The Effect of Different Instruction Methods on the Acquisition of Figure Concepts in Tanzanian School Children

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The Effect of Different Instruction Methods on the Acquisition of Figure Concepts in Tanzanian School Children

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In general, knowledges or ideas which a learner has made up by himself through his daily activities have been derived mostly from his narrow experiences. Consequently, some of them are incorrect in terms of scientific concepts. The instances are demonstrated in a wide variety of ideas appeared in every day life such as the idea of "flower", "seed", "bird" and so on. Children often have the idea that a flower always has some colorful petals, so that they can not recognize some flowers without colorful petals such as flowers of zebra grass, rice plant and pine tree as flowers. And children often think that a seed is not edible so that they would not categorize a grain of rice and a sesami seed into a group of seeds (Hosoya 1983).

In school education, some teachers have successfully made good use of those incorrect ideas for having pupils acquire new correct ideas. The experimental teaching about figure concepts is a good example. Generally speaking, Japanese children have been quite familiar to the words of "triangle" and "quadrangle". They make up firm images about those figures since their early childhood. Their images or concepts of "triangle" and "quadrangle" are very restricted to regular triangles and squares or the likely figures to them. In other words, it seems as if they thought that every triangle should have equal steep angles, and every quadrangle should have right angles and equal sides. Consequently, it is quite difficult for them to classify irregular triangles or quadrangles into a group of "triangle" or "quadrangle". Magara and Fushimi (1982) tried to have children acquire the correct figure concepts by using some irregular triangles and quadrangles as the focus instances. While teaching the rule: "If a figure has three corners, the figure is a triangle", they showed children an irregular triangle as an example to explain the rule. In this experimental teaching they may have expected the effect of cognitive conflicts which would be aroused in children's minds when they were shown an irregular figure as the focus instance. And as they expected, most of the children improved their ideas of figures. But at the same time it turned out that there were a few children who could not correct their wrong ideas.

Magara and Fushimi (1982) tried to give those children another instruction, in which a regular triangle and a regular quadrangle were used as the focus instances at the beginning in order to have the children understand the rule of these figures, and after making sure that they understood it, irregular but not very much irregular figures were introduced as the instances of the rule.

Footnotes:
1 This study was rendered service and help of the Tanzania Scientific Research Council.
2 The author thanks to Mrs. B.T. Seif of the Ministry of National Education for conducting the experiments at primary schools, and the teachers of both Uhuru girls primary school and Mbagara primary school for their cooperation in conducting experiments.
Consequently, the children succeeded to obtain the new ideas of figures. From this result, it can be said that the process of assimilation worked effectively in this type of children. Clearly, both teaching methods made good use of the effects of learners’ prior knowledges for the acquisition of new knowledges, the former used the effect of cognitive conflict and the latter used the effect of assimilation.

As shown above, in the teaching-learning process it is quite important to find what kind of knowledges or ideas learners have already had, and then to figure out which instruction method is suitable for them to acquire new ideas. In the present study, an experimental education was given to Tanzanian school children, aiming at having them acquire the correct ideas of figures, who seemed to have been grown up in different environments, culturally and educationally, from those of Japanese children. One of the purposes of this study was to examine what kind of figure concept Tanzanian children had developed before they received one experimental education. They didn’t have many experiences about geometric figures such as playing with building blocks, folding and cutting color papers, composing figures with color boards and watching geometrical animated cartoons on TV or reading picture books, which were quite familiar to Japanese children. Under those environmental conditions, would they have developed the restricted figure concepts about triangles and quadrangles like Japanese children as mentioned above?

Another purpose of this study was to investigate whether the instruction which had had certain effects on Japanese children could have the same influence on Tanzanian children and what kind of interaction between their prior knowledges and the given instructions could be seen. In Tanzania, figure education starts from the second grade, but generally, especially in lower grades, it is not sufficient in quality and quantity. One of the reasons may be that the calculation skill in arithmetic education is too much emphasized. The objectives of the figure education in each grade of Tanzanian primary schools are as follows; Grade 2: to recognize triangles, quadrangles and circles. Grade 3: to draw triangles, quadrangles and circles. Grade 4: to divide lines, to distinguish rectangles from squares. Grade 5: to recognize various kinds of angles, to find the length of a triangle’s circumference and a quadrangle’s circumference and to find each area of them. Grade 6: to find the length of a circle’s circumference and the area of a circle, to find the area of a parallelogram, to divide angles. Grade 7: to measure and to draw angles using a pair of compasses, a protractor and a ruler, to find the length of one side of a right-angled triangle using Pythagoras’s theorem, to draw figures using the idea of surveying and proportion. Seeing those objectives overall, it is noticed that the lack of space concepts is one serious problem of figure education in Tanzania. Figures are not grasped as being able to be moved in a space and also to be transformed in various ways in it. Accordingly, figure education in lower grades is only a simple training of rote memorization of regular figures.

In addition to rather monotonous contents of instruction, Tanzania’s school education seems to be characterized by the way of teaching in each class, in which a teacher pushes correct answers into pupils’ head one-sidedly. Pupils’ own ideas and their prior knowledges which they have acquired by themselves through their daily activities are paid no attention by a teacher in the teaching process.

The same kind of drawbacks exists more or less in Japanese school education. This is why a lot of teachers and study groups are trying to improve the contents and ways of instruction. Some of the efforts have produced excellent results. The basic ideas suggested by the research were as follows; (1) to try to find pupils’ ideas which they made up through their own experiences (2) to
have pupils enjoy learning and have intellectual curiosity toward new subjects (3) to teach scientific rules to pupils which they can easily apply to the matters around them (4) to make pupils use the new rules (ideas, knowledges) which they have learned from instruction (5) to evoke various images in pupils’ minds (6) to have pupils use their hands and bodies fully and effectively in the process of learning. The instructions in the present study were devised on the basis of these ideas. Accordingly, the contents and ways of instruction may be quite different from those of Tanzania. How the Tanzanian pupils responded to the new instructions is described in the pages that follow.

Method

Subjects
Subjects were 56 pupils of class A and class B in Uhuru girls primary school located in the central part of Dar es Salaam in Tanzania, and 38 pupils of class A and class C in Mbagara primary school located in 20km from Uhuru girls primary school. The Uhuru pupils were all girls, and the Mbagara pupils were boys and girls. They were all in the first grade. They were 10 years old on the average with an age range of 7 to 12, being born in 1973–1977. Both schools were selected for the present study by the Tanzania Ministry of Education.

Outline of the experiment
The present experiment consisted of three sessions: a pre-test, an instruction session and a post-test. In a pre-test, we examined what kind of concepts of triangles and quadrangles the subjects have in their mind. In an instruction session, the subjects of two classes in each school were taught the rule of triangles and quadrangles by means of different instruction methods. One class of each school was instructed in the way to let the process of assimilation work effectively, and the other class was instructed in the way to evoke cognitive conflicts in learners. In a post-test, the subjects were asked to answer the same questions as in the pre-test and the effects of instruction were examined.

Those three sessions were conducted to all the subjects in each class. The post-test was done three days after the instruction session. The experiment was carried out during 2 weeks in August, 1985.

Test items and test procedure
The pre-test and the post-test had 17 questions about triangles and quadrangles, shown in Fig. 1. They consist of 11 regular figures, of which 4 are triangles and 7 are quadrangles, and 6 irregular figures, of which 2 are triangles and 4 are quadrangles. The former is called “RF-type” figure (see 1-11), the latter “IF-type” figure (see 12-17). Figure 1 shows a five-cornered figure added as a transfer-test.

Each subject was given a test paper and requested to answer whether each figure was a triangle or a quadrangle or neither of them, by putting a mark of A, B or C, respectively.

Learning task and group organization
The subjects were expected to acquire the rule: if a figure has three corners, the figure is a threecornered figure (triangle), and if it has four corners, the figure is a four-cornered figure (quadrangle). The subjects were grouped into four. The subjects of class A and class B in Uhuru girls primary school were named Group UA and Group UB respectively, in accordance with the way of instruction, Type A or Type B, which they received in the instruction session, as shown later. Each group had 28 subjects. In the same way, the subjects of class A and class C in Mbagara primary school were named Group RA and Group RB. Both groups had 19 subjects. In the instruction session, UA and RA received different kind of instruction from UB and RB.
Content and procedure of instruction

The instruction was given in two ways. The first one was to help the subjects to keep their eyes on the number of corners of a figure. The second one was to help them to draw up several kinds of triangles and quadrangles by connecting three or four dots, which contained IF-type figures that most of the subjects had not recognized as a triangle or a quadrangle before.

Two different series of subject-matters were designed. As shown in Figs. 2 and 3, both series of subject-matters consisted of three pairs of a triangle and a quadrangle. The series in Fig. 2 of the figures whose shapes were slightly changed from regular figures was called Type A. On the other hand, the series in Fig. 3 were all irregular figures. This series of subject-matters was called Type B. The procedure of the instruction was all the same in both types, where the subjects were expected to learn the rule of figures, by drawing the figures by themselves connecting three or four dots with lines.

Each subject was given a ruler, a pencil, red and blue crayons and a sheet of learning paper on which the above mentioned series of subject-matters were printed. Instructors who were the classroom teachers, showed the first pair of a triangle and a quadrangle on the board with similar shapes to those on the learning paper, and explained to the subjects as follows; “There are three dots drawn here. You will find the similar three dots on your paper too. Now, draw lines, connecting those three dots with your ruler to make up a figure on your paper.” After the subjects finished their tasks, the instructor drew lines and made a figure on a card-sample on the board, and asked them, pointing the figure, “What do you call this figure? This is called a triangle. Do you know the reason why this figure is a triangle? It is because it has three corners. Let’s count the number of corners again.” The instructor drew a red circle on each corner of the figure, counting one by one. Next, the instructor pointed another four dots drawn on the other side of the card-sample, and explained in the same way as before.
Kujifunza maumbo:

1. pana nukta tatu.
   Unganisha nukta tatu kwa mistari.
   Umbo litabuniwa gani?

   Umbo hili ni Pembetatu.
   Unajua sababu?
   Kwa sababu umbo hili lina pembe tatu. Hesabu namba za pembe za umbo hili.

2. Unganisha nukta tatu kwa mistari.

   Umbo hili ni nini?
   Hesabu namba za pembe za umbo hili.
   Umbo hili linaitwa ( ) kwa sababu lina pembe tatu.

3. Unganisha nukta tatu kwa mistari.

   Umbo hili ni Pembetatu au Pembenne?
   Hesabu namba za pembe za umbo hili.
   Umbo hili ni ( ) kwa sababu lina pembe ( ).

Hivyo umebuni maumbo ya namna nyingi.
Maumbo yote haya yana pembe tatu.
Kwa hiyo maumbo yote haya ni PEMBETATU.

Darasa ( ) Jina ( )

Pana nukta nne.
Unganisha nukta nne kwa mistari lisivukane.
Umbo litabuniwa gani?

Umbo hili ni Pembenne.
Unajua sababu?
Kwa sababu umbo hili lina pembe nne.
Hesabu namba za pembe za umbo hili.

Unganisha nukta nne kwa mistari.

Umbo hili ni nini?
Hesabu namba za pembe za umbo hili.
Umbo hili linaitwa ( ) kwa sababu lina pembe nne.

Unganisha nukta nne kwa mistari.

Umbo hili ni Pembetatu au Pembenne?
Hesabu namba za pembe za umbo hili.
Umbo hili ni ( ) kwa sababu lina pembe ( ).

Hivyo umebuni maumbo ya namna nyingi.
Maumbo yote haya yana pembe nne.
Kwa hiyo maumbo yote haya ni PEMBENNE.

Fig. 2 A–type series of subject matters
### Darasa ( ) Jina ( )

<table>
<thead>
<tr>
<th>Pana nukta nne.</th>
<th>Unganisha nukta nne kwa mistari lisivukane.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Umbo litabuniwa gani ?</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pana nukta tatu.</th>
<th>Unganisha nukta tatu kwa mistari.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Umbo litabuniwa gani ?</td>
<td></td>
</tr>
</tbody>
</table>

### Fig. 3 B-type series of subject matters

Hivyo umebuni maumbo ya namna nyingi. Maumbo yote haya yana pembe tatu. Kwa hiyo maumbo yote haya ni PEMBETATU.

Hivyo umebuni maumbo ya namna nyingi. Maumbo yote haya yana pembe nne. Kwa hiyo maumbo yote haya ni PEMBENNE.
The instruction was continued by the same procedure either with the second pair of a triangle and a quadrangle, or with the third one. After the subjects completed their tasks with three pairs of figures, the instructor requested them to pay attention to the series of three different triangles just drawn, and to reconfirm that their shapes were different each other, but that they were all triangles because they had three corners. As to the quadrangles, the same procedure was repeated.

The subjects were given a short test after the instruction. They were shown 15 figures, as seen in Fig. 4 and asked to classify them into triangles and quadrangles, marking triangles with a red crayon and quadrangles with a blue crayon. The instruction session lasted for about 50 minutes in each group, the last 10 minutes was spent for the test.

Fig. 4 Test figures in the instruction session

Prediction

1. A-type instruction is based on the idea of assimilation. That is, a regular figure is used as the first instance to explain the rule of figures, and afterwards slightly different figures from the first instance are used for the purpose of confirmation and extention of the rule. This instruction method was expected to have an effect on the subjects whose ideas of a triangle and a quadrangle were highly sticked to regular figures and had no variations.

We expected that they would easily accept the rule of figures and be able to extend the rule gradually, since the regular figures had already been quite familiar to them. On the contrary, if they are shown an irregular figure as the instance of the rule from the beginning, they would not identify it with the instance of the rule, or they might even ignore the instruction itself.

2. B-type instruction is a way of taking advantage of learners’ cognitive conflicts occurring in them whenever they come across different ideas from theirs. This instruction method was expected to be effective on the subjects who had already had some explicit ideas of figures but who were flexible enough to change the ideas a little.

We expected that if they were shown an irregular figure as the instance of the rule, they would instantly become aware of the difference between the new idea and the idea they had in their mind,
and at the same time, conflict aroused in this way would stimulate them to take interest in the new idea and eventually lead them to acquire it.

**Results**

The results of the pre-test and the post-test were assessed by the scores of correct responses and their mean percentages. A correct response to each question was given one point, so that the full score for each subject was 11 points for regular figures and 6 points for irregular ones.

**Equivalence in pre-test performances of groups**

Table 1 shows the mean percentages of correct response to each question, comparing between pre-test and post-test in four groups. In Table 1, the result of Japanese pupils reported by Sakuma and Yamaguchi (1983) are also shown for reference. Table 2 shows the mean scores and percentages of correct responses on RF-type and IF-type figures separately. Table 3 shows the distribution of the number of subjects by the score on RF-type and IF-type figures in the pre-test.

As seen in Tables 2 and 3, the performances of UA and UB in the pre-test and the distributions of subjects by their performances were almost the same. Therefore, both groups were considered to be equivalent in the pre-test performances. The same thing could be said of RA and RB from their responses to RF-type figures. But as seen in Table 2 and 3, the responses of the two groups to IF-type figures were quite different from each other in the pre-test. In this sense, it was questionable to admit the equivalency between RA and RB.

**Table 1  Mean percentages of correct responses in the pre-test and the post-test**

<table>
<thead>
<tr>
<th>Figure</th>
<th>UA</th>
<th>UB</th>
<th>RA</th>
<th>RB</th>
<th>Japanese</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>pre</td>
<td>post</td>
<td>pre</td>
<td>post</td>
<td>pre</td>
</tr>
<tr>
<td>1</td>
<td>79%</td>
<td>75%</td>
<td>86%</td>
<td>93%</td>
<td>95%</td>
</tr>
<tr>
<td>2</td>
<td>86</td>
<td>82</td>
<td>79</td>
<td>86</td>
<td>95</td>
</tr>
<tr>
<td>3</td>
<td>96</td>
<td>96</td>
<td>100</td>
<td>96</td>
<td>95</td>
</tr>
<tr>
<td>4</td>
<td>68</td>
<td>79</td>
<td>82</td>
<td>89</td>
<td>95</td>
</tr>
<tr>
<td>5</td>
<td>68</td>
<td>79</td>
<td>71</td>
<td>82</td>
<td>100</td>
</tr>
<tr>
<td>6</td>
<td>75</td>
<td>72</td>
<td>79</td>
<td>82</td>
<td>84</td>
</tr>
<tr>
<td>7</td>
<td>79</td>
<td>93</td>
<td>86</td>
<td>89</td>
<td>95</td>
</tr>
<tr>
<td>8</td>
<td>79</td>
<td>93</td>
<td>89</td>
<td>93</td>
<td>95</td>
</tr>
<tr>
<td>9</td>
<td>93</td>
<td>83</td>
<td>75</td>
<td>96</td>
<td>95</td>
</tr>
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<td>10</td>
<td>82</td>
<td>96</td>
<td>96</td>
<td>93</td>
<td>100</td>
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<td>11</td>
<td>82</td>
<td>75</td>
<td>86</td>
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<td>75</td>
<td>75</td>
<td>79</td>
<td>100</td>
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<td>68</td>
<td>75</td>
<td>79</td>
<td>61</td>
<td>95</td>
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<td>14</td>
<td>50</td>
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<td>29</td>
<td>54</td>
<td>95</td>
</tr>
<tr>
<td>15</td>
<td>54</td>
<td>39</td>
<td>39</td>
<td>32</td>
<td>68</td>
</tr>
<tr>
<td>16</td>
<td>57</td>
<td>64</td>
<td>68</td>
<td>61</td>
<td>84</td>
</tr>
<tr>
<td>17</td>
<td>43</td>
<td>21</td>
<td>32</td>
<td>43</td>
<td>47</td>
</tr>
<tr>
<td>18</td>
<td>61</td>
<td>61</td>
<td>32</td>
<td>90</td>
<td>74</td>
</tr>
</tbody>
</table>
Table 2  Mean scores and percentages of correct responses on RF type and IF type figures

<table>
<thead>
<tr>
<th></th>
<th>RF type (11)</th>
<th>IF type (6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>pre</td>
<td>post</td>
<td>pre</td>
</tr>
<tr>
<td>UA</td>
<td>8.78 (79.8%)</td>
<td>9.21 (83.7)</td>
</tr>
<tr>
<td>UB</td>
<td>9.5 (86.3%)</td>
<td>9.96 (90.5)</td>
</tr>
<tr>
<td>RA</td>
<td>10.4 (94.1%)</td>
<td>10.9 (99.5)</td>
</tr>
<tr>
<td>RB</td>
<td>10.0 (90.9%)</td>
<td>10.6 (96.6)</td>
</tr>
</tbody>
</table>

Table 3 Mean percentages of the number of subjects by the score on RF-type and IF-type figures in the pre-test

<table>
<thead>
<tr>
<th></th>
<th>RF-type figures</th>
<th></th>
<th></th>
<th></th>
<th>IF-type figures</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>point</td>
<td>UA</td>
<td>UB</td>
<td>RA</td>
<td>RB</td>
<td>UA</td>
<td>UB</td>
<td>RA</td>
<td>RB</td>
</tr>
<tr>
<td>7—11</td>
<td>79%</td>
<td>82%</td>
<td>95%</td>
<td>95%</td>
<td>50%</td>
<td>50%</td>
<td>84%</td>
<td>58%</td>
</tr>
<tr>
<td>0—6</td>
<td>21</td>
<td>18</td>
<td>5</td>
<td>5</td>
<td>50%</td>
<td>50%</td>
<td>16%</td>
<td>42%</td>
</tr>
</tbody>
</table>

Result of the pre-test

As shown in Table 2, the mean scores on RF-type figures in the pre-test were considerably high in all groups. From Table 3, the ratio of the subjects who got more than 7 points on RF-type figures was close to 80% in UA and UB and 95% in RA and RB. To get more than 7 points means that he or she can categorize some other RF-type figures correctly besides typical regular figures such as the figures 1, 2, 3 and 4 in Fig. 1. Among RF-type figures, the correct response rates in the figures including a square, a diamond, a trapezoid and an inverted triangle were a little lower than others in UA, UB and RB, as shown in Table 1. On the contrary to RF-type figures, the results in the IF-type figures were considerably low in UA, UB and RB, their mean percentages of correct responses being less than 60%. The comparison of responses to triangles and those to quadrangles in IF-type figures in Table 1 showed that the correct response rates in quadrangles were much lower than those in triangles in all four groups. Among the irregular figures, the correct response rates for figures 14, 15 and 17 were very low in UA and UB, and for figures 15 and 17 in RA and RB. Most of the pupils in these classes identified those figures with “triangle”. In comparison with Japanese pupils, Tanzanian pupils achieved much higher scores on IF-figures, and lower scores on
figures 1, 4, 5 and 9, which were typical regular figures.

Modification of prediction

From the result of the pre-test, it was surmised that the B-type instruction in the present experiment could have the positive effect on all the subjects. Possibly, they had acquired flexible ideas of figures which can admit slight variations, since they had achieved high scores on RF-type figures in the pre-test containing not only typical regular figures but also some other variations. Therefore, it was predicted that UB and RB groups would show the progress in their performances after the B-type instruction where the conflict between their prior knowledges and new ideas would be aroused and eventually it would lead them to the new ideas. On the other hand, UA and RA groups would not make much progress because the A-type instruction may not evoke any wonders or curiosity toward new ideas.

Extent of performance from pre-test to post-test

As seen in Table 2, there were prominent differences among groups in the post-test performances on IF-type figures, while there were no significant differences on RF-type figures. Group RB showed remarkable improvement in the post-test performance. The mean score on IF-type figures in RB increased from 3.6 to 5.2, which showed a significant difference between the pre-test and the post-test by 1% level (t = 3.44, df = 36). In Group RA, the percentage of correct responses to IF-type figures decreased in the post-test, and also the performance of RA was poor, compared to that of RB in the post-test, although statistically there was no significant difference between them. Accordingly, the results of RA and RB were consistent with the prediction.

On the other hand, the mean percentages of correct responses to IF-type figures in UA and UB stayed low at about 50% level in the post-test as well as in the pre-test. The B-type instruction could not have a positive effect on Group UB, contrary to the prediction.

Responses in the instruction session

Table 4 shows the mean percentages of correct responses to two figures in the short test during the instruction session. Among all the test figures, Figures 2 and 10 were found to be difficult for the subjects to classify correctly. As to the other figures, almost all the subjects gave correct answers, even to the irregular figures. As shown in Table 4, among the four groups, RB showed the highest performance in accordance with the results of the post-test, although the correct response rate was rather low. UA and UB had very low correct response rates. Probably, these kinds of figures, which have angles of more than 180° may give children special difficulty in classifying.

<table>
<thead>
<tr>
<th></th>
<th>(2)</th>
<th>(10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>UA</td>
<td>25.0%</td>
<td>28.6%</td>
</tr>
<tr>
<td>UB</td>
<td>28.6%</td>
<td>17.9%</td>
</tr>
<tr>
<td>RA</td>
<td>47.3%</td>
<td>47.3%</td>
</tr>
<tr>
<td>RB</td>
<td>63.2%</td>
<td>73.7%</td>
</tr>
</tbody>
</table>

Table 4 Results of the test in education session
Table 5 shows the mean percentages of correct responses to drawing figures in the instruction session. Their responses were marked by the point whether figures were drawn correctly by each dot being connected with a straight line. Table 5 shows the performance of RB is superior to the other groups. Almost 90% of the subjects in Group RB drew figures correctly. From this result, the performance of drawing figures was considered to be highly correlated with the attainment of figure concepts. Clearly, connecting dots with lines and drawing figures helped learners to pay attention to the corners of figures and change their ideas.

Table 5 Correct responses on drawing figures

<table>
<thead>
<tr>
<th></th>
<th>UA</th>
<th>UB</th>
<th>RA</th>
<th>RE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>67.9%</td>
<td>64.3%</td>
<td>68.5%</td>
<td>89.5%</td>
</tr>
</tbody>
</table>

Finally, as to the response to a five-cornered figure, shown in Table 1, the increase in the mean percentages between the pre-test and the post-test in UB was outstanding, being quite different from the other results just mentioned. Group UB showed almost a 90% correct response rate in the post-test.

Discussion

The obtained results were partially consistent with the prediction. In fact, the subjects in Group RB showed the great improvement in the post-test, while the subjects in Group RA did not. Fig. 6 shows linear regressions of the pre-test and post-test performances on IF-type figures in RA and RB groups \((Y = 2.2 + 0.8 X, Y = 2.7 + 0.4 X)\). Fig. 6 indicates that the B-type instruction had a sure effect on every subject in Group RB, while the A-type instruction had an effect on poor performers and a rather negative effect on better performers in Group RA in the pre-test. And also the interaction between the two lines suggests that on balance, the B-type instruction would be more effective to high performers on IF-type figures in the pre-test.

On the other hand, the B-type instruction could not have a positive effect on Group UB. Fig. 5 shows the increase in scores on IF-type figures from the pre-test to the post-test in UA and UB, when compared good performers with poor performers in the pre-test. The good performers who achieved more than 4 points on IF-type figures in the pre-test were grouped into UA-H and UB-H, respectively, and the poor performers who got less than 4 points were grouped into UA-L and UB-L. Fig. 5 shows that the score of UB-H pupils increased from 4.4 to 4.8 and the score of UB-L pupils decreased from 2.0 to 1.8. The B-type instruction proved to have had a negative effect on the poor performers in Group UB.

What is the most prominent difference between UB and RB? The results of UB seem to be related with their responses in the instruction session. The UB pupils drew figures far more poorly than the pupils in Group RB. In addition, the correct response rates of Group UB on figures 2 and 10 in the short test were also much lower than those of RB. From these facts, it might be concluded that the subjects in UB could not grasp the relationship between each corner and a formation of a figure, but they only learned how to count the number of conspicuous corners of a figure through the given tasks. Thus, their incorrect ideas did not change basically. The fact that
they improved the scores remarkably on the question about a five-cornered figure might be related with this.

Finally, we will discuss whether there were some differences between Tanzanian pupils and Japanese pupils in the developmental features of figure concepts and in effects of the instruction. According to the previous study (Sakuma & Yamaguchi 1983), Japanese pupils in the first grade
of elementary school showed following responses to the same questions as those in the present study. As shown in Table 1, the correct response rates on RF-type figures were nearly 90%, while those on IF-type figures, especially irregular quadrangles, were extremely low. In particular, they had great difficulty in classifying figures with an angle more than 180°. In their incorrect responses to IF-type figures, the answers: “neither triangle nor quadrangle” were more frequent than the answers: “triangle”. Thus, referring those findings to the responses of Tanzanian pupils, it is clear that both pupils had considerable similarities in the ideas of figures they had in mind before having instructions. However, we found that there were some differences as well. The most important difference is that not a few pupils in Tanzania hesitated to classify typical regular figures such as a square, a rectangle or an isosceles triangle into a quadrangle or a triangle. Those responses are not likely to be found in Japanese pupils. In addition, Tanzanian pupils showed much more correct responses to irregular quadrangles than the Japanese pupils did in the pre-test. Another difference is that in incorrect responses to irregular quadrangles, Tanzanian pupils tended to answer “triangle” rather than “neither triangle nor quadrangle”. From all these facts, it can be said that Tanzanian pupils had developed less firm and restricted ideas of a triangle and a quadrangle, whether those were correct or not, than the Japanese pupils. This difference may be attributed to the different environmental conditions of young children of the two countries, as mentioned before.

In reference to the effect of instruction on the pupils of both countries, the responses of RA and RB groups to the instruction were quite similar to those of the Japanese pupils. Unexpectedly, however, UB pupils showed a different response to the instruction from RB pupils and very few UA pupils changed their responses to IF-type figures after the instruction. According to the previous study by Magara and Fushimi (1982), five-year-old Japanese children increased their correct response rate on IF-type figures from 21% to 79% after a A-type instruction, and from 20% to 60% after a B-type instruction. The responses of UA and UB suggest that we should examine learners’ prior knowledges and their stability more precisely in relation to the learners’ previous experiences including their learning conditions, and then find out suitable instruction methods. At the same time we need to consider the possibility that other cognitive states of learners such as the attitude toward new instructions or the intensity of interests in new things could have an influence on the effect of instruction. These subjects should be studied in further research.

References


Abstract

This experiment was designed to examine the interaction between pupils' prior knowledges of figures and the effect of instruction on the acquisition of figure concepts. Two different instruction methods, one based on the idea of assimilation and the other on the idea of cognitive conflict, were given to Tanzanian pupils of Grade 1 in the primary school. It was predicted that the instruction aiming to evoke cognitive conflict would have great effects on the learners, since Tanzanian pupils had already developed their own ideas of figures, which were considered to be fairly restricted, but are flexible enough in changing those preconceived ideas. The results partially supported the prediction. That is, the instruction had a certain effect on one group of the subjects but not on the others. The difference between Tanzanian pupils and Japanese pupils in the developmental features of figure concepts and in the effect of instructions is also discussed.

Key words: figure concepts, instructions, Tanzanian pupils,