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Review article

Technology and note-taking in the classroom, boardroom, hospital room, and courtroom

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ABSTRACT

To date, technological interventions in note-taking have been generally unsuccessful in improving performance. One reason for this lack of success may be that developers focus on making note-taking easier, while neglecting how the technologies could affect the other psychological processes underlying effective note-taking. Importantly, since note-taking serves different purposes in different situations, the effectiveness of various technologies will also be situationally dependent. In this paper, we explore four distinct note-taking settings: the classroom, the boardroom, the hospital room, and the courtroom. In each section, we quickly review important past research before addressing the current state of note-taking in that arena, with special attention given to technological interventions. We conclude each section with a short discussion of what kinds of new technologies would be most helpful for note-taking in those situations.

Contents

1. The impact of technology on note-taking in the classroom, boardroom, hospital room, and courtroom

Experimental research on note-taking has a long history [1]; for overviews, see Kiewra, Kobayashi [2,3]. While there is a great deal of nuance and complexity in the literature, one consistent theme is that note taking is not easy. The act of note taking requires a number of simultaneous, cognitively demanding processes. The note-taker has to comprehend the material, identify what content is worth recording, and recreate that content in an abridged form. The difficulty is exacerbated by the fact that the process typically occurs under severe time pressure, often without opportunities for reflection or clarification. In fact, it has been argued that note-taking can be as cognitively demanding as expert chess playing [4].

This difficulty is reflected in the quality of notes that people take. For example, it is not uncommon for people to fail to record half of the main points within a lecture [5,6]. Given the challenges inherent in note-taking, it seems plausible that technological innovations could be used to reduce cognitive burdens and facilitate more effective note-taking. Unfortunately, to date there is a dearth of examples of successful technology assisted note-taking. In fact, the bulk of the literature shows that incorporating technology into note-taking has either no effect or a deleterious effect.

The lack of effective technological interventions in note-taking should not be interpreted to suggest that technology could never

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Table 1
Summary of goals, challenges, and technology solutions across different domains.

Note-taking situation	Goal (s)	Problems	How can technology help?
Classroom	Deep understanding of content long-term learning External record of material for future review	Students taking notes on laptops have a hard-to-overcome tendency to take verbatim notes and thus fail to process lecture content as deeply as longhand note takers	Tablet/stylus technology requires notes to be taken by hand, but allows for a saved electronic copy Technology that asks questions and helps students think about notes being taken
Boardroom	Comprehensive and accurate record of what was discussed for use by self and others Facilitate participation and idea generation	Workers take notes at the expense of participating in discussion	Typing notes on a laptop would lessen working memory demands on employees, allowing them to participate in meetings and still take detailed notes
Hospital room	Record information for future reference over long-term treatment and patient care Documentation against malpractice claims Build and maintain trust with patient	Note-taking may interfere with patient rapport	Lessintrusive note-taking would be less likely to impair rapport (e.g., tablet as opposed to laptop or desktop)
Courtroom	Accurate account of witness interview or witness testimony to refer to later Maintain trust and satisfaction with legal system	Interviewer notes tend to miss many important pieces of information Jurors are unsure what information is important	"Smart pen" for interviewers, allowing audio recording and contemporaneous notes Structured note-taking guide for jurors

be helpful. Indeed, the rapid evolution and application of digital technology to note-taking environments offers the hope of major advances in note-taking technology in the near future. However, for this to happen, developers of new technology need to understand what features the technology will need to have in order to capitalize on our cognitive systems to improve note-taking. New technologies should not only alleviate challenges that note-takers face, but should also avoid undermining the processes that make note-takers successful.

Of course, note-taking serves many different purposes, and the technologies required to facilitate note-taking will therefore depend on the situation; appropriate technology will look different for different goals. As such, in the present paper we will explore four distinct note-taking settings: the classroom, the boardroom, the hospital room, and the courtroom. While all of the settings share a common goal of creating an external record for one's future reference, they differ in key other goals. In the classroom setting (where the majority of past research has taken place), note-taking should serve to enhance learning and comprehension of the material. In the boardroom, notes are often intended to create an external record for *someone else's* use or reference, and occasionally are meant to facilitate (or at least not impede) exchange of information. In the hospital room, note-taking needs to be done in such a way as to avoid undermining rapport between patients and health care workers. And in the courtroom, note taking can help jurors identify legally relevant details of a case, and keep jurors involved and satisfied with the legal process (see Table 1 for summary).

As we turn to each distinct setting, we first give a quick overview of important past research and then address the current state of note-taking and note-taking research with an emphasis on the effectiveness of technological innovations. Finally, we will discuss what sorts of technologies would be most helpful for the note-taking goals in each of the four arenas.

2. Classroom

The prototypical note-taking situation involves students, so it is logical that the majority of note-taking research investigates academic situations. In general, note-taking has been shown to have non-trivial benefits for mastery of course materials [2,3]. Most undergraduates take notes in their classes and think that note-taking is important for learning [7,8].

However, technology in the university classroom is changing rapidly. Most current undergraduates have a laptop; studies suggest the proportion may be as high as 89–99% [10,11]. However, the extent to which they use laptops to take notes in class varies greatly across institutions. In our research, approximately two-thirds of Princeton students reported regularly using a laptop to take notes, while less than half of UCLA students reported doing so [12]. Researchers at UCIrvine report that only 29% of students bring their laptop to class every day [13].[1]

At this point, students seem to be ambivalent about note-taking on laptops. They tend to believe that their ability to take more notes quickly on a laptop is an asset, rather than a liability, noting that efficiency is the biggest advantage of laptops [14]. Indeed, students consistently report that they believe laptops are beneficial for learning [15–17]. Despite this, some students seem to realize that by transcribing lectures, they are not processing or understanding the content, as evidenced by studies that interview students about note taking experiences, e.g., "[Y]ou have become a typing machine…too busy writing down what is being said to thoroughly process its contents." [14], p. 46. Students at the University of North Carolina—Pembroke reported that compared to laptops, tablets, and phones, using pen and paper for note-taking was significantly more natural, efficient, easy, and effective [18]. They also reported an increased ability to express their thoughts when using pen and paper. Despite this, 41% of the students reported that they used an electronic interface to take notes.

Just as students have mixed feelings about using laptops for note-taking, the research on how laptop note-taking affects learning outcomes is nuanced. While a number of studies have shown that laptops can offer advantages for immediate factual recall, [19–21] laptop note-takers do not perform as well as longhand note-takers on conceptual questions, or on recall of content following a delay [12]. Mueller & Oppenheimer [12] randomly assigned students to take notes on a short lecture either on a

[1] These studies are now several years old, and it is likely that an even higher percentage of students carry laptops, though some may have replaced them with tablets.