

## Students' Use of Notebook Computers in the College Classroom: Benefits and Pitfalls

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This study aims to understand the overall experiences of students who use notebook computers in class by using a qualitative approach. Interview data were collected from 23 Korean college students at a Korean university, who use notebook computers in their classes; the data were analyzed through the constant comparison method. The results from this study can be categorized into two themes: the positive and negative effects of using a notebook computer in class, and different perspectives on the effects of using a notebook computer in class. The positive effects of notebook computer usage were specified as production of lecture notes, performing searches for information, management of learning materials, and effective time management. However, behaviors such as perusing other works not associated with the class were indicated as negative effects. The participants had different perceptions about the effect of notebook computer usage in increasing academic performance, although they were satisfied in their experience with notebook computers in general. These results imply that appropriate methods of technology usage are needed and that the support of an instructor is essential to achieve fully beneficial use of notebook computers in class.

*Keywords : notebook computer, college student learning, one-to-one computing*

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## Introduction

In college classrooms, increasing numbers of students bring their notebook computers to use in class instead of notebooks (Kay & Lauricella, 2011). Laptop initiative at the college level around the world is still growing (Zhu et al., 2011). This trend has resulted from the introduction of low-cost, high-performance notebook computers, which students today can easily purchase (Wilen-Daugenti, 2008). According to a 2010 study, approximately 89% of the undergraduate students in the United States has notebook computers in the form of a laptop or a netbook (Smith & Caruso, 2010). Another reason accounting for the increasing usage of notebook computers lies in the adoption of the notion of u-learning, which yields learning benefits through the easy availability of a wireless internet connection on campus (McCrea, 2010).

The use of a notebook computer in the classroom has become widespread, regardless of school level. The notion of one-to-one computing had been tested in primary, secondary, and higher educational settings from the beginning of the 1990s (Garthwait & Weller, 2005). Efforts to construct future learning environments (such as McCrea, 2010 and Gehlen-Baum & Weinberger, 2012) had been performed in various aspects, including one-to-one computing, u-learning, and u-campus. These studies indicate the multiple ways that learners use notebook computers, the impact of notebook computers on learning, and the main causes for the success or failure of notebook computer usage in learning (Penuel, 2006; Byun 2009).

Penuel (2006) synthesized results from studies conducted until 2005 that analyzed implementation and effects of one-to-one computing in K-12 education setting from a variety of countries, and Byun (2009) synthesized similar research carried out from then and until 2008. They found that positive effects of one-to-one computing on students' academic achievement cannot be conclusively determined, since previous studies show conflicting findings on academic

performance in several areas, such as mathematics, English and science.

In terms of the studies abroad that have been conducted in university-level settings, the findings have reported that the use of notebook computers increases the learning motivation of students (e.g., Finn & Inman, 2004; Mouza, 2008; Trimmel & Bachman, 2004) and is also a critical factor that accounts for the difference in study habits among students (Demb, Erickson, & Hawkins-Wilding, 2004). In addition, usage of notebook computers results in greater learning by easing the burden on learners (Barak, Lipson, & Lerman, 2006; Mitra & Steffensmeier, 2000). However, by contrast, some studies report that using a notebook computer in class decreases concentration among students and that therefore the device does not have a positive impact on learning (Aguilar-Roca, Williams, & O'Dowd, 2012; Gehlen-Baum & Weinberger, 2012). Thus, allowing a notebook computer in class including smart devices such as a smartphone has been issued in most educational institutes, although many faculties see bringing notebook computers in class as an opportunity for more innovative teaching (Zhu et al., 2011). Especially, allowing a notebook computer in class seems more problematic in that a notebook computer arouses students distracting, communicating (e.g. instant messaging), and entertaining simultaneously, and the students pretend as if they are working on something related to the class (Kay & Lauricella, 2011).

Even domestically, extensive research has been conducted on the use of a notebook computer for learning. However, such studies tended to focus on assessing the effectiveness of u-learning or digital textbooks in K-12 model schools (e.g., Lee, 2012; Lyu & Byun, 2012; Ahn & Jeong, 2009; Lee, Han, & Lee, 2009; Lee & Kim, 2007). Like similar studies abroad, these studies have offered conflicting results regarding students' academic performance. Most studies, however, have revealed positive impacts of using notebook computers on the affected areas, such as students' perceived satisfaction, attitude, and academic interest.

Nevertheless, domestic studies on one-to-one computing have not obtained practical results (Ahn & Jeong, 2009). They are still at the early stages compared to

studies abroad (Byun, 2009), because most domestic studies have measured short-term outcomes and have been based on experiments that are not relatively rigorous, whereas studies abroad have sought to obtain long-term effects. In addition, studies conducted domestically focused largely on K-12 school settings. Few studies have been conducted in university-level settings, and those consisted of simple surveys related to u-learning and suggested unspecified future plans.

Moreover, some studies using the quantitative approach are likely to take a process-product perspective and, consequently, fail to reveal the classroom behavior of students in classrooms in which notebook computers are used. However, the results from many other qualitative studies conducted abroad demonstrate a deep understanding of changes in learning styles and the change of or impact on the perception and attitude of students when notebook computers are used in the classroom (Burns & Polman, 2006; Mouza, Cavalier, & Nadolny, 2008). Nevertheless, these results still present limitations in understanding the overall experiences of students associated with their use of notebook computers in class. Even domestically, there is still a lack of evidence from qualitative studies, especially in university-level settings.

This study attempted to reveal and document students' experiences related to their use of notebook computers in class and to analyze the implied meanings of the results in depth by using a qualitative approach. In this respect, this study posed the following two research questions:

1. How do university students use notebook computers in the classroom?
2. How do university students perceive the educational impact of their use of notebook computers in class?

## Research Method

### Participants

This study used qualitative methods with a cohort of 23 Korean college students at a Korean university to deeply understand students' experiences of using notebook computers in class. In selecting participants, typical case selection was used, which selects case individuals who share the most characteristics that are unique to the population (Merriam, 2009). The participants were selected on the basis of their overall experiences of using notebook computers in class among the students volunteered to participate in the study. This sampling method satisfies the criteria of appropriateness and adequacy (Patton, 2002).

To meet the principle of adequacy, all participants must have used notebook computers for at least a semester; also, their usage of notebook computers in a class must account for more than 80% of total class hours. Also, the study recruited participants continuously without a pre-determined case size, per the purposes of the research, until the research team judged that no new information would be found and data saturation emerged; hence, the study followed the principle of appropriateness. During the process, undergraduate and graduate students from different majors and different academic years were selected based on the idea that students' experience will vary according to their majors and academic years.

Table 1 specifies the general characteristics of the 23 case individuals selected for this study. Among them, 15 students were men and the remaining 8 students were women; all were distributed among various majors and academic years. The case individuals were using four different types of notebook computers in their classes, namely, common notebook computers, tablet personal computers (TPCs), netbooks, and ultra-mobile personal computers (UMPCs) which is using a touch screen and usually smaller than notebook computers. The length of time of using notebook computers in class varied from one semester to eight semesters. The students were

able to access wireless internet in their classroom because the Korean university attended by the case individuals provides free wireless local area network (LAN) service to the entire campus.

Table 1. General Characteristics of the 23 Case Individuals

Name	Sex	Major	Grade Level	Type	Semesters
Student 1	M	Geography Education	Undergraduate, 4 <sup>th</sup> year	Tablet PC	4 <sup>th</sup>
Student 2	M	Education	Undergraduate, 3 <sup>rd</sup> year	UMPC	2 <sup>nd</sup>
Student 3	F	Education	Undergraduate, 2 <sup>nd</sup> year	Netbook	4 <sup>th</sup>
Student 4	M	Education	Undergraduate, 4 <sup>th</sup> year	Netbook	5 <sup>th</sup>
Student 5	M	Education	Undergraduate, 3 <sup>rd</sup> year	Netbook	2 <sup>nd</sup>
Student 6	M	Education	Undergraduate, 3 <sup>rd</sup> year	Netbook	4 <sup>th</sup>
Student 7	F	Education	Undergraduate, 2 <sup>nd</sup> year	Netbook	2 <sup>nd</sup>
Student 8	F	Education	Undergraduate, 4 <sup>th</sup> year	Tablet PC	2 <sup>nd</sup>
Student 9	F	Education	Undergraduate, 4 <sup>th</sup> year	Netbook	2 <sup>nd</sup>
Student 10	M	English	Undergraduate, 4 <sup>th</sup> year	Notebook	2 <sup>nd</sup>
Student 11	M	Sociology	Undergraduate, 4 <sup>th</sup> year	Netbook	4 <sup>th</sup>
Student 12	M	Sociology	Undergraduate, 3 <sup>rd</sup> year	Notebook	2 <sup>nd</sup>
Student 13	M	Education	Graduate, 4 <sup>th</sup> semester	Notebook	7 <sup>th</sup>
Student 14	F	Chinese	Graduate, 3 <sup>rd</sup> semester	Netbook	2 <sup>nd</sup>
Student 15	F	Business	Undergraduate, 1 <sup>st</sup> year	Notebook	2 <sup>nd</sup>
Student 16	M	Mechanical Engineering	Undergraduate, 4 <sup>th</sup> year	Netbook	4 <sup>th</sup>
Student 17	M	Computer Science	Undergraduate, 2 <sup>nd</sup> year	Netbook	1 <sup>st</sup>
Student 18	M	Law	Undergraduate, 4 <sup>th</sup> year	Netbook	2 <sup>nd</sup>
Student 19	F	Sociology	Graduate, 1 <sup>st</sup> semester	Notebook	2 <sup>nd</sup>
Student 20	M	Architectural Engineering	Undergraduate, 2 <sup>nd</sup> year	Netbook	2 <sup>nd</sup>
Student 21	M	Computer Science	Undergraduate, 4 <sup>th</sup> year	Notebook	6 <sup>th</sup>
Student 22	F	Material Science	Undergraduate, 2 <sup>nd</sup> year	Notebook	2 <sup>nd</sup>
Student 23	M	Computer Science	Undergraduate, 4 <sup>th</sup> year	Notebook	8 <sup>th</sup>

## Data Collection

Data for this study were obtained using individual in-depth interviews, which is the most proper method for this study because it enables us to understand individual experiences thoroughly.

In this study, semi-structured pilot interviews were conducted with five participants, who were asked to describe freely about their experiences of using notebook computers as a learning tool in class. Throughout the pilot interview, the semi-structured interview guide was constructed and modified. The questions used were as follows:

- What strategies have you used when using a notebook computer as a learning tool in class?
- What are the strengths and weaknesses of notebook computers as a writing instrument compared with note-taking on paper?
- What are the advantages of notebook computers other than as a writing instrument?
- What are the difficulties of using notebook computers in class?
- How does the experience of using a notebook computer in class affect you?

Subsequently, semi-structured interviews with 23 participants were conducted based on the interview guide, which had been revised from the version used in the pilot interviews. Each participant had one face-to-face interview session of 40 to 60 minutes in length; when needed, follow-up interview was conducted in-person. Especially, during the follow-up interviews the interviewees were asked to give additional discussion and confirm the results. The interviews were all digitally recorded. During the interviews, in order to make students feel more comfortable, the research team decided that a member of research team who have no personal stake in their academic life took care of interviews. The interviewer started by asking some general questions, and then students were told that the interviewer was interested in their experience and thinking rather than in getting correct answer.

## Data Analysis

The data from this study were analyzed using the constant-comparative method, derived from grounded theory (Glaser & Strauss, 1967). The constant comparative method is a systematic approach to identify similarities and differences between incidents described in the data (Merriam, 2009). The constant comparative method enabled data to be grouped into categories and themes to answer research questions. The first step was to figure out the general content of the interview transcriptions by carefully reading the entire transcriptions several times. Next, the meaning units were identified in the process of reading the transcriptions repeatedly, and each meaning units is compared against existing data. This process involves ascribing meaning to a specific note in an interview, which is compared with other interview note. When similarities of meaning are found, they are grouped into themes (Lomas & Ursin, 2009). For example, the initial meaning unit included storing note permanently, saving all contents into notebook computers, and managing learning materials. These meaning units collapsed into one conceptual category, easier management of learning resources. Reviewing the transcriptions, finding particular meanings, and naming processes were performed until three researchers do not hold a different view: the three researchers compared findings at this point; read independently, identified categories and shared analyses. This inductive process led to eight sub-components.

These sub-components suggest two overarching themes indicative of the nature of using notebook computer in class: 1) positive and negative effects of using notebook computers in class, and 2) different perspectives on the effects of using notebook computers in class. In the process of analyzing the collected data, two central components and eight sub-components emerged, as shown in Table 2.

## Validity and Reliability

Lincoln and Guba (1985) have suggested terms for qualitative research



Table 2. Components of the Research Findings

Theme	Sub-Component
Positive and negative effects of using a notebook computer in class	Fast and accurate note-taking
	Better understanding of class content by performing searches for related information
	Easier management of learning resources
	Efficient time management
	A notebook computer as an attractive learning tool
	Distraction and difficulty in mentally returning to class
Perspectives on the effects of using a notebook computer in class	Skepticism during transcribing: Am I a stenographer or a student?
	Different perspectives on performance-improvement effects
	Common recognition regarding satisfaction with the class

methodology, such as credibility, certainty, transferability, dependability, and confirmability, as alternative terms for an experimental study corresponding to internal validity, external validity, reliability, and objectivity. This study used a variety of strategies suggested by Lincoln and Guba (1985) to achieve validity and reliability of data collection and analysis process and results.

First, the researchers attempted to draw up detailed descriptions by listening to interview data repeatedly and reviewing transcriptions several times to gain a vivid experience of the information provided by the cohort. In addition, interviewees confirmed the results and contributed to discussions on the studied topic; their additional opinions on the subject were solicited. This process was undertaken to guarantee credibility and certainty, such that an interviewee would not act as merely the subject but also as a participant in the research project (Stake, 1995).

Further, three experienced qualitative researchers and three different educational technologists reviewed the research process and results. The qualifying process enabled us to evaluate the study from diverse perspectives and, therefore, to reduce the risks of biased interpretation among the researchers and guarantee the

credibility and confirmability of the results (Lincoln & Guba 1985). Data for this study were obtained using individual in-depth interviews, which is the most proper method for this study because it enables us to understand individual experiences thoroughly.

## **Positive and Negative Effects of Using Notebook Computers in Class**

**Notebook computers as an attractive learning tool.**

### **Fast and accurate note-taking**

Of the 23 total participants, 19 reported that the primary use of their notebook computers was to take notes in class. For these participants, the most evident advantage of a notebook computer was its efficiency as a means of note-taking. This was the main reason why the participants continued to bring their notebook computers to class despite the presumed inconvenience of using and maintaining a notebook computer. All participants agreed that note-taking using a notebook computer, compared with hand-writing, enables them to capture a much greater proportion of the lesson contents during class. As Student 10 states:

*When you are hand-writing, you are not able to speed up. I mean, let's say if a professor delivers 100 stories, you have to summarize only 50 because you cannot write it all down. With a notebook computer, however, you can write them all down without any typos, if you put your mind to it.*

Similarly, participants considered their ability to use the notebook computer for rapid, easy typing of lecture contents to be the greatest strength of the device. They reported that it is much easier to review material they had transcribed via notebook computer, compared with handwritten notes, because the transcript

contains many clues and links to content that had been presented during the class. Further, the transcript provides a more accurate reflection of the class contents, in that the context of a class is documented in narrative form, as Student 11 indicated.

*I am much less burdened in studying for a test because I've got the content of every lesson transcribed, so I just need to remind myself to review the transcripts three weeks before a test. Secondly, it helps when reviewing classes because the transcript helps me to recall the in-class context and what was taught during the class.*

In addition to facilitating speediness in transcription, accuracy was indicated as another advantage of using notebook computers. Some participants who reported that they were poor at handwriting mentioned that they have difficulties when they review their handwritten notes taken during fast-paced classes because those notes are illegible. For those participants, notebook computers confer the advantage of helping the students to produce neat, legible notes. As Student 14 states, "It's definitely much faster than handwriting. You cannot recognize your own handwriting if you write too fast. Typing seems much more accurate..."

#### **Better understanding of class content by performing searches for related information**

The participants used notebook computers to search for information related to class content during class. The pattern of using notebook computers for information searching can be categorized into two subcategories: searching for information stored in their own notebook computers and searching online for new information or explanation of concepts of which they are uncertain.

The participants said they were able to compare the lesson content from different classes by opening previous lecture notes or handouts while they were learning content associated with other classes. They also reported that they browse the internet for related contents when they face uncertain concepts during a class. These behaviors were mostly performed spontaneously but sometimes were

induced by an instructor who asked students with notebook computers to search for certain information, while the lecture is being delivered to complement insufficient portions of a lecture. As Student 5 mentions:

*I experienced, a few times, a professor giving students with a notebook computer a look to ask them to search for information about which the professor is uncertain. It's a sign saying 'search for it on the internet.' When a student finds the information, the professor talks about it.*

This type of usage seems to promote students' understanding of class contents. Instructors sometimes proceed with the class on the assumption that students understand certain concepts, which causes difficulty for students who do not know enough about those concepts to understand the class. Student 15 specifies the main reason why students bring their notebook computers to class:

*In the first statistics class, I just sat still in the classroom because I did not understand what the professor was saying. I did not bring my notebook computer to class, and I did not know that I had learned the content until I got back home. I wished that I had known one word...the same word the professor used throughout the class, which made me think I might not have learned the content at all. When I knew what the word meant, I figured out why a certain story was presented in class and how the story was related to other concepts.*

### **Easier management of learning resources**

Ease of managing learning materials was the most common benefit of notebook computers, as pointed out by every participant. The main reason was that there is little risk of losing lecture notes and no need to print out handouts. These advantages were especially attractive for students who often lose or forget to bring class materials, such as textbooks or handouts, and for classes in which a vast number of handouts are provided to students. Another advantage was the ease of transmitting lecture notes by e-mail or portable storage devices, such as USB flash

drives, because the learning materials are stored in notebook computers in a digital format. The participants mentioned that they often exchange digitized lecture notes and can complement the content of each other's notes.

*I am usually not good at managing learning materials, such as handouts. However, I can organize the lecture notes only to type in the dates day-to-day on my lecture notes files in a folder, and I just can open the files and see them, even after 10 years, unless I have deleted the files. Whenever I need them, I can carry them in my flash drive. It definitely is convenient in terms of portability.*

- Student 5

The ease of learning-material management produced another advantage as the stored materials accumulated, which is that students set up, in the notebook computers, a personal-study portfolio system for their class notes. Most of the participants stated that they save all handouts and lecture notes in electronic folders labeled for each of their class.

*I made a big folder, and then inside the folder I made subfolders for each semester. I also organized report and notes files in the separate folders for every class I took, under the corresponding semester folder. So, basically, I make it a rule to create a file per class, and make a note of each class by date.*

- Student 12

### **Efficient time management**

The participants stated that they can manage their spare time or save time for completing their assignments through the use of notebook computers. As Student 4 reports, since their assignments usually require computer usage, such as word processing, students who own notebook computers said they are likely to use their between-class time to work on their assignments. Students mentioned that they can save time by completing and uploading assignments instantly during a class (Student 5) or can upload the results of a team project activity on time (Student 7); otherwise,

students would have to schedule time to complete their assignments or projects.

*If I haven't finished my homework, I can do it in my spare time. Even if the class starts at nine o'clock, it doesn't necessarily mean the instructor comes in at nine o'clock (I have a few minutes before class starts)... Or I can do what will be needed beforehand, so I can save time in that manner.*

- Student 4

*In a distance education class, the online bulletin was used as a learning tool; I completed a certain assignment during class time. The assignment was to upload questions associated with the presentation that day. Actually, the questions come to mind during the presentation, you know. So, I uploaded them instantly.*

- Student 5

*You know, sometimes the assignment is given during class time, so I summarize the ideas that the group members brainstormed during the group activity and then I send them to the members through e-mail and collect their opinions back again. So, using a notebook computer in class is definitely better, in that it is a simple and easy way to communicate and learn.*

- Student 7

**Notebook computers as a risky learning tool.**

#### **Distraction and difficulty in mentally returning to class**

In general, seventeen participants strongly emphasized the negative effects of the use of notebook computers in class, although they were aware that notebook computers have many advantages and may help to improve learning. The main problem reported was that students are more likely to be distracted by the other functions of notebook computers. Most of the participants stated that they were tempted by their notebook computers to do unrelated activities during class, such as Web surfing, instant messaging, and doing homework for other classes.

Among the variety of causes for the participants to lose their concentration in class, the most indicated was related to certain teaching strategies used by instructors. Participants stated that they were easily tempted to do outside activities using notebook computers when instructors merely read their lecture notes (Student 11); when they use a slow rate of speech and lack of convincibility during class, which students find boring (Student 22); and when they lecture without interacting with students (Student 4).

*You know... if a professor repeatedly points out the contents of the textbook, you don't need to take notes and would likely lose attention.*

- Student 11

*I have a class that is so boring, and you don't get to concentrate on the content if the professor starts saying "ubb...ubb...ubb...", so I think I would rather read a book. In such a class, I sometimes do something else with my notebook computer because it's hard to concentrate on the class.*

- Student 22

*Sometimes there are professors who keep their distance from students. If they keep their distance, I look elsewhere, spontaneously, in the moment.*

- Student 4

Meanwhile, during class, students using notebook computers often experience difficulties in returning to class while surfing the internet for study materials. Student 15 mentions such an example:

*For example... I was taking notes well at first, then a concept came up that I didn't know well, so I got on the internet. I should have searched for what I was looking for and then come off the internet right away, but the contents of a portal site distracted me before I could perform the search... then I got into clicking on a Web site, and then another... I realized that five minutes had passed...*

### **Skepticism during transcribing: Am I a stenographer or a student?**

The participants expressed doubts about transcribing as an instructor talked, although they specified efficient note-taking as the best advantage conferred by notebook computers. The participants stated that while they are transcribing, they feel like they are merely taking shorthand rather than understanding the class. Also, the participants took the stance that transcribing is an inappropriate attitude during class.

*I transcribed as what was told by an instructor. I wrote down thing, but it got hurt my hands, and at some point I felt like "What is it all about?" I wasn't participating in the class, but just typing.*

- Student 7

*When you take down notes by hand, you think... because anyhow, you cannot write down everything, you process what you should write down spontaneously while you are listening. That makes you write down key points. On the other hand, you realize that you have become a typing machine, at the moment you are too busy writing down what is being said to thoroughly process its contents.*

- Student 10

There were several factors that might encourage students to transcribe what is spoken during class, even if they later regretted it. The first factor, the main cause, was the instructor's method of delivering the lecture. Student 15 reported that students tend to write down what the instructor says during a class if there are no learning materials provided. In this case, students tend to use a notebook computer instead of hand-writing to capture notes because the computer is more efficient for transcription.

*...there were no materials provided. The professor just wrote down something on the blackboard and sometimes he spoke about it and that was all. There was no textbook either. Such a class, I was writing by hand at first...but then, I figured, "For this*



*class...I have to write down the material," so I brought my notebook computer in order to type. And it seemed more efficient.*

*- Student 15*

Even if there are textbooks or instructional materials selected for the class, the lecture can be delivered by spontaneous discourse due to the vast amount of content to be delivered rather than confined to the textbook. In such cases, the students feel a much greater necessity to transcribe the discourse by means of notebook computers.

*...it depends on the class. I didn't use a computer in every class... In a case when the instructor has a lot to deliver, I would be busy writing it all down... To take detailed notes, I used [Microsoft] Word software... I only used a notebook computer for that purpose.*

*- Student 19*

Another cause for the use of notebook computers in class was the level of difficulty of the class content. That is, the participants tended to type what the instructor literally said, rather than selectively typing the points that they thought were important; this occurred more often when students believed the course content was very difficult or unfamiliar. Although the main purpose of note-taking is to gain a deep understanding of the material, as indicated by Student 22 in the following quote, the participants were first typing the entire discourse verbatim and then reorganizing their lecture notes while reviewing them after class.

*Although the most basic purpose of note-taking is to understand the material deeply, it is hard to understand it immediately during the class period. So, I just write down what is being said first, and it's easier to ask the professor questions about it. Also, I want to find information from the textbook...and to catch up on what I didn't know when I study later...*

*- Student 22*

## Perspectives on the Effects of Using Notebook Computers in Class

### Different perspectives on performance improvement effects

The participants had different perspectives on whether using a notebook computer in class directly causes performance improvement. Student 11 and Student 5 believe that using notebook computers had a positive effect, in that their grades had improved. They stated that they were each able to get a good grade in a certain class because on tests, they wrote down answers that had been captured in their transcribed materials.

*I got a good grade, and it might be due in part to my notebook computer. You know, there is at least one more reference or title of publication available when you do a data search in your notebook computer. It is a great strategy to use if you write down all the answers referring to books, such as "This was said by so-and-so according to such-and-such book and, therefore, my idea is this." The professor also recognizes, "Oh, this student has searched further and studied."*

- Student 11

*That's true...because I emphasize on my notes when studying. I used to borrow notes from my friends...but now I transcribe almost everything, and then I borrow their notes if I still need them... Then, it's easy to add or edit the notes. So, I neatly printed out my notes, then studied with them, and my grades improved.*

- Student 5

However, other participants perceived that learning activities other than mere use of notebook computers had had a direct impact on grade improvement. Student 10 stated that lecture notes typed on a notebook computer promoted convenience of studying during exam periods, whereas the transcribing action itself made the student focus less strongly and understand course content less effectively during the

class. Therefore, Student 10 concluded that the use of notebook computers does not positively affect grades because the advantages of a notebook computer are offset by its disadvantages.

*I actually observed no big difference. I got As and Bs from the course that I took using a notebook computer to take notes, but I don't think my grades would have been better or worse if I had written my notes by hand. I admit... it was much more convenient when I studied during exam periods because I just had to print out my lecture notes and review them... that was convenient... but as I said, when it comes to my understanding of the material after a class session... from that perspective, notebook computers seem to fall behind in terms of their effectiveness. I mean, the positives and negatives offset each other, and I don't think my grade was affected.*

- Student 10

### **Common recognition of the positive effect of notebook computer usage on satisfaction with classes.**

All participants except one agreed on the positive effects on notebook computer use in class, although they expressed differing opinions about whether using this tool enhances learning performance. The participants expressed satisfaction with their learning activities when using notebook computers, saying things like, “my notebook computer helped a lot,” “I am thankful for its existence,” and, “I felt great when using it.” Student 15, who is a first-year undergraduate student, said he fully realized that he had become a college student when he entered a classroom with a notebook computer, and that he felt confident when he was diligently typing lecture notes using his notebook computer.

*You know, you feel great sometimes when you study hard. Without the use of a notebook computer, I don't get feelings such as, “Oh, I worked hard,” “I accomplished something,” or, “I feel confident.” When I was a high-school student, I used to take notes by hand, but now, I use a notebook computer instead... so now I*

*feel like a college student...*

*- Student 15*

## **Discussion and Conclusions**

This study aimed to understand the overall experiences of the participants who use notebook computers in class by adopting the constant comparative method. The 23 participants consist of Korean undergraduate or graduate students of a Korean university. The results show that there are two primary categories of opinions of the educational effects of notebook computer usage in the college classroom among participants, namely, positive and negative. Based on these two categories, several implications have been derived, which will be discussed as follows.

First, the participants perceived notebook computers to be very attractive but risky learning tools. The four reasons for their attractiveness were determined as follows: 1) note-taking by typing might be faster and more precise than by hand-writing; 2) information-searching using notebook computers might promote deep understanding of class content; 3) notebook computers make managing learning materials much easier; and 4) efficient time management across the learning process might be facilitated by notebook computers.

The participants performed information searches, continuous recording and monitoring, and construction of their own learning environment while taking classes using notebook computers; these items are analogous to the items of self-regulated learning strategy suggested by Zimmerman and Martinez-Pons (1986). Hence, notebook computers facilitate self-regulated learning strategies. Also, the results of this study indicate that learners are likely to boost their self-regulated learning ability through use of notebook computers when this ability is developed through proper strategies associated with self-regulated learning (Ley & Young, 2001). This is because self-regulated learning ability is not an innate talent and is

not naturally acquired over the development stages.

Second, most of the participants stated that they had been tempted to do outside work with their notebook computers and that if they give in to this temptation, it is especially difficult to turn their attention back to the class. This explained why the participants perceived that the use of notebook computers can be a double-edged sword. Distraction while using notebook computers is the most concerning issue (Gehlen-Baum & Weinberger, 2012). However, it is notable that the cause is not attributed by the participants to themselves but rather is blamed on external factors, such as the lecture style of an instructor.

For example, the participants said that they tend to transcribe using notebook computers when additional lecture materials are not given. By contrast, the participants reported that the presence of lecture materials with content that includes all the discourse given during a class sometimes discourages the desire or need for using notebook computers for study when a class proceeds based exactly on the content of the written materials and that it arouses the desire to do outside activities using notebook computers. It is understood that students easily lose their attention when only listening to the lecture without interaction, which consequently leads to the negative effect of using notebook computers in class for outside work. This confirms the findings in the literature that state that a set of actions, such as listening to what an instructor says, selecting what to write down, and taking notes, promotes learners' attention (Peck & Hannafin 1983). Overall, we must understand that learners' will or attitudes should not be viewed as the cause of the problem from the perspective of the instructor. That is, the results of this study emphasize the importance of the role of the instructor and provide strong suggestions on what information the instructor should take into account when producing lecture materials or handouts.

Third, students' perspectives on the educational effect of using notebook computers in class emerged: participants agreed that the devices had positive effects on their learning experiences and were considered to contribute to successful

learning. In terms of academic achievement, the participants expressed conflicting opinions on whether the use of notebook computers positively affected their academic achievement. Approximately half of the participants stated that using notebook computers in class directly contributed to their higher grades, whereas others disagree with the idea although they admitted that the tools are useful in gaining a better understanding of lesson content and managing learning materials. The previous studies have also shown conflicting results. For example, Aguilar-Roca et al. (2012) revealed that students taking notes by hand perform better than notebook computer users. In summary, the impact of notebook computers on academic achievement is still questionable (Penuel, 2006).

This study has limitations as to the generalizability of its results because it uses a qualitative approach based on the experiences stated by the interviewees. However, this study is significant in that the results from the study are expected to provide a better understanding of students' usage of notebook computers, to help instructors and academic staff to create and teach lessons and to construct learning environments. Lastly, to yield positive effects on future learning, further studies on the various ways of using notebook computers in class should be conducted.

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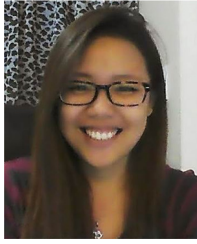
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