

# **Students' Notes and Their Relation to Comprehension and Recall of Lecture Information**

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## **Introduction**

Lecture is a primary teaching method in many secondary classes (Putnam, Deshler, & Schumaker, 1993; Thomas, Iventosch, & Rowher, 1987) and lecture notes are an important part of academic learning for most students (Peveryly, Ramaswamy, Brown, Sumowski, Alidoost and Garner, 2007). Most students take notes in classes (Brobst, 1996) and studies have shown that students' note taking during lectures are related to better comprehension and improving later recall of lecture information (Bligh, 2000, Bretzing and Kulhavy, 1979; DiVesta and Gray, 1972; Kiewra, 1984; Boyle and Weishaar, 2001).

Among the cognitive learning theories, note taking is perhaps best viewed in the context of the Information Processing Theory Model of Memory (IPT). According to the theory, similar to the computer, the mind receives information, "changes its form and content, stores the information, retrieves it when needed, and generates responses to it" (Woolfolk, 2004, p. 239 ). Thus, three operations have been identified by the theory as regards the flow of information in the mind: encoding, storage and retrieval. In note taking, students are engaged in the same three operations: they encode the information not only in their minds but also in an external storage (the notes), which the students "retrieve" when they review their notes.

Notes are defined as short condensations of a source material that are generated by writing them down while simultaneously listening, studying, or observing.

Their function is to gather data distributed in a lecture, a reading or in any other situation that needs to be remembered. In other words, notes serve as external memory (Piolat, Olive and Kellog, 2004).

Because notes, the product of note taking, function as an external memory available for later use by the student, it can be said that they are useful insofar as they effectively aid the author to review the contents of a lecture and to act on them in order to comprehend and generate inferences by relating ideas to one another. The proof of effectiveness is commonly provided by the resulting test scores: high test scores will usually imply a good set of notes (Peper and Mayer, 1986). Researches on the effect of note taking on comprehension and recall of information as measured by achievement in tests have indicated that students not only learn while taking down notes, but also when they review their notes (Pevery et al., 2007; Pevery, Brobst, Graham and Shaw, 2003; Piolat et al., 2001). Several studies have emphasized the bigger help in learning that the review of notes can provide (Kiewra, 1985 ; Kiewra, DuBois, Christian, McShane, Meyerhoffer, and Rosekelley, 1991; Henk and Stahl, 1985; Carter and VanMatre, 1975).

If actual notes are indeed a significant help to learning especially as regards review, what kind of notes facilitates review?

Apparently, many students are poor note takers. They miss out more than half of the crucial points or important ideas of a lecture (Baker and Lombardi, 1985; O'Donnell and Dansereau, 1993; Kiewra, 1985c). Kiewra (1985 b) posits that even successful students usually miss to note down 20 to 40% of the important ideas in a lecture and record incomplete notes.

What makes student notes bad or what constitutes quality notes was a question Dunkel (1988) raised and tackled in her study. She highlighted the value of terseness in note taking, which involves the recording of lecture propositions or information units in the retention of lecture information. Quality notes have more information units which are defined as units of knowledge that can stand as a separate assertion and can be judged true or false (Anderson, 1980; Dunkel, 1988). These are different from independent data which are isolated names, dates and terms that students take down and are not in the form of propositions. Relatedly, Einstein, Morris, and Smith (1985, cited in Potts, 1993) claim that successful students' notes generally contain more propositions than less successful notes.

Figure 1 below shows students' notes with more information units (left) and notes with more independent data (right).

Notes on lecture video: The Japanese War

- 1937, defended against the western settlers
- decisions were made in a conference in Tokyo
- The Economy was strictly controlled
  - no factories were made
- They thought they were superior people
- 1942, Japan conquered many areas outside of itself
- Then the Americans conquered their territories and bombed them 9 times.
- Admiral Chester Nimitz
- 1944, the Americans conquered Ipan, Guam, E
- Battle of Leyte Gulf
- The Americans defeated the Japanese
- Battle of Okinawa
- The Americans defeated them, the attacks on mainland Japan
- 14,000 soldiers were injured and/or dead
- 21,000 Japanese fought in the battle.
- 400 were captured, the rest made Harakiri
- July 1945, The Japanese asked the soviet union to be allies. The rejected their offer

Notes on lecture video: The Japanese War

Self - Defense  
liberation

Tokyo - Japan

Needs of Japanese army  
Control of local economies

1942 - expansion

USA vs Japan  
AIR ATTACK  
victory

Frankly Roosevelt

Leyte Gulf

Potsdam Conference

Gen Douglas MacArthur

October

Japan asked Russians

GEAW  
Gater East Asian War

POPEASH  
VCI MATUM

SURPRISE  
PROGRESSION  
TRIALS OF WAR  
COURT

Cherster Nimitz

October

Cherster Nimitz

Cherster Nimitz

**Fig. 1: Samples of Students Notes**

On the other hand, there are studies that suggest that 'quantity is quality' (Johnstone and Su, 1994); that is, quality or good notes contain the highest total amount of words (data and ideas) from a lecture. In short, comprehension and recall of information is better facilitated when the total amount of words recorded in their notes abound. Quantity or the amount of notes have been measured in different ways, such as the number of words noted down from a lecture (Norton, 1981), the number of thought units (Locke, 1977), the number of main and minor points (Nye, 1978), and the number of critical points and examples (Austin, Lee, and Carr, 2004). In all these studies, there was a significant correlation between quantity of notes, or the total notes score, and test performance.

One factor that can affect the quantity of notes is background or prior knowledge that students have of the lecture topic (Van Meter, Yokoi and Pressley, 1994).

Students tend to have fewer notes when they are more familiar with the contents of a lecture. But it is not all quantity of notes that prior knowledge affects. In a subjective way, prior knowledge can affect the level of confidence of students as regards memory capacity. Consequently, those who have no background knowledge about a new lesson will tend to take down a lot more notes to circumvent the limited capacity of the working memory (Piolat et al., 2004).

Prior knowledge is an essential ingredient in meaningful learning (Christen and Murphy, 1991). Studies in educational psychology have shown that 30-60% of the variance in study results could be explained by this variable (Dochy, 1988).

Several theories try to explain how prior knowledge facilitates learning. Dochy (1988) summarized them in Table 1:

**Table 1. Theoretical views of the facilitating effect of prior knowledge during the learning process (Source: Dochy, F.J. R.C., 1988, p. 13)**

|   | <b>Theory</b>         | <b>How does prior knowledge influence the learning process? (key concept)</b>   |
|---|-----------------------|---|
| 1 | Restructuring         | Information is structured in a different way in the long term memory. (Structure)   |
| 2 | Elaboration           | The production of elaborations leads to multiple redundant retrieval paths in the cognitive representation. (Elaboration)   |
| 3 | Accessibility         | Prior knowledge increases the accessibility of knowledge and consequently the load on the working memory is reduced and more information can be processed per time unit. (Rapidity) |
| 4 | Selective attention   | Attention is directed selectively at passages relevant to prior knowledge which are subjected to a deeper level of processing. (Selection, steering)                                |
| 5 | Availability          | Prior knowledge increases the availability of information during the learning process and leads to a higher level of retention. (Availability)                                      |
| 6 | Retrieval-aid         | Prior knowledge and access to relevant cognitive structures increases retrieval. (Retrieval)  |
| 7 | Schema-transfer       | Prior knowledge implies the presence of relevant schemes, the new information has to be fit in the right scheme. (Couple information-scheme)  |
| 8 | Representation saving | Propositions which are part of the prior knowledge no longer have to be encoded. The encoding effort is, in consequence, considerably reduced. (Proposition)                        |

Taking into account the value of prior knowledge, teachers should count more on what it can contribute to students' learning. This can be done through prior knowledge activation strategies that include activities such as pre-teaching vocabulary and the enrichment of background knowledge (Christen and Murphy, 1991) by giving previews and related or relevant background information (Graves and Cook, 1980; 1983; Stevens, 1982; Hayes and Tierney, 1982).

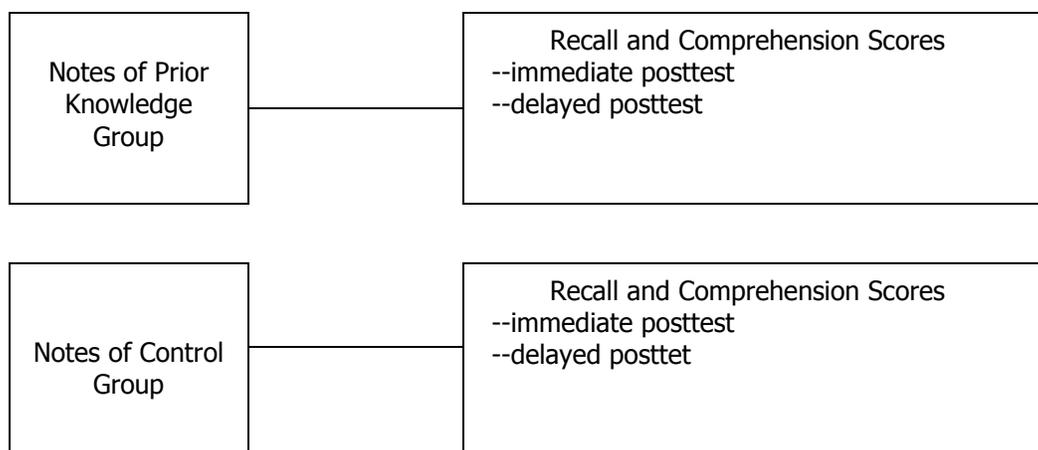
### Research problems

This study looked into the relations between the quantitative and qualitative

aspects of students' notes and their comprehension and recall of lecture information. It investigated three problems.

First, is there a difference in the notes scores of the prior knowledge group and the control group in the following: (a) the number of information units; (b) the number of independent data; and (c) the total notes scores? Second, is there a difference in the comprehension and recall scores of the two groups? And third, is there a relation between the scores on notes and the scores on comprehension and recall in each group? Figure 2 illustrates the conceptual framework of the study.

**Figure 2. Conceptual framework**



### Research participants

The study utilized a quasi-experimental design. Two intact classes of 52 freshmen high school students from a private school for boys in Metro Manila participated in the study. The two classes were randomly picked from a total of three classes. Five students from each class were not included in the study because of incomplete data due to absences.

### Instruments

*Prior-knowledge handout and test*

A handout on the Manhattan Project, the project of the United States that developed the atomic bomb that was dropped in Hiroshima and Nagasaki, was given to the prior knowledge group to study. The students were told to be ready for a check-up test on the contents of the handout the following meeting.

The check-up test was a multiple choice quiz of 15 items. The students were given 15 minutes to accomplish the test. The test was validated by the senior Social Studies teacher of the school. Seven out of the fifteen items of the test were also discussed in the videotaped lecture.

The item analysis of the test showed that the scores on these items could be used to identify the prior knowledge level of the students.

#### *Videotaped lecture*

The videotaped lecture summarized the history of Japan in the Second World War. It was part of the first year high school curriculum of the school. The lecture, which was delivered by the researcher using the English language as medium of instruction, lasted for almost 24 minutes at a less than moderate pace of approximately 97 words per minute for a lecture to accommodate note taking by students (Peters, 1972). Occasional photographs, maps and a few animated slides were included to make the lecture more attractive and interesting to students. The videotaped lecture was previewed and approved by the Social Studies expert of the school.

#### *Immediate and delayed post-tests*

The immediate and delayed post-tests were identical tests with 20 items. It was a multiple choice test constructed by the researcher and measured both the comprehension and recall of details in the videotaped lecture. It was pilot-tested and underwent validity and reliability tests.

The senior Social Studies teacher and the Social Studies expert of the school validated the items of the test. The test had a reliability coefficient of 0.74 using the Split-Half Method corrected according to the Spearman-Brown formula.

Five items of the post-test were labelled "critical items". These items appeared both in the prior knowledge handout and in the videotaped lecture. Those with high prior knowledge were expected to answer these five items correctly.

### **Procedure**

#### *Pre-experimental phase*

The equivalence of the two groups was tested using the results of the Stanford Achievement Test (SAT) of the students in two skills, .

Language and listening, which are both important to note taking. Also, the scores in these two skills measured the preparedness of the students to follow and understand well the contents of the videotaped lecture. The t-test for independent groups showed no significant difference in the mean scores of the two groups in the two skills

#### *Experimental phrase*

By drawing lots, two intact classes of freshmen high school boys were assigned to the prior knowledge group (PK) and another to the control group (CG). The classes had 26 students each. A reading handout was provided to PK to serve as background knowledge of the students on a portion of the contents of the videotaped lecture. A test on the contents of the handout measured the level of prior knowledge of the students before the videotaped lecture.

The two classes attended separately the videotaped lecture entitled, *The Japanese War*, during their respective Social Studies period. As soon as the lecture was over, students' notes were collected and the immediate post-test was administered. A week later, the students took the same test but after their personal notes were returned to them and 20 minutes of review were allotted. The students were told to review only their own notes.

The notes collected from the students were assessed by three raters in terms of the number of information units and independent data they contained. Information units are notes taken down by students in the form of propositions; that is, in terms of phrases or sentences that can be judged to be true or false. Examples of information units would be: "Little Boy bomb dropped in Hiroshima", "Enola Gay carried Little Boy", "Japan signed surrender on board Missouri (battleship)". Independent data are notes which cannot be judged as either true or false and usually come in the form of significant names, dates, or figures. Examples would be "1937", "B-29 bombers", or "Battle of Leyte Gulf".

An acceptable range of inter-rater coefficient of correlation (from 0.735 to 0.861 at  $p < .01$ ) was obtained for both information units and independent data.

The *t-test* for independent groups was computed using the Excel Mega Stat Version 8.9 to compare the mean scores on notes and post-tests. Pearson's Product-Moment Correlation Coefficient was used to determine coefficients of correlation in the study.

Aware of the ethical principle involved in conducting research of this nature, the researcher informed the two intact classes of their participation in the study and its findings at the end of the study.

## Discussion of Results

### *On students' notes*

The study explored if there is a difference between PK and CG in terms of: (a) the number of information units; (b) the number of independent data; and (c) the total notes scores.

**Table 2 presents the notes scores of the two groups.**

|      | PK ( N = 26 ) |       | CG ( N = 26 ) |       | <i>t</i> | <i>p</i> -value |
|------|---------------|-------|---------------|-------|----------|-----------------|
|      | M             | SD    | M             | SD    |          |                 |
| info | 20.78         | 11.6  | 26.14         | 9.32  | -1.84    | 0.072           |
| data | 6.33          | 3.66  | 9.38          | 4.84  | -2.57    | 0.0134          |
| tns  | 27.12         | 12.36 | 35.53         | 10.09 | -2.69    | 0.0097          |

Note. info = information units; data = independent data; tns = total notes scores.

The notes scores reveal that there is a significant difference in the notes of the two groups as far as independent data and total notes scores (the sum total of information units and independent data) are concerned. However, there is no significant difference in the mean scores of information units between the two groups.

The exposure to the handout of one group could have affected the scores on notes of the students—PK had less notes in terms of information units, independent data and total notes score than CG. This finding corresponds with the study of Van Meter et al. (1994) which

posits that students resort to selective note taking and take lesser notes when they have some familiarity with the lesson. This too, is implied in another research (Brobst, 1996) in which students who were presented background information related to the lesson to be learned took fewer lecture notes. Thus, PK's enriched background or prior knowledge helped the students to process the lecture information more rapidly that the effort required for encoding has been considerably reduced (Dochy, 1988), as manifested in their notes.

That CG has significantly more independent data and total notes score than PK tends to support studies that suggest that students take more notes when they are less confident about

remembering lecture data and overcompensate for this (Piolat et al., 2004; Kalnikaite and Whittaker, 2007).

Both groups chose to take down notes more in terms of information units than independent data. Dunkel (1988) discussed the importance of terseness in note taking over mere quantity of notes. The findings hint that the levels of terseness of the two groups in note taking—that is, having critical pieces of information from the lecture

in compacted propositions—, are equivalent.

#### *On recall and comprehension scores*

The second research question explored if there is a difference in the comprehension and recall scores between PK and CG. Results presented on Table 3 show that the two groups are equivalent in the post-test scores

**Table 3.**  
**Means and standard deviations of the two groups in the two post-tests**

|                 | PK (N = 26) |      | CG (N = 26) |      | <i>t</i> | <i>p</i> -value |
|-----------------|-------------|------|-------------|------|----------|-----------------|
|                 | M           | SD   | M           | SD   |          |                 |
| imm-pt          | 13.69       | 3.73 | 13          | 3.57 | 0.68     | 0.497           |
| dly-pt          | 14.04       | 3.75 | 13          | 3.48 | 1.03     | 3.082           |
| <i>t</i>        | -0.34       |      | 0.0         |      |          |                 |
| <i>p</i> -value | 0.7372      |      | 1.00        |      |          |                 |

Note: imm-pt = immediate posttest; dly-pt = delayed posttest.

The immediate post-test was given right after the lecture, without any chance for review. The absence of a significant difference in the mean scores of CG and PK could be explained primarily by the comparability of their listening and language skills. It can be recalled that there were no significant differences in the language and listening skills of the two groups as measured by the SAT.

The immediate post-test results show the effectiveness of the encoding function of note taking. CG's high mean score on total notes suggests that the group might have managed to encode well enough while exercising note taking during the videotaped lecture.

As regards the delayed post-test, the absence of a significant difference in the mean scores between the two groups could be due to the objective limitations of the notes themselves. According to Baker and Lombardi (1985) who investigated on the relationship between students' notes and their test performance, students frequently answer post lecture questions

correctly if they have the information in their notes. However, the findings in this study suggest that the students of both groups could have missed out other important ideas from the lecture.

Also, even if the students were allotted time for review—and several studies have noted the bigger help that the review of notes can provide (Kiewra, 1985; Kiewra, DuBois, Christian, McShane, Meyerhoffer, and Rosekelley, 1991; Henk and Stahl, 1985; Carter and VanMatre, 1975)--, the absence of a more complete set of notes could not produce a significant difference in the mean scores of the two groups in the delayed posttest.

Since there was no significant difference in the scores of the two groups in the immediate and delayed post-tests, it seemed that PK did not really have any advantage over CG considering the test scores. Investigating the scores of the two groups in the critical items, no significant difference was noted in the immediate post-test. However, PK did significantly better than CG at  $p < .05$  in the de-

This finding reveals the advantage of having prior knowledge and how it “increases the availability of information during the learning process and leads to a higher level of retention” (Dochy, 1988, p. 13). Table 4 presents the means and standard deviations of the two groups in the critical items.

**Table 4. Means and standard deviations of the two groups in the critical points**

|        | PK   |      | CG   |      | t    | p-value |
|--------|------|------|------|------|------|---------|
|        | M    | SD   | M    | SD   |      |         |
| imm-pt | 3.81 | 1.39 | 3.42 | 1.45 | 0.98 | 0.3324  |
| dly-pt | 3.96 | 1.27 | 3.23 | 1.27 | 2.04 | 0.0465  |

Note: imm-pt = immediate post-test; dly-pt = delayed post-test.

This suggests that PK still kept the background knowledge advantage it had even after a week. In the context of the Information Processing Theory, this could mean that the background knowledge of PK had already been stored in the long term memory. Consequently, though they actually had lesser notes than CG, PK still had better scores in the critical items. This could also explain why CG could not outperform PK in the post-tests because they were limited by what they could review in their notes on the critical items.

PK already had as prior knowledge some of what they had to know of the critical items, even if they were not in their notes.

*Relation between students’ notes and recall and comprehension scores.*

The third problem explored the relation between the students’ notes and the scores on comprehension and recall both in the immediate and delayed post-test. Table 5 presents the correlation matrix between the notes scores and the immediate post-test scores.

**Table 5. Correlation matrix of notes scores and the immediate post-test scores**

| imm-pt | info    | data  | tns      |
|--------|---------|-------|----------|
| PK     | 0.333   | 0.323 | .408 *   |
| CG     | 0.541** | 0.122 | 0.588 ** |

Note. info = information units; data = independent data; tns = total notes scores; imm-pt = immediate post-test scores

In the immediate posttest, test scores of PK are associated only with total notes scores ( $p < .05$ ). On the other hand, high test scores of CG are associated with information units and total notes scores, both at  $p < .01$ .

the significant correlation of the total notes scores suggests that indeed encoding was taking place in the minds of the students while taking down notes (Bretzing et al., 2001; Williams and Eggert, 2002).

Because notes could reflect what the students understood in the lecture,

Whether notes were jotted down in the form of information units or independent data

students were learning while they were note taking. The form by which the notes were taken, whether as information units or as independent data, might not have mattered much immediately after the lecture since the contents of the lecture were still fresh in the minds of the students. Note taking positively influences test scores even when notes are not reviewed (Kiewra, 1985a). This finding concurs with the study of Johnstone and Su (1994) that the more students record, the more they remember.

Table 6 presents the correlation matrix between the notes scores and the delayed post-test scores.

**Table 6.**  
**Correlation matrix of notes scores and the delayed post-test scores**

| dly-pt | info   | data   | tns    |
|--------|--------|--------|--------|
| PK     | 0.405* | 0.166  | 0.120  |
| CG     | 0.443* | -0.006 | 0.406* |

*Note.* info = information units; data = independent data; tns = total notes scores; dly-pt = delayed posttest scores

\*\*p < .01, \*p < .05

In the delayed post-test, test scores are positively and significantly correlated with information units for both PK and CG. Independent data in both groups are not correlated with test scores. Only the total notes score of CG is significantly correlated with test scores.

High test scores are associated with the review of more information units, and not of independent data, in both groups. This implies that the quality of notes—that is, the form in which they were taken, influenced the recall and comprehension of the contents of the lecture for both groups. This supports studies that highlighted the value of notes recorded in terms of propositions which is related to high test scores (Dunkel, 1988).

### Conclusions and Implications

Notes, from the point of view of Information Processing Theory, can be considered an aid to the limited capacity of the working memory. Notes expand the working memory so it could accept more data with little or no danger of overloading it. Once data have been noted down, the working memory could pick them up again at

another time for due processing. Review is the process by which notes or information in the “extension of the working memory” is brought to the long term memory. Once in the long term memory, it can be retrieved and serve as prior knowledge to further learning.

As it is, a cognitive theory like the IPT helps explain the value of note taking as an effective learning strategy. Further research can take this into account to help clarify the strengths of note taking as an effective learning strategy.

As earlier studies have verified, note taking facilitates recall and comprehension of lecture content. This it does through encoding and its external storage function. While the second function is deemed more important than the first because it aids review, it is a fact that good notes are a prerequisite to a good review. Review cannot significantly improve test scores if in the first place students’ notes are incomplete or lacking in essential ideas.

Prior knowledge, while it could affect the amount of notes students take in a lecture, has no effect on the quality of notes.

With or without prior knowledge, students take notes in a way that could facilitate their later review. As such, both groups in this study took down more information units than independent data.

While the form of notes, whether in terms of information units or independent data, would not matter for immediate post lecture tests that do not allot time for review, it seems it would for a test that is taken days after a lecture and the students had been given time to review. It matters, therefore, that teachers train students in jotting down propositions in lectures and not mere isolated names, terms or figures. On the students' part, they should get into the habit of reconstructing their notes as soon as possible so that independent data are not left as they are, but are turned into propositions or information units that facilitate the recall of lecture content better.

Finally, because note taking is a fundamental skill that affects test scores in high school, teachers should encourage students to look for ways and means to make it more efficient and effective. Furthermore, teachers could modify their manner of presenting lessons, such as speaking a little slower during lectures, providing outlines and presenting background information related to the topic to be learned and providing cues for key lecture ideas.

Future studies on note taking can focus on higher order cognitive thinking. This study was limited to testing knowledge recall and comprehension. The gender factor can also be taken into consideration and a comparative study of note taking skills between high school male and female students can be done. Lastly, the proper grade level when note taking skills can be taught or introduced can be explored bearing in mind the relationship of this skill to other thinking and learning processes.

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