Education Quarterly Reviews

The Asian Institute of Research *Education Quarterly Reviews* is a peer-reviewed International Journal. The journal covers scholarly articles in the fields of education, linguistics, literature, educational theory, research, and methodologies, curriculum, elementary and secondary education, higher education, foreign language education, teaching and learning, teacher education, education of special groups, and other fields of study related to education. As the journal is Open Access, it ensures high visibility and the increase of citations for all research articles published. The *Education Quarterly Reviews* aims to facilitate scholarly work on recent theoretical and practical aspects of education.

ASIAN INSTITUTE OF RESEARCH
Connecting Scholars Worldwide

The Effect of Verbatim and Generative Notes Taken by Hand and Keyboard at University Level on Success and Persistence

Tahir GÜR[1]

[1] Gaziantep University, Turkey

Abstract
The lecturing instruction method stands out as the most used education method in university classrooms. Students and researchers have developed study techniques to reduce the disadvantages of this method to increase success at the undergraduate level. The most important, common, and traditional of them is taking note. The verbatim notetaking, which is widely used outside of the lesson, is seen as well as it is also seen that the note takers take it by generating them in their own way. With the development of technology in the notetaking process, it is seen that digital tools have become widespread in addition to the pen. In this study, the effects of generative and verbatim taking notes on success and its persistence were examined. The study group of the study consists of 116 education faculty students studying in Turkish and Social Sciences education programs. Within the scope of the research, demographic information will be presented to the participants in a way that does not violate personal privacy; In the analysis of the opinions, utmost attention was paid to the rules of scientific and research ethics, assuring that the participants will be coded in a way that does not evoke identity information. A pre-experimental study was conducted with four groups of 29 students. The groups made the verbatim and generative note taking with pen and keyboard. The first and second post-tests were applied to measure the success of taking notes during the lesson and its persistence. According to the results of the study, it was determined that taking notes with a pen by the generative method has more positive effects than using the keyboard or taking verbatim notes on both success and persistence.

Keywords: Handwriting, Keyboard Writing, Note Taking, Success, University Student

1. Introduction

The lecturing method is still the most widely used teaching method in universities (Wirt et al., 2001; Carrier, Williams & Dalagard, 1988, p. 223; Shaughnessy, 2001). Although there were various criticisms, students and other stakeholders sought methods and techniques that could gain more efficiency in university classrooms where the traditional lecturing method was used. For this purpose, students have always used strategies and techniques for learning and remembering more during lecturing, such as active listening, developing note taking strategies, focusing attention, and recording. Among these, students mostly used note taking and found it suitable for lecturing (Palmatier & Bennett, 1974; Dunkel & Davy, 1989; Carrier 1983; Moin, Magiera, & Zigmond, 2009), because it has been determined that students who take notes are more successful in the cognitive process related to remembering later (Dunlosky, Rawson, Marsh, Nathan & Willingham, 2013).

Note-taking, which is a method that increases student achievement in a lecturing environment (Armbruster, 2009), is inherently related to the methods and tools used in writing skill. While note taking with a pen was a favorite - maybe the only option - in the past, recent developments in technology and the lifestyle associated with it have also changed notetaking habits. Therefore, the computer dimension has been added to recent notetaking studies (Bauer & Koedinger, 2006; Crooks, White, & Barnard, 2007; Igo, Bruning, & McCrudden, 2005; McQuiggan, Goth, Ha, Rowe, & Lester, 2008). In this study, the success and recall of information in various notetaking methods using hand and keyboard typing were examined.

1.1 Comparison of Writing Process and Note-Taking Tools

The story of human's writing, which begins with the pictures drawn on the cave walls, is a process that includes the invention of writing, the invention of the printing house, the invention of the typewriter, the invention of the computer, and the development of keyboards (Cortada, 2015). It is seen that the desire and need of the human to learn, understand, and explain have not changed-basically- throughout the ages, but the tools and techniques used have changed. In this context, there are discussions and researches about writing with the keyboard and writing with handwriting - pen-,, which has increased in recent years.

With the introduction of computers into human life, the development of writing programs, and the widespread use of digital devices, the use of these programs and tools in writing instead of writing with a pen has intensified (Cochran-Smith, 1991; Freedman, Hull, Higgs and Booten, 2016). Accordingly, the use of the keyboard, which has become widespread in schools and in school-related writing tasks, was compared, and the pen-keyboard found a place in both administrative regulations and academic literature and discussions. For example, UNESCO stated in its reports that if schools do not switch from paper pedagogy to digital pedagogy in order to comply with the digital age, they will not be able to adapt to digital tools (Cornu, 2011) and expressed its view that keyboard writing should be preferred to pen for the age we are in. Spiro (2004), Leu, Forzani, Burlingame, Kulikowich, Sedransk, Coiro, & Kennedy (2013) and Kordigel Aberšek, Dolenc, Flogie & Koritnik, (2015), defending technologies known as online, digital or high technology, made reading or writing with technology more prominent or preferred than handwriting. In the context of these studies and the studies that support them, it can be concluded that "keyboard use or digitization is inevitable, even replacing writing with a pen and can be preferred instead of writing with a pen."

However, in the process of learning to read and write, which is the first step, it has been found that before starting to write competently, while learning to read and write, their ability to remember and recognize letters is more developed when they write by hand and children learn to read by handwriting more easily (Naka, 1998; Naka & Naoi, 1995; Cunningham & Stanovich, 1990). It has also been found that the high-level mental processes required for reading in children develop better in handwriting (Graham & Weintraub, 1996). In addition, writing, which is one of the ways of expressing oneself, is also used to monitor or evaluate what students have learned (Applebee, 1981; Graves, 1989). As reading and writing are very interrelated skills, they develop together and in relation to mental and physiological aspects (Fitzgerald & Shanahan, 2000). Therefore, it can be said with the literature review that handwriting should be preferred more in the literacy learning process.

In addition to these, there are also studies in the literature that found that writing with a pen is more efficient in some aspects, especially in terms of learning. For example, Mueller and Oppenheimer (2014) determined in their study with university students that students who take notes by hand learn better than those who write on the keyboard. In this context, although computerized education has been glorified - relatively - in recent years, it has been observed that reframing while taking notes with handwriting, the effort to reflect one's opinion, produce interpretation, and establish relationships increases learning and better coding into memory. In this context, activation areas were formed differently in brain imaging studies with keyboard and handwriting. Therefore, when the part of brain studies with writing was examined, it was found that there was a difference between the use of the keyboard and the use of the pen, both in-process and result. Willis (2011) stated that handwriting intensifies the brain's attention focuses more on the lesson and homework, activates the long-term memory, and brings the brain to the highest activity. In the same direction, in another study, remembering words written with handwriting

occurred more than words typed with a keyboard. In addition, other studies (Smoker, Murphy & Rockwell, 2009; Mangen et al., 2015; Mueller & Oppenheimer, 2014) found that handwriting was mentally more active and more effective in learning than typing with the keyboard.

To summarize, although the use of keyboard has increased recently, the importance of handwriting and writing is still acknowledged, and it is stated that pen and paper are still more accessible, affordable and portable, and more efficient in learning (Graham, 2009/2010; Mueller & Oppenheimer, 2014).

1.2 Note Taking

Notes are taken for many purposes, from the simplest to-do list to learning, remembering, organizing, and planning what was said during the lesson. The history of studies that reveal findings that taking note increases academic achievement in academic studies on learning can be traced back to the beginning of the last century (Crawford, 1925). First of all, notetaking is a conscious and demanding action to achieve the goal. In other words, it takes place within the framework of the note taker's will, technique and individuality and in order to be successful (Kiewra, Dubois, Christian, McShane, Meyerhoffer & Roskelley, 1991). On the other hand, notetaking in academic settings usually encodes what is spoken under time pressure or the effect awakened on them. In other words, taking notes by listening is done to listen carefully to what is heard and important points and to remember them later (Zohrabi & Esfandyari, 2014). In other words, the notetaking process is a cognitive process since its auditive, sensory-motor, visual and cognitive perceptive tasks reveal a written product (Daneman & Merikler, 1996) with understanding (van Dijk & Klintsch, 1983) that takes place within a certain time limit (Piolat, olive, & Kellogg, 2005). In this context, cognitive activities such as attention, choosing the necessary information, re-expressing with their own expressions, and remembering in the notetaking process occur in various dimensions (Steimle, Brdiczka, & Mühlhäuser, 2009; Stefanou, Hoffman, & Vielee, 2008; Einstein, Morris & Smith, 1985). Therefore, it can be said that note taking consists of multidimensional cognitive processes and is the most used study activity by students.

Kiewra (1985) divides the functions of note taking into two: the "process" by which information is encoded and the "product" categories by which information is reused. In the process part, the student records what is told in a unique way, using tactics such as active listening, relating, summarizing, determining important points (O'Hara, 2005), and relating to previous information (Peverly, 2006). In the product category, the student uses the notes he/she has taken as "external storage." In other words, he/she uses the information in his/her notes to review and remember. Although both categories are considered important in notetaking, there are also studies showing that not taking notes but having and working on them brings academic success (Carter and Van Matre, 1975). In this context, studying notes reduces the negative effect of time on memory loss and familiarity on the subject (Kiewra, 1985).

The quality of notes taken during a course depends on the cognitive load during note taking (Baddeley, Chincotta and Adlam, 2001). The main cognitive processes used in this context are comprehension, accuracy, complexity, metacognition, and memorization. More cognitive load in note taking means more success. In particular, metacognitive generation is generally effective on academic achievement, as it is an efficient learning strategy (Sperling, Howard, Staley, & DuBois, 2004; Hacker, Dunlosky, & Graesser, 1998). Note takers record and learn information according to their own competence and characteristics with a way of taking notes suitable for them. It is also stated that this is a metacognitive activity since it supervises their own thoughts and products in terms of remembering information (White & Frederiksen, 1998).

Note taking with the keyboard is more advantageous than writing with a pen, especially in terms of speed (Brown, 1988). Therefore, it has more information storage capacity in this way. In some studies (Peverly et al., 2007; Peverly & Sumowski, 2012), it was found that there is a positive relationship between taking text notes/taking course notes and writing speed. As more details mean more information, the content and quality of the notes are important, as well as the speed of note taking (Armbruster, 2009; Mueller & Oppenheimer, 2014). From this point of view, it is advantageous as it is faster to take notes with the keyboard and contains more details and information.

In this study, handwriting and typing with a keyboard were compared with an experimental pattern, which was investigated and compared in various aspects in the literature, and the efficiency of hand typing on notetaking techniques was compared. Verbatim notetaking was taken as complete recordings word by word; generative notetaking was taken to summarize and take notes with the student's own style. In the study, the qualifications of the notes are beyond the scope of the study, and the focus has been on success and persistence. For persistence, it is limited to the measurement made at the end of a week.

2. Method

In this study, the effect of the note taking styles students use on their achievement was examined. In this study conducted with 116 university students, the effects of their notetaking style on their achievement were examined, as well as the effects of pen-keyboard notetaking styles on their success and persistence. In this direction, the problems of the study are as follows:
1. What is the effect of note taking styles on success?
2. What is the effect of note taking styles on persistence in learning?

This study was carried out using a pre-experimental design with four groups without a control group. The visual expression of the pattern is as follows.

Groups (randomly assigned)	pretest	Application (X)	Success test	Time interval	Persistence
D1(n=29)	O1	Verbatim notetaking with a pen (x1)	O2	One week	O3
D2(n=29)	O1	Verbatim notetaking with a keyboard (x2)	O2	One week	O3
D3(n=29)	O1	Generative note taking with a pen (X3)	O2	One week	O3
D4(n=29)	O1	Generative note taking with a keyboard (X4)	O2	One week	O3

2.1 Participants

116 (n=116) students from Gaziantep University Faculty of Education participated in this study. Sixty of these students who study in the Turkish Language Arts and Social Studies Teaching departments of the faculty are male, and 56 of them are female. Since the effect of notetaking styles on achievement and persistence of information was investigated in the study, four experimental groups to apply verbatim and generative notetaking techniques using pen and keyboard were randomly assigned from among these students. In these groups, the practice groups of verbatim note taking with a pen, verbatim note taking with keyboard, generative note taking with a pen, and generative note taking with the keyboard were determined as 29 people.

According to the questionnaire forms given to the students participating in the study, all of them consider themselves competent in typing with the keyboard, and all of them have stated that they have worked with computers since their secondary school years. All of these students also stated that they used the keyboard in some way. That is, they wrote with their cell phones, laptops, or tablets and used at least one of them daily. In the study, a list of science fields was given for the students to choose a subject with a high level of knowledge that is outside of their current field of study, and the field of zoology, which no student thought of and selected as a subject of interest and study, was used in the selection of the subject to be discussed in practice for this study.

2.2 Procedure And Measurements

In this study, the results on the success and persistence of verbatim and generative note taking techniques taken using pen and keyboard were compared. At the beginning of the study, a pretest of 30 questions including general zoological information, was applied to all groups. Later, the groups took notes with the notetaking technique determined for them and listened to the lesson in lecturing in two lesson hours provided that they were from the same teacher. The course is intensive in terms of information, and sixty questions were produced from the course content in the tests. Thirty of these questions were asked in the exam two hours after the notetaking exercise, while the other 30 were asked in the exam one week later. In the distribution of the questions to two tests, the opinions and suggestions of the three field experts were taken to ensure that the difficulty levels of the tests were equal, and accordingly, the distribution of the questions in the tests was determined. Each question's value in the tests was determined as one point, so evaluations were made over 30 full points. The chance factor was tried to be minimized by using the fill-in-the-gap questions in all tests, including the pretest. In addition, within the scope of the research, demographic information will be presented in a way that does not violate personal privacy; In the analysis of the opinions, utmost attention was paid to scientific and research ethics rules, assuring that the participants would be coded in a way that would not evoke their identity information.

3. Results

Firstly, in the study, whether the groups are equal or not, was tested with a pretest. Descriptive statistics of pretest scores of 30 questions and ANOVA test results were examined.

Descriptives
Pretest-O1

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
X1	29	2.3448	1.26140	.23424	1.8650	2.8246	.00	5.00
X2	29	2.3448	.89745	.16665	2.0035	2.6862	1.00	4.00
X3	29	2.1724	.96618	.17941	1.8049	2.5399	.00	4.00
X4	29	2.3448	1.17339	.21789	1.8985	2.7912	.00	5.00
Total	116	2.3017	1.07315	.09964	2.1044	2.4991	.00	5.00

ANOVA
Pretest-O1

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.647	3	.216	.183	.908
Within Groups	131.793	112	1.177		
Total	132.440	115			

As can be seen in the tables, it was determined that the arithmetic means in the descriptive statistics of the pretests were very close to each other, and there was no significant difference at the 0.05 significance level in the Anova test. With these results, it can be said that the groups are equal.

3.1 Findings and results regarding the first problem

In the first problem of the study, the effect of verbatim and generative note taking on student achievement using pen and keyboard was examined. For this purpose, test (O2) scores right after the lesson, descriptive statistics, and ANOVA test results were used to determine the success of the groups.

Descriptives

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
X1	29	15.1724	4.92855	.91521	13.2977	17.0471	5.00	24.00
X2	29	11.1379	3.52262	.65413	9.7980	12.4779	6.00	21.00
X3	29	18.9655	4.57854	.85021	17.2239	20.7071	9.00	27.00
X4	29	16.9310	3.32664	.61774	15.6657	18.1964	12.00	23.00
Total	116	15.5517	5.01015	.46518	14.6303	16.4732	5.00	27.00

ANOVA					
Post-test					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	962.276	3	320.759	18.668	.000
Within Groups	1924.414	112	17.182		
Total	2886.690	115			

As seen in the table, it was observed that students who took notes by the generative method with a pen in the achievement test performed right after the lesson were the highest, while the averages of students who took notes by the generative method were higher than those who took verbatim notes. It was seen from the ANOVA test results of the groups that there was a significant difference at the 0.05 significance level.

3.2 Findings and results regarding the second problem

In the second problem of the study, the effect of notetaking styles on persistence was investigated. For this purpose, the second achievement test results, which measure the persistence of the information made one week after the lecture, were examined by descriptive statistics and ANOVA tests. Then, the difference between the success and persistence tests was examined with the Mann Whitney U Test.

Descriptives
Persistence

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
X1	29	13.0000	5.11999	.95076	11.0525	14.9475	3.00	22.00
X2	29	8.8621	3.43016	.63697	7.5573	10.1668	4.00	17.00
X3	29	17.5862	4.73978	.88016	15.7833	19.3891	6.00	24.00
X4	29	13.8621	2.50320	.46483	12.9099	14.8142	10.00	21.00
Total	116	13.3276	5.09352	.47292	12.3908	14.2644	3.00	24.00

ANOVA
Persistence

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1115.621	3	371.874	22.297	.000
Within Groups	1867.931	112	16.678		
Total	2983.552	115			

Considering the ANOVA results of the persistence tests, it is seen that there are significant differences between the groups, and in descriptive statistics, the highest success score according to the arithmetic average is in the generative handwriting method.

In the Mann Whitney U test, the analysis was made using the differences between the success (O2) and persistence (O3) tests of the groups. According to the results of the test, it was determined that the highest persistence was in generative taking notes by handwriting.

Ranks

	Group	N	Mean Rank
O2 -O3 persistence	X1	29	57.74
	X2	29	64.41
	X3	29	41.21
	X4	29	70.64
	Total	116	

Test Statistics[.b]

	O2-O3 Persistence
Chi-Square	12.880
df	3
Asymp. Sig.	.005

a. Kruskal Wallis Test

b. Grouping Variable: Group

In this study, the effect of students' different notetaking styles on their achievement and persistence of information was compared. Success tests applied as a result of generative and verbatim note taking processes using keyboard and pen were compared with success with the first test and the persistence of information with the second one. Considering the study results as a whole, it was concluded that generative note taking with handwriting is more efficient in both success and persistence than other note taking types. In this context, it was revealed as another result of the study that besides the note taking technique, writing by hand is more effective in learning and persistence. In addition, considering the results of the study in terms of writing education, it was found that more efficient results were obtained on the learning and persistence of information by handwriting.

4. Discussion and Recommendations

In this study, the efficiency of verbatim and generative note taking techniques that students take with handwriting and keyboard during the lecture, which is taught with the lecturing technique, was examined. In the study, persistence test scores in learning were compared with the achievement test done right after the lesson and the tests performed after a while. Generative note taking by handwriting has been found to be the most efficient note taking technique for both success and persistence.

All of the students in the study group in which this study was conducted used handwriting mainly from the literacy learning process until they came to university, except for a few courses. In the primary and secondary school curricula in our country, the obligation of using a computer or using a keyboard is almost non-existent. Therefore, the keyboard-computer competencies of the student group studied for this study are based on their own acceptance and declaration. But there is no student study group whose competencies have been measured in concrete and standard terms. Therefore, it should be assumed that the students in the study group have relatively little use of the keyboard or computer in the school environment. The effect of students' computer use background should also be considered on the results of the study by doing the study with groups in countries that have received more computer

or keyboard training and are used more frequently. It is clear that in this way, more holistic and more valid results will be obtained.

Although there are studies on which handwriting and keyboard use is efficient in the literature, it has been observed that there is no consensus on one of them (Longcamp, Zerbato-Poudou & Velay, 2005; Sülzenbrück, Hegele, Rinkenauer & Heuer, 2011). However, studies have determined that both have some advantages and disadvantages. Keyboard note taking stands out as the main advantage of writing faster and more words and taking more detailed notes. In handwriting note taking, it has come to the fore as the main advantage in which more cognitive processes are activated. In this study, unlike many studies in the literature, verbatim and generative note taking techniques with the use of handwriting and keyboard were compared. In the study, students were asked to use the note taking technique determined by the researchers for the group from which they were chosen while choosing a topic from an area of interest. The literature on this subject should be developed by studying the types of note taking that students consider themselves competent in the courses of their interest.

Estibaliz et al. (2016) compared health science students' note taking with pen and computer in their study. They found that the notes taken using the computer were more successful in spelling, word count, and sentence studies. It was observed that students who took notes by hand were better at recall studies and were more successful than students who took notes with a computer in terms of success. In this study, since it was seen that students who took handwriting grades had higher success and higher permanence test results, while it was seen to support Estibaliz et al.'s work, it also improved their work with both knowledge and persistence tests.

Aguilar-Roca, Williams and O'Dowd (2012) examined the free zone created to use notebooks and student success in their study. In some of their studies, they found that those who took notes using pen and paper were more successful in biology lessons than those who took notes with a notebook. Although the main purpose of that study was to examine student success in notebook free zones, this study supports their findings on the effect of taking paper and notebook notes on success.

Increasing student success in schools is the biggest goal of all education system stakeholders. In this context, while the way of taking notes and progressive techniques during the lesson is available as an independent lesson only in some faculties and high schools in some countries, they are mostly left to the individual interests and development of the students in a random manner. The situation is the same in our country. Educational activities or courses should be given to increase students' competence in this regard, and deliberate and competency-oriented education should be given.

Writing can be accomplished in a very well coordinated manner, regardless of the means and ways, such as motor, cognitive skills, and perception. Many theoretical and practical studies have compared the use of a pen or keyboard (Connelly, Gee, & Walsh, 2007; Crook & Bennet, 2007). In many of these studies, writing using a pen in the basal reading stage was seen as advantageous in many ways. In the more advanced classes, the writing was compared in both ways in the studies, some of which are mentioned above. In such discussions for a long time, many detections and complaints that the handwriting is now obsolete and has lost its importance or complaints have been seen (Baron, 2009; Konnikova, 2014; Dijck, Ketelaar, & Neef, 2006; Hensher, 2012). Educators and researchers should seek methods that can take advantage of both ways of writing, with good coordination and programs, instead of competing with these two styles of writing or rejecting one completely.

Ethic Information

In the individual interviews conducted by the researchers with the participants, it was announced that the collected data would only be used for this study. Within the scope of the research, demographic information will be presented in a way that does not violate personal privacy; In the analysis of the opinions, utmost attention was paid to scientific and research ethics rules, assuring that the participants would be coded in a way that would not evoke their identity information. In this article, the journal writing rules, publication principles, research and publication

ethics, and journal ethical rules were followed. The responsibility belongs to the author (s) for any violations that may arise regarding the article.

References

Aguilar-Roca N. M., Williams, E., O'Dowd, D. K. (2012). The impact of laptop-free zones on student performance and attitudes in large lectures. *Computers & Education* 59. 1300–1308. https://doi:10.1016/j.compedu.2012.05.002.

Aragon-Mendizabel E., Delgado-Casas, C., Navarro-Guzman, J. I., Menacho-Jimenez, I. & Romero-Oliva, M. F. (2016). A comparative study of handwriting and computer typing in notetaking by university students. *Media Education Research Journal,* 48, pp.99-107.

Armbruster, B. B. (2009). Taking notes from lectures. In R. F. Flippo, & D. C. Caverly (Eds.). *Handbook of college reading and study strategy research* (pp. 220–248). New York, NY: Routledge.

Baddeley, A. D., Chincotta, D., & Adlam, A. (2001). Working memory and the control of action: Evidence from task switching. Journal of Experimental Psychology: General, 130(4), 641-657.

Bauer, A., & Koedinger, K. (2006). Pasting and Encoding: Note-taking in online courses. *Proceedings of the sixth IEEE international conference on advanced learning technologies (ICALT'06)* (pp. 789–793). Kerkrade, The Netherlands: IEEE Computer Society.

Brown, C. M. (1988). Comparison of typing and handwriting in "two-finger typists." *Proceedings of the Human Factors and Ergonomics Society Annual Meeting,* 32(5), 381–385.

Carter, J. F., & Van Matre, N. H. (1975). Note taking versus note having. *Journal of Educational Psychology*, 67, 900–904.

Charles Crook, Lindsey Bennett, Does using a computer disturb the organization of children's writing? *Br. J. Dev. Psychol.* 25 (2) (2007) 313–321.

Cochran-Smith, M. (1991). Learning to teach against the grain. *Harvard Educational Review*, 61, 279-310.

Connelly, V., Gee, D. & Walsh, E. (2007). A comparison of keyboarded and handwritten compositions and the relationship with transcription speed. *Br. J. Educ. Psychol.* 77, 479–492.

Cortada, J. (2015). *Before the computer: IBM, NCR, Burroughs, and Remington Rand and the industry they created 1865–1956.* Princeton: Princeton University Press.

Crawford, C. C. (1925). The correlation between college lecture notes and quiz papers. *Journal of Educational Research*, 12, 282–291.

Crooks, S. M., White, D. R., & Barnard, L. (2007). Factors influencing the effectiveness of note taking on computer-based graphic organizers. *Journal of Educational Computing Research*, 37(4), 369–391.

Cunningham, A. E., & Stanovich, K. E. (1990). Early spelling acquisition: Writing beats the computer. *Journal of Educational Psychology*, 82, 159–162.

Daneman, M., & Merikle, P. M. (1996). Working memory and language comprehension: a meta-analysis. *Psychonomic Bulletin & Review,* 3(4),422-433.

Dennis Baron, A. (2009). *Better Pencil: Readers, Writers, and The Digital Revolution,* Oxford University Press, New York.

Einstein, G. O., Morris, J., & Smith, S. (1985). Notetaking, Individual Differences, and Memory for Lecture Information. *Journal of Educational Psychology,* 77(5), 522-532. doi: http://dx.doi.org/-10.1037/0022-0663.77.5.522

Fitzgerald, J., & Shanahan, T. (2000). Reading and writing relationships and their development. *Educational Psychologist,* 35, 39–50.

Freedman, S. W., Hull, G. A., Higgs, J. M., & Booten, K. P. (2016). Teaching writing in a digital and global age: Toward access, learning, and development for all. In D. H. Gitomer & C. A. Bell (Eds.), *Handbook of research on teaching (5th ed., pp. 1389–1450)*. Washington, DC: American Educational Research Association.

Graham, S. (2009/2010). Handwriting still counts. *American Educator*, 33, 20–27.

Graham, S., & Rijlaarsdam, G. (2016). Writing education around the globe: Introduction and call for a new global analysis. *Reading & Writing: An Interdisciplinary Journal*, 29, 781–792.

Graham, S., & Weintraub, N. (1996). A review of handwriting research: Progress and prospects from 1980 to 1994. *Educational Psychology Review*, 8(1), 7–87.

Hacker, D. J., Dunlosky, J, & Graesser, A. C. (Eds) (1998). *Metacognition in educational theory and practice.* Mahwah, NJ: Lawrence Erlbaum Associates.

Hensher, P. (2012). *The Missing Ink: The Lost Art of Handwriting*. Pan Macmillan, London.

Igo, L. B., Bruning, R., & McCrudden, M. T. (2005). Exploring differences in students' copy-and-paste decision making and processing: A mixed-methods study. *Journal of Educational Psychology*, 97(1), 103–116.

Ketelaar, E. & Ketelaar, F. C. J. (Eds.) (2006). *Sign Here: Handwriting in the Age of New Media,* Amsterdam University Press, Amsterdam.

Kiewra, K. A. (1985). Investigating notetaking and review: A depth of processing alternative. *Educational Psychologist*, 20, 23–32.

Kiewra, K. A., Dubois, N. F., Christian, D., McShane, A. Meyerhoffer, M., & Roskelley, D. (1991). Notetaking functions and techniques. *Journal of Educational Psychology*, 83, 240-245.

Konnikova, M. (2014). *What's Lost as Handwriting Fades,* New York Times, New York.

Kordigel Aberšek, M., Dolenc, K., Flogie, A., & Koritnik, A (2015). The new literacies of online research and comprehension: to teach or not to teach. *Journal of Baltic Science Education,* 14 (4), 460-473.

Leu, D. J., Forzani, E., Burlingame, C., Kulikowich, J. M., Sedransk, N., Coiro, J. & Kennedy, C. (2013). The new literacies of online research and comprehension: Assessing and preparing students for the 21st century with Common Core State Standards. dards. In S.B. Neuman & L.B. Gambreil (Eds.), *Quality reading instruction in the age of Common Core Standards* (pp. 219-236). Newark, DE: International Reading Association

Longcamp, M., Anton, J. L., Roth, M., & Velay, J. L. (2005). Premotor activations in response to visually presented single letters depend on the hand used to write: A study in left-handers. *Neuropsychologia*, 43 (12), 1801-1809.

Longcamp, M., Zerbato-Poudou, M. T. & Velay, J. L. (2005). The influence of writing practice on letter recognition in preschool children: A comparison between handwriting and typing *Acta Psychologica* 119(1), 67–79. doi: http://dx.doi.org/10.1016/j.actpsy.2004.10.019

Mangen, A., Anda, L. G., Oxenborough, G. & Brønnick, K. (2015). Handwriting versus typewriting: Effect on word recall. *Journal of Writing Research,* 7 (2), 227-247

McQuiggan, S. W., Goth, J., Ha, E., Rowe, J. P., & Lester, J. C. (2008). Student notetaking in narrative-centered learning environments: Individual differences and learning effects. In B. P. Woolf, E. Aïmeur, R. Nkambou, & S. Lajoie (Eds.). *Proceedings of the 9th international conference on intelligent tutoring systems (ITS 2008)* (pp. 510–519). Berlin, Heidelberg: Springer.

Mueller, P. A. & Oppenheimer, D. M. (2014). The pen is mightier than the keyboard: Advantages of longhand over laptop note taking. *Psychological Science,* 25 (6), 1159-1168

Naka, M. (1998). Repeated writing facilitates children's memory for pseudocharacters and foreign letters. *Memory and Cognition,* 26, 804–809.

Naka, M. & Naoi, H. (1995). The effect of repeated writing on memory. *Memory and Cognition,* 23, 201–212.

Neuman, S. B. & Gambrell, L. B. (Eds.), (2013). *Quality reading instruction in the age of Common Core Standards* (219–236). Newark, DE: International Reading Association.

O'Hara, S. (2005) *Improving Your Study Skills: Study Smart, Study Less.* Wiley 57 -70 Cliffs Notes

Peverly, S. T. & Sumowski, J. F. (2012). What variables predict the quality of text notes and are text notes related to performance on different types of tests? *Applied Cognitive Psychology*, 26(1), 104–117.

Peverly, S. T., Ramaswamy, V., Brown, C., Sumowski, J., Alidoost, M. & Garner, J. (2007). What predicts skill in lecture note taking? *Journal of Educational Psychology*, 99(1), 167–180

Peverly, S. T. (2006). The Importance of Handwriting Speed in Adult Writing. *Developmental Neuropsychology,* 29(1), 197-216.

Piolat, A., Olive, T. & Kellogg, R. T. (2005). Cognitive Effort during Note Taking. Applied *Cognitive Psychology*, 19, 291-312.

Smoker, T. J., Murphy & Rockwell, A., K. (2009). Comparing memory for handwriting versus typing. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, 53 (22), 1744-1747.

Sperling, R. A., Howard, B. C., Staley, R. & DuBois, N. (2004). Metacognition and Self-Regulated Learning Constructs. *Educational Research and Evaluation,* 10 (2), 117-139.

Spiro, R. J. (2004). Principled pluralism for adaptive flexibility in teaching and learning. In Ruddel, R. B. & Unrau, n. (Eds.), *Theoretical models and processes of reading* (5th Ed., 654-659). Newark, DE: International Reading Association.

Stefanou, C., Hoffman, L. & Vielee N. (2008). Note Taking in the College Classroom as Evidence of Generative Learning. *Learning Environments Research*, 11, 1-17. doi: http://dx.doi.org/10.1007/s10984-007-9033-0

Steimle, J., Brdiczka, O., & Mühlhäuser, M. (2009). Collaborative Paper-based Annotation of Lecture Slides. *Educational Technology & Society,* 12, 125-137. doi: http://dx.doi.org/10.1109/TLT.200- 9.27

Sülzenbrück, S., Hegele, M., Rinkenauer, G. & Heuer, H. (2011). The Death of Handwriting: Secondary Effects of Frequent Computer Use on Basic Motor Skills. Journal of Motor Behavior, 43(3), 247-251. doi: http://dx.doi.org/10.1080/00222895.2011

Van Dijk, T. & Kintsch, W. (1983). *Strategies of discourse comprehension.* New York: Academic Press.

White, B., & Frederiksen, J. (2008). Inquiry, Modeling, and Metacognition: Making Science Accessible to All Students. *Cognition and Instruction,* Vol 16, No.1, 79