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Smartpens as an Aid for Lecture Notetaking

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With the growth of English Medium Instruction (EMI) in countries around the world, L2 learners face many challenges, one of which is lecture notetaking. Researchers in the field of L2 listening have sought ways to improve learners' notetaking skills, but one potentially useful tool, the smartpen, has received little attention. With smartpens, learners can take notes on paper, digitize them, then synchronize them with an audio recording of the lecture. They can then tap anywhere in their digitized notes and hear the corresponding audio for that section, greatly facilitating review. With this functionality in mind, this paper examines the potential benefits of smartpens for notetaking. It first provides an overview of the skill of notetaking and a description of smartpens, and then examines research on their use in L1 and L2 contexts. The paper concludes with a call for more research into this potentially productive area.

世界各国では、授業言語としての英語(EMI: English as a Medium of Instruction)の普及に伴い、EFL学習者は様々な課題に直面しており、その一つが講義を聞きながらノートをとるノートテーキングである。これまでもL2リスニング研究者は学習者のノートテーキング・スキルの向上方法を探ってきたが、一つのツール、すなわちスマートペンはあまり注目されてこなかった。スマートペンを利用すると、学習者が手書きでノートを取り、それをデジタル化し、講義の音声と同期させることができる。そうすれば、デジタル化したノートのどこにでも触れられその部分の音声を聞くことができるため、講義の復習を促進する。これを踏まえ、本論では、講義ノートテーキングにおけるスマートペンの潜在的な利点を考察する。講義ノートテーキング・スキルを概観した後、スマートペンの特徴を説明し、L1及びL2環境における研究について述べる。最後に、この潜在的に有益な研究分野において、さらなる研究の必要性を示唆する。

Everyone has heard of smartphones, but what about smartpens? These devices have been around for over a decade but are not as widely known as smartphones. Smartpens (also referred to as digital pens) are devices that are widely used for converting text or images created on paper to digital data. In other words, they bridge the analog-digital divide. Compared to smartphones, smartpens are relatively simple devices, but they have several potential uses in educational contexts, including lecture notetaking. With a smartpen, not only can students digitize handwritten lecture notes, but they can also audio-record lectures and synchronize them with their notes, greatly facilitating lecture review.

This paper first summarizes the skill of notetaking, including discussing difficulties students face in taking comprehensive notes, followed by discussion of two technology-driven solutions to them. The remainder of the paper focuses on the second solution, smartpens. After a brief description of them, research on their use in first language (L1) and second language (L2) contexts is examined. As explained below, the amount of research into L1 contexts is greater than into L2 contexts. Accordingly, the paper ends with a call for more L2 research into this potentially productive area.

The Skill of Lecture Notetaking

Lectures are the main method of conveying subject-related information to students from junior high school onward (Peverly & Wolf, 2019). The primary method that students employ to digest and learn this information is notetaking. While notetaking is a skill often taken for granted (van der Meer, 2012), research has shown that it is cognitively demanding and challenging for many students. Accordingly, it is not surprising that many students' notes are "woefully incomplete" (Kiewra et al., 2018, p. 2), containing on average only about a third of the key ideas in a lecture.

While lecture notetaking poses challenges for students listening to lectures in their L1, such as keeping up with the speed of the lecture, the challenges are even greater for students listening in an L2. With the rise of English medium instruction (EMI) at universities worldwide, including in Japan, this is an issue that requires attention. Clerehan (1995) states that L2 note takers are at a "huge disadvantage" (p. 145) when compared with their L1 peers, and Siegel (2019) writes that "listening to and following a lecture in an L2 can prove to be an arduous undertaking" (p. 20). However, often overlooked is the fact that in certain L1 contexts, some student populations are also at a significant disadvantage, particularly those with learning disabilities (LD). Belson et al. (2013) noted that lectures pose a significant challenge for students with auditory processing disabilities, and that those with language-based learning disabilities such as

limited working memory may have problems with the multitasking nature of notetaking. While clearly there are significant differences between disabled L1 learners and mainstream L2 learners, at least to some degree there are similarities in the challenges they face with notetaking. Potential solutions to these challenges may prove beneficial for both groups.

Laptop computers are a possible solution to help students overcome some of the difficulties they face taking notes and has received attention from researchers. People can usually type more quickly than they can write, enabling the recording of more information. However, there are issues with the use of laptops, including off-task use due to distractions, less class participation, and poor comprehension (Peverly & Wolf, 2019). Additionally, some research has found benefits for longhand notes over laptops. In a widely cited study, Mueller and Oppenheimer (2014) found that learners who took longhand notes wrote fewer words than learners who took notes with computers; however, they took more notes in their own words, which is a sign of better understanding. This points to the generative nature of handwritten notes, in which learners take in new information, process it cognitively, and then paraphrase it in their own words. The benefits of this approach as opposed to the more mechanical method of writing down verbatim what the lecturer says may partially explain why recent survey investigations have found that American university students still express a preference for paper and pencil over laptops (Peverly & Wolf, 2019; Morehead et al., 2019).

Another possible solution is smartpens. Smartpens retain the benefits of longhand notetaking while adding certain advantages; in particular, these advantages include the ability to synchronize lecture notes with audio-recordings of lectures. Practitioners and researchers investigating LD student populations have recognized the potential benefits of these devices, and consequently much of the research on the use of smartpens in the classroom comes from them. Researchers such as Boyle et al. (2015) suggest that smartpens are a promising technology that can ease the difficulties LD learners face with notetaking.

Smartpens: A Brief Description

Most smartpens resemble slightly oversized ordinary ball-point pens. However, they are small handheld computers that can be used to take handwritten text on paper and convert it to digital data. While this may seem relatively simple, the technology is quite advanced. Most smartpens work by shining infrared light onto specially designed paper lined with nearly invisible dots (Fisher & Raines, 2014). This light picks up everything written on the paper, stores it as images, and transfers it via Bluetooth to a handheld device (such as a smartphone) or computer. From there, the text can be left as it appeared on the paper, or it can be converted into editable text that can be imported into word-processing programs. With most smartpens this can be done in multiple languages, including Japanese.

Smartpens are different from styluses, which allow users to write directly onto the screen of a handheld device or computer without the need for paper. Styluses are strictly digital, while smartpens bridge the analog-digital divide. Smartpens also allow users to synchronize their notes with audio recorded as they are writing (Palmer, 2011). This is done with either a built-in microphone in the pen, or by using the microphone in another device such as a tablet computer or smartphone. This is convenient for something like lecture notetaking, as users can simply tap anywhere in their digitized notes and whatever was being said at that time can be played. This provides students with a very efficient method for reviewing lectures and their notes.

Research on Smartpens in L1 Contexts

The first smartpen, developed by Livescribe, went on the market in 2008. The pen was designed for a wide range of users, but its potential in the field of education was recognized from the start. One year after debuting the device, the company published a report about uses for the pen in K-12 education (Van Schaack, 2009). In the report, Van Schaack (2009) describes a number of different functions and uses for the pen in educational settings, stating that it has potential benefits for all users, adding that there are "significant advantages to using it as a platform to facilitate learning and communication for individuals with disabilities" (p. 13). An article in the New York Times Magazine (Thompson, 2010) similarly promoted the benefits of the pen, as did a more academically oriented article that focused on the technology behind it (Bouck et al., 2012).

Empirical research on smartpen use has also been undertaken. Belson (2013) conducted a study of ten high school students in the United States with various language-based disabilities to examine the use of the pens for notetaking. The students received instructions on how to use the pens, and improvement in their notetaking skills over the course of a 16-week school term was measured using a comprehensive rubric of note quality. The content of their notes improved significantly from pre-implemen-

tation to post-implementation, as did their ability to write summaries after lectures based on their notes. Similar positive results were found in a larger study involving 54 American high school students in inclusive classes with disabled and non-disabled students (Joyce & Boyle, 2019). Students were divided randomly into experimental and control groups, with the experimental group using smartpens to take lecture notes and the control group traditional paper and pencil. After taking notes this way for 12 classes the groups were compared in a post-test, with the students using the smartpen noting down significantly more lecture points and overall words. They also performed better on a post-lecture comprehension test. Finally, in a mixed-methods study involving interviews and questionnaires, disabled students at a university in Ireland were asked about various aspects of smartpens. The students noted many benefits, leading the author to conclude that the "impact of using smart pens on students has been overwhelmingly positive and learning has been measurably transformed" (Ahern, 2016, p. 4).

Research on Smartpens in L2 Contexts

Compared to L1 contexts, the amount of literature related to the use of smartpens in L2 contexts is limited. In one study conducted at an Australian university (Knox et al., 2011), 22 adult participants were provided smartpens and encouraged to use them during a language orientation program aimed at acclimatizing newly arrived foreign academic staff to the university. At the end of the program, the participants were interviewed about their experiences using the pens. Participants noted being able to listen to lectures more than once and the ability to link lectures with notes as a benefit, with one person referring to this function as "very amazing" (Knox et al., 2011, p. 5). In a theoretical paper, Mancilla (2013) explains the difficulty of notetaking for L2 learners by focusing on the concept of split attention, which is based on the idea that the brain is only able to process a certain amount of information at a time, as well as the fact that affective factors such as anxiety can exacerbate limited attentional resources. Mancilla (2013) pointed to smartpens as a "smart solution to split attention" (p. 216) in notetaking and laments the lack of research in this area. She concludes by outlining three possible avenues for future research:

1. measuring the cognitive load of note takers with and without smartpens;
2. examining the usefulness of smartpens for notetaking depending on lecture length and content; and
3. exploring the effectiveness of smartpens for improving the quantity and quality of notes.

In addition to these three areas, several other topics warrant attention, such as the extent to which smartpens aid comprehension and the potential for collaborative notetaking that they provide.

Conclusion

Smartpens have been on the market for just over a decade, yet research on their potential benefits for L2 learners is still in its infancy. Considering the benefits that have been found for learners in L1 contexts, it would be beneficial for researchers and practitioners working in L2 contexts to examine their potential in "uncharted, yet necessary, territory" (Mancilla, 2013, p. 222), in particular for L2 lecture notetaking. With more and more universities offering EMI programs in which lectures are conducted in English, L2 learners require support for improving their notetaking skills, and smartpens could very well be a preferred method for providing such support.

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