

How to Write Experiment Reports

— Use of Report Writing Templates for Beginners —

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1. The Proportions of Children Who Like to Express Themselves

The question here is approximately how many students there are who like to express themselves. A longitudinal study on science and mathematics was conducted of students in five areas of eastern Japan from their fifth grade (fiscal year 1989) to their twelfth grade (fiscal year 1996). Let us look at the results (Longitudinal Study Group on Science and Mathematics, 1997). Table 1 shows the percentages of students in three categories: (1) Students who are interested enough in experimental apparatus from their first sight of it that they go ahead and try to use the apparatus; (2) students who like to actively present their own views; and (3) students who like to reason through things. The figures represent results for 314 subjects tracked over an eight-year period.

Nearly half of the students throughout elementary, lower secondary, and upper secondary schools actively moved to use new experimental equipment. The percentage

of students who liked to express their own views changed across the three-year period of lower secondary school, but overall was at the 30-40% level. The number of students who liked to reason through things amounted to nearly half of the total, and in the twelfth grade they exceeded half.

Table 1 Students' Perception (Longitudinal Study Group on Science and Mathematics, 1998)

N=314	Grade 5	-	Grade 8	-	Grade 11
Actively uses new equipment	45.2%	-	48.7%	-	43.3%
N=314	Grade 6	Grade 7	Grade 9	Grade 10	Grade 12
Likes to present own views	40.7%	40.5%	25.7%	32.8%	29.6%
Likes reasoning through things	48.1%	44.6%	46.8%	44.3%	54.8%

This shows, in other words, that about one-third of the students like to present their own views. Nearly half of the students like to actively use new experimental apparatus and they like to reason through things.

The next question is how teachers of science and mathematics in lower secondary school view self-expression and thought. The

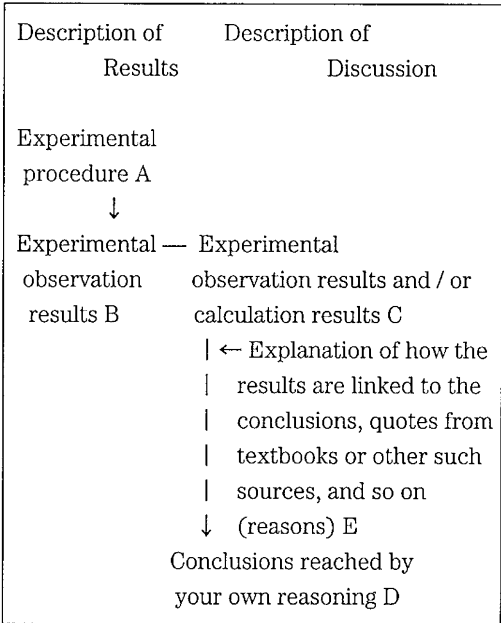
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Report Writing Template for results:
 "When A (the procedure) was done,
 B (the result) happened"
 Report Writing Template for discussion:
 "I infer D (the conclusion) from C (the
 result). The reason for this is E (the
 grounds or reasons)."



These report writing templates are intended to develop the students' expressive ability with regard to experiments. In writing these passages, thought was given to the elements that are necessary in the results and discussion sections, and text incorporating these elements was developed to serve students as a model. The three elements of results C, conclusions D, and reasons E in the report writing templates for use in discussion text are not just applicable to discussing experiments. They also correspond to elements that Inoue (1989) has identified, from among the six elements in the structure of declaration and argumentation known as the Toulmin Model, as being essential to debate. These elements, in other words, are

thought to be absolutely necessary to the process of organizing one's thoughts and expressing them.

In a class in lower secondary schools, the distinction between results and discussion was explained as follows: "For experimental results, you write down just what you saw, so you can write it without reasoning it out. The content of the discussion is something that you cannot write without thinking it out yourself." (Komoriya, 1997) The result was that almost all the lower and upper secondary school students became able to compose their results and discussion in writing.

It was also apparent that the students themselves became aware that they had become able to write these parts. They obviously felt pleased or satisfied as a result. This suggested that the reason the students had not previously been composing their experimental reports in writing was not because they had not tried to write them, but rather because they did not know how to go about writing them.

This case of learning about expression in experiment reports is an example of how students could evaluate their expression in the form of descriptions that they could see in visible form, so that the students could perceive their own growth and understand the significance of learning.

3. Points to Be Checked in Experiment Reports

There are 12 points that can be used to check the descriptions in experiment reports, and particularly those parts that use report writing templates. These points were identified as the result of a survey of lower and upper secondary schools (Arimoto and Yoshida, 1997).

In order for students to express themselves logically, the questions on these points would have to be answered satisfactorily. The matters in checkpoints 6, 7, and 8 are about making the distinction between facts (results) and opinions (conclusions), about writing the discussion so that it is relevant to the purpose, and about the discussion should be written to state an explanation (reasons or grounds) of how the students' own opinions (conclusions) are derived from experimental facts (results). These points are all crucial to logical expression.

Conversely, distinguishing facts from

Points for Overall Checking

1. Does it address matters that require explanation?
2. Does it specify what happened, what it happened to, how it happened, and what was done?
3. Are subjects and verbs matched?
4. Is there too much information packed into single sentences?

Points for Checking Related to Results

5. Do the sentences that explain results follow the report writing templates (do they include the elements of procedure and results)?
6. Does the explanation of results have discussion mixed in?

Points for Checking Related to Discussion

7. Is the discussion suited to the purpose?
8. Is the text of the discussion missing any statement of grounds or reasons?
9. Does the text of the discussion furnish the grounds or reasons required?
10. Does the text of the discussion provide the conclusions and then the grounds or reasons in that order?
11. Does the text of the discussion match the report writing templates (does it include the elements of results, conclusions, and grounds or reasons)?
12. Does the text of the discussion present the causes for the experimental results (in the form, "the experiment produced these results because ...")?

opinions, reconfirming the purpose of the experiment, and other such practices help make it easier for students to write out their discussion.

The points for checking enumerated above also provide reference points for examining the instructional materials given to students to define their assignment. Using it, we can determine whether the content of those materials is suitable for discussion and for organization and formulation of a report.

For example, the materials should be written so that the purpose of the experiment is suited to the content to be discussed. It is important to examine the materials fully to make sure this point is made explicit before assigning them to the students. This same matter is raised in checkpoint 7 as something to evaluate in the students' writing.

Experiments that are performed in lower and upper secondary schools include those experiments done to ascertain and verify the properties of substances and phenomena, and those done to explore research topics or resolve other questions of some similar kind. In the latter kind, the grounds or reasons (explanation that links the results to the conclusions drawn) in discussion sections holds particular significance. With the former experiments of verification, however, there are cases when it would be pointless to specify the reasons or grounds. It is not possible, in such cases, to use report writing templates to satisfy checkpoints 8-11 in the written discussion.

In other words, the checkpoints enumerated above also serve as points for checking the instructional materials for an experiment to determine whether their purpose is suited to the discussion. They can also be used to determine whether the instructional

materials contain the kind of substance for discussion that is needed to develop the students' expressive ability and cognitive ability. In addition, they can be used as points of reference for checking whether instructional materials are for experiments done for verification or experiments done for resolution of questions.

4. Additional Comments

The creation of written reports using report writing templates of the kind discussed above means that all the students will end up with the same descriptive text. There has been some concern that the students will not be allowed to write in their own words, and that they might therefore lose their individuality. Therefore a new space for impressions was added to the space for report writing templates to follow immediately after the space for discussion. The result was that those students who wrote extensive impressions in general also had well-written discussion sections that used the report writing templates. It was also apparent that the students were writing in a way that distinguished discussion from impressions just as they distinguished results from discussion (Nouchi, et al., 1998).

The students were also told that the readers they were writing down their

thoughts for were not the teachers who knew the "right answers" for the experiment. Instead, they were writing for their classmates and the students in grades below them. Thereupon most of the students made an effort to explain their grounds or reasons in a way that would be more easily understood by classmates and other students below them who did not already know the material. There were students who previously did not bother to explain their reasons in detail for teachers, who already knew the right answers, but even these students wrote at greater length (Matsubara, 1996). In other words, when the students were made aware that they were writing to be understood by others, they tended to write in their own words. Eventually they also began to think about the issues at hand and come up with their own questions.

It was also observed that when time was set aside for the students to organize their reports, they spontaneously began to discuss their experiments and exchange views on them. For the same reasons noted above, providing opportunities for the students to talk with each other and teach each other in this way appears to be of help in developing their expressive ability, as well.

It is likely that programs of this kind would also serve as opportunities for students themselves to evaluate their own growth.

This paper is modified the original paper 'MATSUBARA Shizuo (2001), Science Education Monthly, 50(8), pp.524-527' and translated from Japanese into English.

How to Write Experiment Reports (for students)

Have all of you had the experience of writing reports on experiments? Those of you who have and those of you who have not can come together here in thinking about experiment reports: What are the headings that must not be left out of these reports? How should the reports be written? There are also other items that need to be included in experiment reports, such as the time, the equipment and reagents you used, and so on. You should investigate these items in your textbooks before writing a report.

Headings Required in Experiment Reports

Purpose: The content to be discussed

Procedure: The actual steps carried out

Results: The facts observed

Discussion: The views or opinions you arrived at (conclusions) and your explanation of them (reasons)

— —————> Discussion suited to the purpose of the experiment

The purpose section is where you write what you were trying to find out through the experiment.

The procedure section is not simply for copying the procedure you find written in your textbooks or experiment handouts. You should write about any points where you used your ingenuity, and anything about your experiment that was different from the printed information. For example, when the experiment handout says "add 2-3 drops," you probably added either 2 drops or 3 drops. You should write down the procedure that you yourself actually followed, using the past tense; for instance, "I added 3 drops."

Next is the content you should put in the results and discussion sections. The results are the facts that you saw with your own eyes when you carried out the experiment. In the discussion, you write a description for other people that tells them what opinions you formed from thinking about the results, and gives them an explanation (reasons) of why you arrived at those ideas. This explanation is about reasons, and it is said that the Japanese people are not good at explaining these kinds of reasons. It is important to distinguish between results and discussion. For experimental results, you write down just what you saw, so you can write it without reasoning it out. The content of the discussion is something that you cannot write without thinking it out yourself. When you develop the habit of writing in this way, you will find that your thoughts also become more organized, and you will become able to keep those thoughts in your mind and make use of them when you are carrying out the experiment.

When you write reports of experiments, you can practice writing the results and discussion by using report writing templates. This will make it easier to write logical experiment reports. You will find this an interesting challenge. Be sure to try it.

How to Use Report Writing Templates in Your Writing

Report Writing Template for results:

"When A (the procedure) was done, B (the result) happened." → Write down exactly what you saw.

Report Writing Template for discussion:

"I infer D (the conclusion) from C (the result). The reason for this is E (the grounds or reasons)." → You will have to think about this in order to write it.

○ Results: "When A (the procedure) was done B (the result) happened."

For B, write a description of the results you observed from the procedure A, in the past tense. For example, write "When the litmus paper was placed in the solution, the litmus paper turned red."

○ Discussion: "I infer D (the conclusion) from C (the result). The reason for this is E (the grounds or reasons)."

C will involve the results of your experiment or observation, or the results of your calculations. The reason for writing this down is that it is important to verify which results led you to reach your conclusions, and to state them explicitly. D will involve the conclusion you reached by your own thought.

The grounds or reasons in E are explanations of how the results are linked to the conclusions. In other words, this means the knowledge or theory that is necessary in order for you to derive the conclusion D from the results C. Here you should write down relevant things that you already know, or facts or theories that you looked up in your textbooks or reference books. Here is a simple example: "I infer that the solution is an acid from the fact that the litmus paper turned red when placed in the solution. The reason for this is that litmus paper is a test paper that turns red when exposed to acids."

As explained above, the explanation of how your results lead to your conclusions (the reasons or grounds) is not supposed to be just based on whatever happens to come to mind or what you happen to remember. Sometimes you should write down things that you look up in your textbooks or reference works. Another point is that it usually is not possible to reach a conclusion from the results of just one experiment. This is because you may find that the results are different when you perform another experiment. However, you can compensate for this by including already known facts, theories, and so on in your explanation (the reasons or grounds). In other words, this is equivalent to looking things up in your textbook, checking reference works, and so on at school in order to verify your own thinking or supplement it.

At these times, you should write down where you looked up your information. This is called citing your sources. Then the citation will be very useful information later if you want to look something up again, or if somebody else wants to look it up. This is why researchers and engineers always write down the sources of their information. You should make an effort to start keeping written notes of your sources, too. You are sure to find it useful later on.

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