| 48. I try to do decisively even a thing which seems to be difficult.  | A | B | C | D |
| 49. I try to challenge in a decisive manner even a problem results of which seem uncertain.                             | A | B | C | D |
| 50. I determine rather immediately how to do, when I face a problem which I am puzzled as to how to deal with.          | A | B | C | D |

Figure 2. Creativity Diagnosis Tests

Table 1. Teaching plan in the “Woodworking” area (35 hours as a whole)

Hour (s)	Teaching Item	Teaching Contents
1	Wood and Life	Relation of Wood and Life
2	Growth and Tissue of Wood	Growth and Construction of Wood
3	Kind of Wood	Softwood and Hardwood Cellular Tissue of Wood
4 ~ 8	Production of the Orientation Material	Marking Hand Sawing Planing Constitution
9 ~10	Strength and Property of Wood	Strength of Wood against the Load Specific Gravity of Wood
11	Joint Method of Wood	Joint of Wood Member Reinforcement Metal Fittings
12	Expression Method of Solid Body	Cabinet Figure Method of Measurement Writing
13~14	Plan and Design of File-Box	Design of File-Box
15~16	Production of the Trail Material	Production of File-Box of Corrugated Paper
17~18	Idea Sketch of File-Box	Drawing a Idea Sketch of File-Box
19	Preparation of Production	Make ous of the Table of Materials and Process for Production
20~34	Production of File-Box	Marking Hand Sawing Planing Jig Sawing Constitution Painting
35	Effective Utilization of Wood	Forest Resources and its Environment Wood Based Materials

### 3. Study results and discussions

In the results of the creativity diagnosis tests, the value which simply averaged the total scores of male and female students is held to be an average score, which is compared before and after productive practices, and the difference between the values of male and female students is examined.

(In comparing the values before and after productive practices and those of male and female students respectively, for examining the significant differences between the average scores, a t-test (both-side test) was conducted at the significance level of 5%. Since the extents of variance could not be considered homogeneous in doing so, a t-test in accordance with the Welch method was conducted. Also in the figure indicating the results, the average values before productive practices are shown on the axis of abscissas and those after productive practices on the axis of ordinates.)

Average scores of “creativity” as a whole and its 3 structures in productive practices of male and female students are shown in Figure 3.

The values of “creativity” as a whole for male students are 2.65 points before productive practices and 2.69 points after those practices, while the values of this category for female students are 2.48 points both before and after productive practices. The values for male students are higher than the mean value 2.5 points both before and after productive practices, while the values for female students are somewhat lower than the mean value 2.5 points both before and after productive practices. In view of the variation of the values before and after productive practices, the value for male students increase after productive practices, while the values for female students show almost no variation.

(As a result of a t-test conducted for average scores of male and female students, there was observed no significant difference before productive practices, while it was found after productive practices.)

In these practices of this course, the values of “creativity” for male students are comparatively high and increase furthermore although slightly through productive practices, while the values of “creativity” for female students hardly vary before and after productive practices.

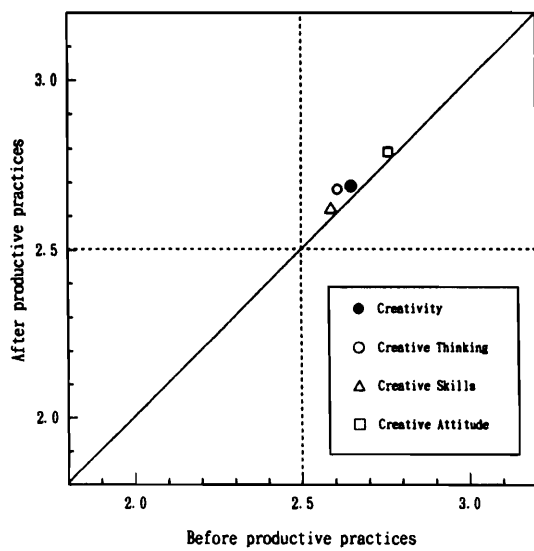
Next, the values of the 3 structures of “creative thinking”, “creative skills” and “creative attitude” for male students are 2.61, 2.59 and 2.76 points respectively before productive practices and 2.68, 2.62 and 2.79 points after productive practices, while the values of them for female students are 2.44, 2.46 and 2.55 respectively before productive practices and 2.47, 2.47 and 2.50 points respectively after productive practices. The structures which have higher values than the mean value 2.50 points both before and after productive practices are “creative thinking”, “creative skills” and “creative attitude” in the case of male students and only the structure “creative attitude” does so in the case of female students. Those structures which have lower values than the mean value 2.50 points both before and after productive practices are female students’ “creative thinking” and “creative skills”. In view of the variation of the values before and after productive practices, the structures which increase the values are male students’ “creative thinking”, “creative skills” and “creative attitude” and female students’ “creative thinking” and “creative skills”, while the structure which decreases the value is female students’ “creative attitude”.

It is found from these results that the values of the all 3 structures of “creative thinking”, “creative skills” and “creative attitude” for male students are higher than those for female students, and especially the values of male students’ “creative attitude” are higher both before and after productive practices.

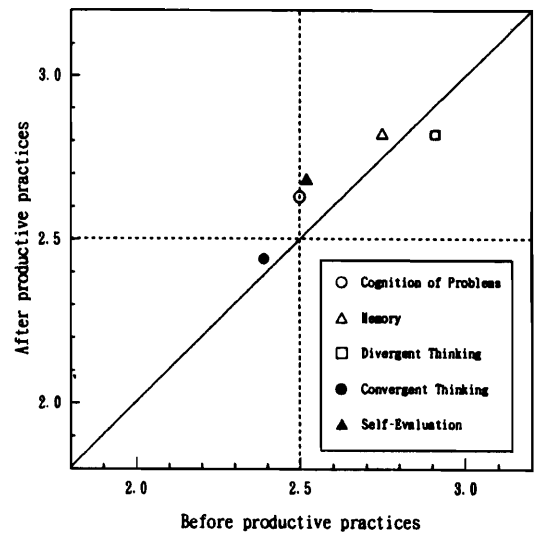
Next, the above-mentioned 3 structures of “creative thinking”, “creative skills” and “creative attitude” will be examined in detail. Values of average scores of the components “cognition of problems”, “memory”, “divergent thinking”, “convergent thinking” and “self-evaluation” concerning the structure “creative thinking” are, as shown in Figure 4, 2.50, 2.75, 2.91, 2.39 and 2.52 points respectively for male students before productive practices and 2.63, 2.82, 2.82, 2.44 and 2.68 points respectively after productive practices, while similar values for female students are 2.45, 2.51, 2.64, 2.08 and 2.54 points respectively before productive practices and 2.51, 2.47, 2.51, 2.23 and 2.62 points respectively after productive practices. The components which have higher values than the mean value 2.50 points both before and after productive practices are “cognition of problems”, “memory”, “divergent thinking” and “self-evaluation” in the case of male students and “divergent thinking” and “self-evaluation” in the case of female students, while the

component which has lower values than the mean value 2.50 points both before and after productive practices is “convergent thinking” both for male and female students. The values of female students’ “cognition of problems” are lower than the mean value 2.50 points before productive practices and higher than that after productive practices. On the contrary, the values of female students’ “memory” are higher than the mean value 2.50 points before productive practices and lower than that after productive practices. In view of the variation of the values before and after productive practices, the components which increase the values are male students’ “cognition of problems”, “memory”, “convergent thinking” and “self-evaluation” and female students’ “cognition of problems”, “convergent thinking” and “self-evaluation”, while the components which decrease the values are male students’ “divergent thinking” and female students’ “memory” and “divergent thinking”.

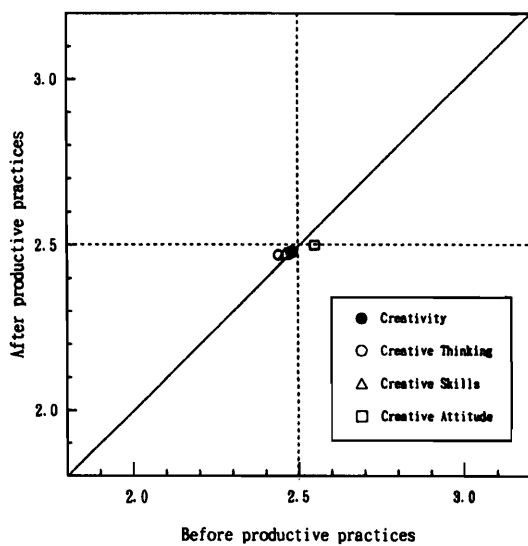
From these results it is found that as the characteristics of male students the values of “memory” and “divergent thinking” are high both before and after productive practices and higher than the values for female students while the values of “convergent thinking” are low, and that as the characteristics of female students the values of “convergent thinking” are low both before and after productive practices and the



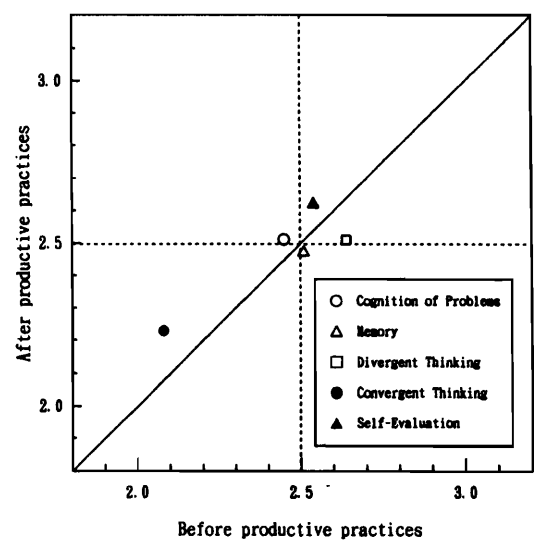
(a) Average scores of male students



(a) Average scores of male students



(b) Average scores of female students



(b) Average scores of female students

Figure 3. Average scores of “creativity” as a whole and the 3 structures of male and female students.

Figure 4. Average scores of “Creative Thinking” of male and female students.

values of “divergent thinking” decrease after productive practices. It is necessary in the future to make a plan of an instruction process to gradually bring up “convergent thinking” both for male and female students.

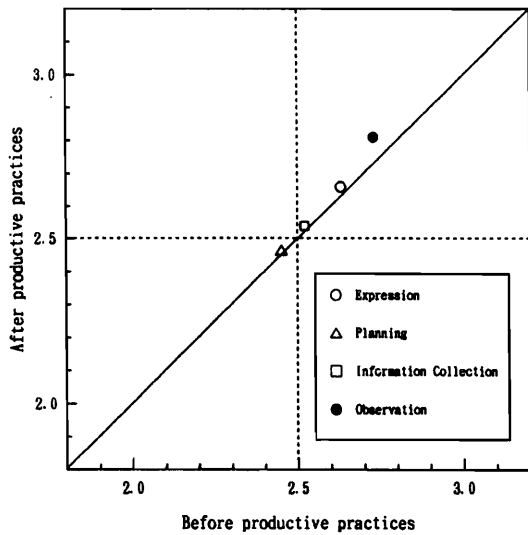
Values of the average scores of the components “expression”, “planning”, “information collection” and “observation” concerning “creative skills” are, as shown in Figure 5, 2.63, 2.45, 2.52 and 2.73 points respectively for male students before productive practices and 2.66, 2.46, 2.54 and 2.81 points after productive practices, while similar values for female students are 2.44, 2.35, 2.45 and 2.68 points respectively before productive practices and 2.50, 2.44, 2.29 and 2.59 respectively after productive practices. The components which have higher values than the mean value 2.50 points both before and after productive practices are “expression”, “information collection” and “observation” for male students and “observation” for female students, while the components which have lower values than the mean value 2.5 points are male students’ “planning” and female students’ “expression”, “planning” and “information collection”. In view of the variation of the values before and after productive practices, the components which increase the values are male students’ “expression”, “planning”, “information collection” and “observation” and female students’ “expression” and “planning”, while the components which reduce the values are female students’ “information collection” and “observation”.

It can be seen from these results that as the characteristics of male students the values of “expression” and “observation” are high both before and after productive practices and especially the values of “expression” and “information collection” are higher than those for female students, and that as the characteristics of female students the values of “information collection” decrease after productive practices. Since the values of “information collection” decrease in particular in the case of female students, it would be important for compensating this defect to teach them methods of collecting and using information.

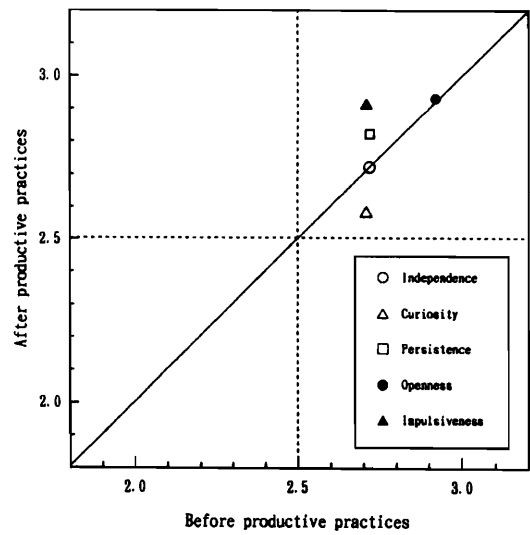
As shown in Figure 6, the components “independence”, “curiosity”, “persistence”, “openness” and “impulsiveness” concerning the structure “creative attitude” have values of the average scores 2.72, 2.71, 2.72, 2.92 and 2.71 points respectively for male students before productive practices and 2.72, 2.58, 2.82, 2.93 and 2.91 points respectively after productive practices, while similar values for female students are 2.51, 2.32, 2.56, 2.84 and 2.53 points respectively before productive practices and 2.42, 2.28, 2.51, 2.79 and 2.49 points respectively after productive practices. The components which have higher values than the mean value 2.50 points both before and after productive practices are male students’ “independence”, “curiosity”, “persistence”, “openness” and “impulsiveness” and female students’ “persistence” and “openness”, while the component which has lower values than the mean value 2.50 points both before and after productive practices is female students’ “curiosity”. The values of female students’ “independence” and “impulsiveness” are higher than the mean value 2.50 points before productive practices and lower than that after productive practices. In view of the variation of the values before and after productive practices, the components which increase the values are male students’ “persistence”, “openness” and “impulsiveness” and the components which decrease the values are male students’ “curiosity” and female students’ “independence”, “curiosity”, “persistence”, “openness” and “impulsiveness”, while male students’ “independence” hardly shows variation.

From these results it is found that as the characteristics of male students the components “independence”, “persistence”, “openness” and “impulsiveness” have high values both before and after productive practices, in particular the values of “independence”, “curiosity”, “persistence” and “impulsiveness” are higher than those for female students and the values of “persistence” and “impulsiveness” grow after productive practices and the values of “curiosity” lower after productive practices, and that as the characteristics of female students “openness” shows high values both before and after productive practices and “curiosity” indicates low values both before and after productive practices. Thus, it is necessary in the future to examine the measures for increasing “curiosity” both for male and female students.

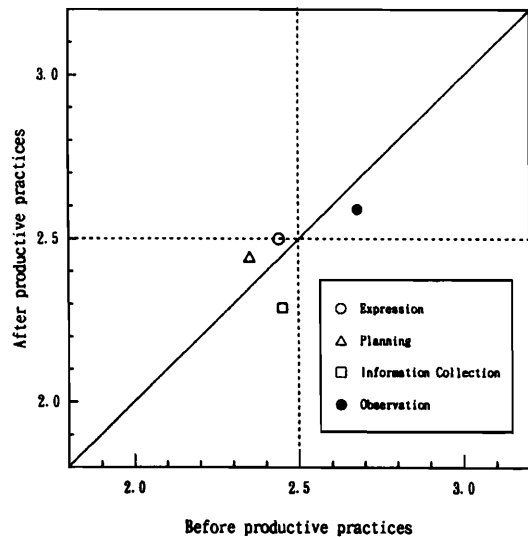




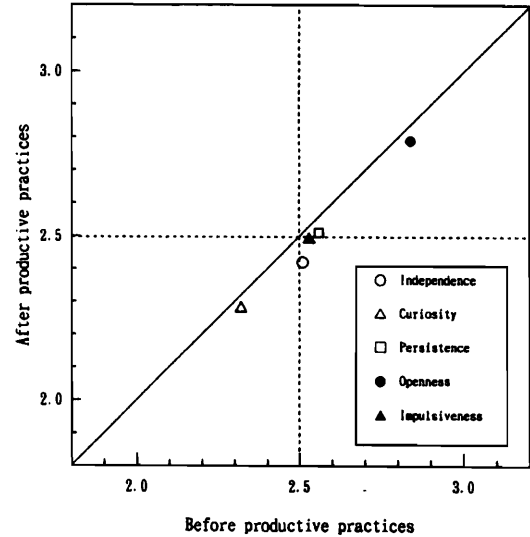
(a) Average scores of male students



(a) Average scores of male students



(b) Average scores of female students



(b) Average scores of female students

Figure 5. Average scores of “Creative Skills” of male and female students.

Figure 6. Average scores of “Creative Attitude” of male and female students.

#### 4. Conclusion

For an example of a lesson of productive practices in the “Woodworking” area, we have conducted creative diagnosis tests to male and female students before and after the practices and found the following about the fostering of creativity.

In view of the difference between male and female students, the components which show especially higher values of the average scores for male students than for female students are: “memory” and “divergent thinking” in “creative thinking”; “observation” in “creative skills”; and “impulsiveness” in “creative attitude”. The components which are necessary to increase their values both for male and female students in the future are; “convergent thinking” in “creative thinking”; “information collection” in “creative skills”; and “curiosity” in “creative attitude”.

Based on the results obtained in this study, we will examine developments of educational method and content for fostering creativity through technology education.

**[Literature]**

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