Title: Improving primary pupils' problem-solving skills in mathematics through classroom-based research

Author(s): Soh, Kay Cheng

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What can I do to improve my pupils’ problem-solving skills in Mathematics? This is a question which keeps ringing in the minds of many conscientious and caring teachers. One possible answer to this question is: Try teaching a topic in a way different from that you have done before and see if it works. This doesn’t seem helpful but it is the most practical suggestion.

This question of how to improve pupils’ problem-solving skills has been bothering Miss Chiang (Note 1) and her colleagues. They tried some ideas which they thought might help and these worked. Here are what they did and how well it worked for them.

A class of 40 Primary 5 pupils were given the problem below to solve:

A room is 10m long and 8m wide. A carpet is placed on the floor of the room, leaving a space of 1m wide all around it. Find the area of the part of the floor that is not covered by the carpet.

Of the 40 pupils who tried this problem, only 19 (47.5%) got it right. This result was not very satisfactory to Miss Chiang. An idea came readily to her mind: If I were to present the same problem with a diagram, would it help?

A week later, she asked the same class to try the same problem again, but now with the diagram as shown below. This time, 32 (80%) of the class got it right. Thus, by using the diagram, the pupils’ performance went up by 32.5%. (Note 2)
Armed with this experience and encouraged by the result, Miss Chiang went on to try another way of improving pupils’ problem-solving in mathematics. She gave the problem below to a class of 47 pupils to work on their own. Only 6 pupils (12.8%) got it right.

**The average mark of 10 pupils taking an examination was 70. What would be the average mark if one pupil who scored 88 marks was absent.**

Would there be any difference if I first ask a few questions to guide the children in thinking through the problem? So, Miss Chiang discussed with the class the ‘givens’ and ‘looked for’ of the problem. After this, the class worked on the problem again and this time 33 pupils (70.2%) got it right! Again, Miss Chiang wanted to make sure that the difference of 57.4% (70.2% - 12.8%) in passes did not happen by chance. (Note 3)

This improvement is certainly impressive but with one interpretative difficulty. The pupils tried the problems without any help first and then tried them a second time with help. Could the increase in passes not due to practice effect? After all, practice makes perfect, doesn’t it?

To check on this, Miss Chiang gave the second problem to another two groups of Primary 4 pupils of comparable mathematics ability. One group was given the problem without any help; they were just told to try their best. The other had a discussion on what was to be found and what had given. The results? See table next page.
Of the guided group, 16 out of 20 (80%) were able to solve the problem, but only 9 out of 21 (42.9%) of the unguided group did so. (Note 4)

What can we say about these 'experiments'?

First of all, teachers do make a difference. We mean, of course, teachers who care, think, and are willing and not afraid to try. A little extra effort to think about different methods of teaching and then try them out may bring about significant improvement in pupil performance.

Secondly, classroom-based research is not difficult, at least not as difficult as the word 'research' seems to suggest. It is actually only one step beyond the normal teaching. Teachers can always reflect on the way they have been teaching a particular topic and think of an alternative way to do the same job with the hope of getting more rewarding results.

Thirdly, some ways of systematically recording and organizing the results are necessary. This does not mean you always need sophisticated statistics to analyze results. If you are familiar with some of the commonly used statistical techniques, that of course is fine. Otherwise, help is always around the corner.

Teachers tend to think of classroom-based research as something separate from their normal professional activities. The fact is that teachers are 'experimenting' all the time without knowing that they having been doing this all the time whenever they are in the classroom. Look at it another way, teaching is the first part of classroom-based research.

<table>
<thead>
<tr>
<th></th>
<th>Unguided</th>
<th>Guided</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pass</td>
<td>9</td>
<td>16</td>
<td>25</td>
</tr>
<tr>
<td>Fail</td>
<td>12</td>
<td>4</td>
<td>16</td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
<td>20</td>
<td>41</td>
</tr>
</tbody>
</table>
Since you have started the first part, why not complete it? Next time you have any idea of teaching differently and probably more effectively, give yourself a chance to check it out scientifically.

Notes:

1. Miss Chiang Wai Leng (formerly of Pei Chun Primary School) provided the information to this article. At the time of writing, she is pursuing the FPCE Programme at IE.

2. While the 32.5% increase in passes was encouraging, it was necessary to check whether this did not happen by chance. So, a four-table was drawn up to classify the pupils by taking into account their performance on both occasions.

<table>
<thead>
<tr>
<th></th>
<th>Fail</th>
<th>Pass</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Without</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>diagram</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Pass</strong></td>
<td>0</td>
<td>19</td>
<td>19 (47.5%)</td>
</tr>
<tr>
<td><strong>Fail</strong></td>
<td>8</td>
<td>13</td>
<td>21</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>8</td>
<td>32</td>
<td>40 (80%)</td>
</tr>
</tbody>
</table>

The test for correlated proportions was run. The result (z=3.606) indicates that the difference of 32.5% (80.0% - 47.5%) was 'real', that is, unlikely to have happened by chance.

3. The test for correlated proportions was run. The result (z=5.196) indicates that the difference was not due to chance.

4. The difference of 37.1% was not due to chance, when checked by the chi-square test, as indicated by the result (chi-square = 5.939).