

# INDONESIAN JELT

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Graduate School of Applied English Linguistics

The English Department, Faculty of Education

Atma Jaya Catholic University

Van Lith Building, 2<sup>nd</sup> Floor, Jalan Jenderal Sudirman 51

Jakarta 12930, Indonesia

Phone/Fax number: (62-21) 5708821

[ijelt@atmajaya.ac.id](mailto:ijelt@atmajaya.ac.id)

website: <http://ojs.atmajaya.ac.id/index.php/ijelt>

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## **Comparing the effect of ICT and longhand note-taking instructions towards learners' comprehension test results**

Clara Herlina Karjo

*Bina Nusantara University, Jakarta, Indonesia*

### **Abstract**

With the advancement of technology nowadays, taking notes by hand seems old-fashioned to most students nowadays. They prefer typing using their various gadgets since it will be done faster, especially when there is a lot of information to be recorded. However, the use of ICT devices (such as laptops, smartphones, and tablets) in the classroom has a tendency to be distracting for the students – it is very easy for the students to take out their gadgets and click on Facebook or other applications during a dull lecture. The purpose of the present study is to find out whether note-taking using ICT devices affect the students' understanding of the lecture. This study will use a quasi-experimental design, with 52 English department students of a private university as the participants. They will be divided into two groups as the control and experimental group. Participants of both groups were instructed to watch a video from TED talks twice. While watching the video, the control group was instructed to take notes by hand, while the other group was instructed to take notes using their various devices. After that, participants had to do a comprehension test of the lecture video. The results revealed that participants who took notes by handwriting performed better in comprehension test compared to those who took notes using ICT devices.

**Keywords:** note-taking, ICT, gadgets, lecture videos, longhand, TED talks.

### **ICT and learning styles**

The use of Information Communication Technology (ICT) devices in the classroom have been debated for a long time. Many teachers believe that computers (and the Internet) often serve as distractions in the classroom, detracting from class discussion and students' learning (Yamamoto, 2007). Hembrooke & Gay (2003) also believe that browsing the internet impair the students' performance in the immediate retention of class materials. Unlike their teachers, students believe that the benefit of using computers in class outweigh the costs (Kay & Lauricella, 2011). However, in their empirical study, Kay & Lauricella (2011) prove the teachers' view that students use

their ICT devices for non-academic purposes, such as for browsing Youtube, chatting via social media, and opening their Facebook account. In other words, gadgets or ICT devices are often disruptive instead of helpful in increasing the students' attention and retention of the materials.

Still, due to the advance of technology, the use of ICT devices in the classroom is unavoidable. Recent advancements in technology have led to more computers being introduced into the classroom and incorporated into students' learning experiences, and the availability of portable computers has resulted in a steady increase in the percentage of college students who own one (Smith & Caruso, 2010). Thus, teachers cannot just forbid the use of computers in class; instead, they can integrate the use of computers in the teaching and learning activities. One way to do that is by implementing in-class note-taking using students' devices such as laptops, tablets and even their cell-phones. Therefore, millennial students who cannot be separated from their gadgets will have the opportunity to use their devices as learning tools. On the contrary, more conventional students can still use pen and paper for taking notes.

Whatever the mode is, in academic environment, note-taking is a powerful and inevitable way of learning. Patterson, Dansereau, & Newbern (1992) classify note-taking as an organizing and focusing strategy. Notes can be used to remember the important points of a lesson and for revision and reference purposes. Similarly, Dunkel & Davy (1989) assert that taking notes while listening to a lecture can increase attention and retention of its contents. According to Arslan (2006), note-taking has three benefits. First, it increases attention to the lesson. When students have to take notes, it is impossible for them to be inattentive or get bored. Secondly, note-taking aids memory for the lesson. Obviously, noted lesson points will be easier to remember than non-noted points. The last one, it produces a set of notes available for review. Our memory is fallible, thus, it is necessary to review the lesson from time to time. Without notes, it is impossible to review.

Accordingly, note-taking affects learning in two ways: encoding and external storage (Kiewra, 1985). The encoding hypothesis suggests that the processing that occurs during the act of note-taking improves learning and retention. The external storage hypothesis, conversely, exhibits the benefits of the ability to review material (even from the notes taken by someone else). In his later study, Kiewra (1989) affirms that students who both take and review their notes (as most do) likely profit from both approaches. In other words, students who both take and review their notes will likely perform better than those who do not do so. Obtained results from the experiment indicate that note-taking can help students to improve their levels of knowledge and maybe application. Kiewra's findings were confirmed by Quade (1996) who also discovers that students take notes

because of both the encoding and storage functions, to maintain written records of what occurs in the text and later use this record to enhance review.

The fulfillment of the encoding and storage functions of note-taking will also depend on the modes of taking notes. Some students still prefer to take lecture notes by hand using pen and paper, while some others are now turning to laptop, tablet, or other forms of portable computers to try to maximize their efficiency in note-taking in the classroom (Mogey et al., 2007; Russell & Haney, 1997). Many experts also believe in the use of computer for note-taking in the classroom. By using laptops for taking classroom notes, students can write more contents and recalled more information in free-short term recall tasks (Brown, 1988; Bui, 2013). This is because laptops use facilitates verbatim transcription of lecture contents since most students can type significantly faster than they can write. Likewise, Olive & Piolat (2012) say that when people used a computer to take notes, they took more notes and recalled more of the lecture than when they took notes by hand. Igo, Brunning, & McCrudden (2005) speculate that students' cognitive resources during a lecture are higher when taking notes via computer. Likewise, computer-based notes allow students to more easily augment, edit, or share notes as they review material before an assessment (Katayama, Shambaugh & Doctor, 2005).

However, taking notes using computers or gadgets do not get favorable acceptance among researchers. In their study to Princeton University students, Mueller and Oppenheimer (2014) found that students who took notes using pen and paper performed better in the test. They argued that because of enhanced encoding, reviewing longhand notes simply reminded participants of lecture information more effectively than reviewing laptop notes did (*ibid.*). Similarly, in their study of the students of Darmstadt University of Technology Turkey, Steimle, Gurevych, & Mühlhäuser, M. (2007) also stated that taking notes with a pen and paper is considered easier and faster and therefore preferred to a laptop by the vast majority of students, even though the participants of this research were computer science students, who are generally more familiar with technologies. Other studies also indicate that students perform better on the basis of whether computers or paper and pencil are used for note-taking or assessment (e.g., Fiorella & Mayer, 2012; Goldberg, Russel, & Cook, 2003). Equally, Baret, et al. (2014) found that students who took notes and assessments by hand actually outperformed students who took notes by hand but were quizzed via computer.

There are two previous studies which are particularly relevant to the present study. The first study was carried out by Mueller & Oppenheimer (2014) entitled "The pen is mightier than the keyboard: advantages of

longhand over laptop note-taking". In this study, Mueller & Oppenheimer employed sixty-seven students from Princeton University as the participants. They used five TED talk videos. Video lectures were projected onto a screen at the front of the room. Participants were divided into two groups, one group was instructed to take notes by hand, and the other was instructed to take notes using their laptops. Participants then were given immediate and delayed comprehension tests and their notes were also analyzed. The results showed that laptop use can negatively affect performance on educational assessments, even when computer is used for easier note-taking.

The second one was done by Bui, Myerson & Hale (2013) in their paper "Note-taking with computers: Exploring alternative strategies for improved recall". In this study, they examined note-taking strategies and their relation to recall. Three experiments were implemented to seventy-six undergraduate students, all of whom were proficient English speakers. The first experiment dealt with the comparison of note-taking strategies (using computers or by hand), while the other experiments focused on note-taking using computers with the emphasis on the quality of notes. Their findings showed that participants who were instructed to take notes using computers showed the best recall on immediate test, and those who took organized notes produced best recall on delayed text. Yet, when participants were given the opportunity to study their notes, better recall on delayed tests was shown by those who transcribed the lecture compared to those who had taken organized notes.

The existing studies regarding the difference between the two note-taking strategies mostly involve the use of computers or laptops, which should be done in computer labs. There have been virtually no researches which address the use of other ICT devices such as tablets, I-pads and cell-phones as learning tools, particularly for note-taking. Moreover, these devices are more common and practical to carry to class. However, in this study, the term computer was extended to several kinds of ICT devices which include laptops, tablets, I-pads, and cell-phones. Even though these devices have different screen sizes, they could be used as tools for storing information by typing into them.

Thus, the researcher conducted an experiment to investigate whether taking notes on ICT devices (gadgets) versus writing longhand affects the students' understanding of the lecture and to explore the type of questions which was most benefited by each note-taking strategy.

If computers or other ICT devices enable people to type faster compared to writing by hand, then it can be assumed that computers provide a chance to increase the quantity of notes produced by the students. Moreover, if the amount of notes can predict the test performance of the students, it can also be assumed that the students who take notes using

computers will perform better in comprehension or recall tests. However, these assumptions should be tested further.

## **Research Methodology**

In universities in Indonesia, not all the students are able to bring computers (laptops or tablets) to class for practicality and economic reasons. The most common device that they can take to class is the cellular phone. Thus, instructing students to take notes as much as possible using computers cannot be implemented in Indonesian context. Instead, computers for this study are extended into ICT devices (gadgets) which include laptops, tablets, I-pads or cell-phones. Therefore, the present study has two research questions.

- (1) To what extent do note-taking by hand and note-taking using gadgets affect the students' test performance?
- (2) What kind of test is most benefited by each note-taking strategy?

Relating to the above research questions, there are two aims for this study. The first aim is to compare the test performance of the two groups of students, i.e. one group who are taking notes by hand and the other group who are taking notes using gadgets. The results will show which note-taking method is more beneficial in aiding comprehension. The second aim is to examine the effect of each note-taking strategy to different types of test.

### ***Research Design***

A quasi-experimental design is chosen for this study because only a convenience sample of participants is possible for the study. Moreover, the posttest-only control group designs (Cresswell, 2009, p. 161). In this design, a treatment is given only to the experimental group, and both groups are measured on the post-test only. The purpose is to measure participants' performances in comprehension test after being instructed to take notes using longhand or gadgets. The hypothesis is that participants who take notes using longhand will perform better in the listening comprehension test compared to those who take notes using their gadgets.

### ***Participants***

The participants for this study were 52 undergraduate English Department students of a private university in Jakarta. They were conveniently selected because the researcher must use naturally formed groups (the researcher's students at the university). At the time of the study, all the participants (who were from two classes) were in the sixth semester taking Research Method subject. The sixth-semester students were chosen



because they already acquired sufficient English proficiency to be able to do the tasks that need high-level of thinking such as writing their thesis. One of the topics in Research Method subject is about writing a literary review or theoretical background, which was used in this study. Thus, their understanding of this material is crucial for them for fulfilling the course requirement.

### ***Research Procedure***

The study used a stimuli in a form of a video from TED Talks (<https://www.ted.com/talks>), entitled “The Process of Writing Literary Review”. The video duration was around 15 minutes. TED (Technology, Entertainment, Design) is a global set of conferences run by the private non-profit Sapling Foundation, under the slogan “Ideas Worth Spreading”. The emphasis is on the educational aspect. This video was chosen because it was related to the topic being discussed in the Research Method subject

The data collection instrument used was a comprehension test. The test consisted of five open-ended questions based on the content of the video. The five questions were constructed to represent five types of task, i.e. recalling diagram, giving definition, summarizing, describing a process and recalling list of information.

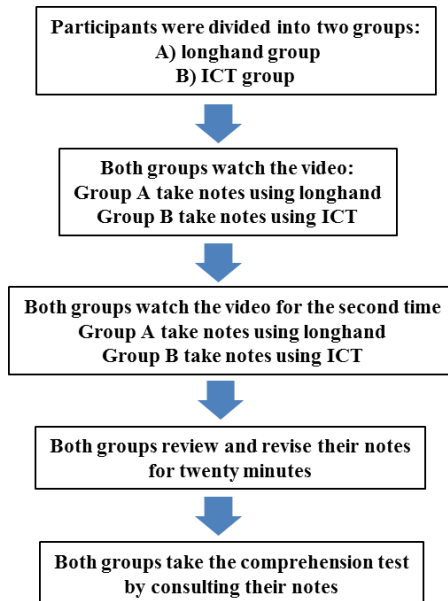
Prior to the experimentation, the students were divided into two groups, longhand (pen and paper) group, and ICT group. During the experiment, both groups were instructed to watch the same video twice. Video lecture was projected onto a screen at the front of the room.

While they were watching the video, they were instructed to take notes according to their group assignment. The longhand group was assigned to make notes using pen and paper; while the other group was assigned to take notes using their ICT devices (cell phones, tablets, IPAD or laptops).

After watching the video and taking notes, they were given twenty minutes time to review their notes by completing missing words or information. Finally, all the participants from the two groups were given the same test regarding the materials they had learned from the video. The test consists of five open-ended comprehension questions which should be done in thirty minutes. Students were allowed to consult their notes while doing their tests.

The data collection procedure can be summarized in diagram 1 below.

**Diagram 1**  
**Data collection procedure**



## Findings and discussion

### *Results of longhand versus ICT devices note-taking*

**Table 1**  
**Independent sample t-test**

Nilai	Levene's test for equality of variance		t-test for equality of means			
	F	Sig.	t.	df	Sig. 2 tailed	Mean differences
Equal variance Assumed	7.635	.008	1.711	50	.093	9.077
Equal variance not assumed				43.404	.094	9.077

Descriptive and independent sample t-test analysis was used to test differences between note-taking medium (longhand vs ICT). The results in Table 1 showed that participants who used pen and paper performed better in comprehension test (longhand: N = 26, M = 79.54, SD = 14.938, St Error

Mean = 2.930 ; ICT : N = 26, M = 70.46, SD = 22.545, St Error Mean = 4.421). There is a mean difference of 9.08 between the longhand group and the ICT group, in which the longhand group got a higher mean score. This difference indicates that students who made notes with pen and paper can perform better in comprehension test, rather than those who made notes with their gadget. The above findings are strengthened by the significance value obtained for the comparison of means.

From the above SPSS results, the assumption that both variances are equal are fulfilled based on the hypothesis:  $H_0: \sigma_1 = \sigma_2$  (in which  $\sigma_1$  = variance of ALT group and  $\sigma_2$  = variance of VLT group). This is because the *p-value* = 0.008 which is smaller than  $\alpha = 0.05$  for equal variance assumed, thus  $H_0: \sigma_1 = \sigma_2$  is rejected. In other words, the equal variances assumed are not fulfilled, then we should use equal variances not assumed. Because the Levene' Test of equal variances is not assumed, the result of independent sample t-test for hypothesis  $H_0: \mu_1 = \mu_2$  gives a  $t = 1.711$  with degree of freedom 43.404 and *p-value* (2-tailed) = 0.094. Because the test is done for one-tailed hypothesis, then *p-value* should be divided by 2 become  $0.094/2 = 0.047$  which is smaller than  $\alpha = 0.05$ , then  $H_0: \mu_1 < \mu_2$  is rejected. Then, it can be concluded that students who take notes with pen and paper perform better in comprehension test.

### ***Results based on question type***

The comprehension test given consisted of five questions and each question was given five points, so the total was twenty-five (25) points. The questions were constructed based on the content of the lecture in the video. Each question was intended to measure the different construct. The first question asked the students to complete a diagram with the vocabulary given in the lecture. The second question asked the students to write a definition. The third question asked them to summarize the talks of John Classen about literature review. The fourth one asked the students to draw a diagram of writing literature review process. Finally, the last question only asked the students to recall several words involved in reviewing. The summary of the type of questions is presented in Table 2.

**Table 2**  
**Examples of each question type**

Question type	Examples
Completion	Mention the types of literature review project.
Definition	What is meant by "literature review"?
Summarizing	What does John Classen say about literature review?
Drawing diagram	Describe the process of writing a literature review.
Listing words	What is involved in reviewing?

The results for each question type were detailed in Table 3 below.

**Table 3**  
**Results based on question type**

Test type	Note-taking with pen and paper	Percent. %	Note-taking with gadgets	Percent. %
Completion	3.81	76.2 %	2.77	55.4 %
Definition	3.58	71.6 %	4.08	81.6 %
Summarizing	3.31	66.2 %	3.00	60 %
Drawing diagram	4.69	93.8 %	4.54	90.8 %
Listing words	4.50	90 %	3.23	64.6 %

For the completion test, students who took note by handwriting achieved 76.2% correct answer compared to gadgets note-taking which only achieved 55.4 %. As has been mentioned by Mueller and Oppenheimer (2014), recalling information from longhand notes might be easier from laptop notes because they still remember the process of writing the notes. On the other hand, when taking notes using laptops or other gadgets, students seemed to take it for granted, meaning that they only tried to record as much information as possible. As the previous studies (see Bui, 2013; Moge, et al., 2007) said, laptops or computers facilitate verbatim note-taking since typing can be done faster than writing.

However, recording more information is quite useful in rewriting the definition of a terminology. In Table 2, it can be seen that the mean score of students using gadgets (81.6 %) is better compared to those who used handwriting (71.6%). Storing more information enables them to give a more accurate definition on the test. As Olive & Piolat (2002) said, people who used a computer to take notes would take more notes and recalled more of the lecture. However, in this study, the students were allowed to consult their notes when they do the test. Results might differ if the test was done without consulting the notes, or if the test was done based on their memory only.

For the other types of question, i.e. summarizing, making diagram and listing of words, the results indicate that longhand group achieved a slightly better score than gadget group. Making a diagram, for example, got 93.8 % compared to 90.8%. Making a diagram can be equalized to concept mapping as well as summarizing, which according to Kiewra (1985) belong to the generative type of note-taking. Making a diagram involves drawing shapes such as lines, squares, circles, etc., besides writing. Thus, it is quite difficult to make even a simple diagram using computers in a short time even though there is a built-in diagram maker on the computer. When they

have to take notes during lectures, students can only record the words but not the shapes. It is a lot easier to draw a simple diagram using a pen on the paper. Steimle, Gurevych, & Mühlhäuser (2007) confirm this by saying that the choice of paper consists of the flexibility of free-form notes and the easy transport.

Word listing type also showed a big gap between gadgets note-takers and longhand note-takers. The longhand group got 90 % while the gadget group got only 64.6 %. Word listing demands recalling a number of specifically arranged words. The participants' performance for this task was related to the format of notes that they made. Kiewra, et al. (1995) mentioned that notes in an outline format, that is an organized format, may be positively correlated with test performance. Writing by hand can facilitate people to make notes in an outline format. In contrast, when typing into the gadgets, the participants may not be able to organize their notes quickly. They would be focusing on storing information as much as possible without thinking of organizing their notes.

Whereas some studies still maintain the use of computers to take notes because of their facility in storing a large amount of information, this study finds that note-taking using pen and paper gives better results in comprehension test of lecture materials. The results of this study confirm the findings of Quade, 1996; Fiorella & Mayer, 2012; Goldberg, Russel, & Cook, 2003; Steimle, Gurevych, & Mühlhäuser, 2007; and Mueller & Oppenheimer, 2014.

Whereas some studies still maintain the use of computers to take notes because of their facility in storing a large amount of information, this study finds that note-taking using pen and paper gives better results in comprehension test of lecture materials. The results of this study confirm the findings of Quade, 1996; Fiorella & Mayer, 2012; Goldberg, Russel, & Cook, 2003; Steimle, Gurevych, & Mühlhäuser, 2007; and Mueller & Oppenheimer, 2014.

Computers, or laptops, due to its size, might be easier to use for typing or taking notes, because one can type faster using ten fingers. On the contrary, smaller devices such as I-pads, tablets or cell-phones are more difficult to use for note-taking. On these devices, one can only type using one, two or three fingers. Thus, typing takes longer and the amount of information recorded may be less than note-taking using computers or even by handwriting. However, in this study, these gadgets were included in the ICT group. This difficulty may probably cause the lower scores of the ICT group in the comprehension test.

However, the results of the comprehension test are also determined by the quality of the notes. Effective notes, according to William and Eggert (2002) are characterized by a clear organization, that is, the hierarchical

delineation between main and subordinate ideas. Effective notes eventually correlate with the students' test performance (Kiewra et al., 1995; Tsai, 2004). Similar findings were shared by Song (2011) who said that note quality could be regarded as a good indicator of test takers' proficiency. Thus, the problem is whether computer users can produce notes of higher quality than notes made using pen and paper. If better or more effective notes can determine the results of the comprehension test, then the results of this study confirm that handwritten notes may probably have better quality than notes made using gadgets. Notes made by using gadgets may contain more information, but handwritten notes may be more structured. Moreover, writing notes using one's own hand involves more than just verbatim copying. As Kiewra (1989) suggests, the act of writing notes can increase the retention of the materials, resulting in better results in the comprehension test.

### **Closing remarks**

ICT devices or gadgets are increasingly used in the classrooms as teaching-learning aids. However, in case of making notes for studying and reviewing, the traditional pen and paper seem irreplaceable with gadgets. This study has confirmed numerous other studies that taking notes with handwriting can give better results in students' understanding of a lecture. Regarding the type of questions, students who take notes with handwriting seem to excel in every question type except in giving a definition, since giving definition require more amount of information.

This study, however, does not measure the retention or recall performance of the students, because the students were allowed to do the test by consulting their notes. For future study, it is suggested that the participants should be allowed to review their notes but not allowed to consult their notes during the test, to measure participants' retention of information.

### **The Author**

Clara Herlina Karjo obtained her bachelor, master and doctorate degree in English applied linguistics from Atma Jaya Catholic University of Indonesia, Jakarta. Currently, she is a teaching staff at Bina Nusantara University and Atma Jaya University. Her research interests include language acquisition, translation, EFL teaching, and phonology.

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