Glean

A guide for faculty

Maximizing student engagement and
achievement with note taking technology

What is Glean?

Our learning technology reduces waste by helping learners to get more value from working with spoken language and using note taking to transform information into knowledge.

"Glean for Education is a full-service solution designed specifically to digitally transform note taking support and bring colleges' systems and processes into the 21st century."
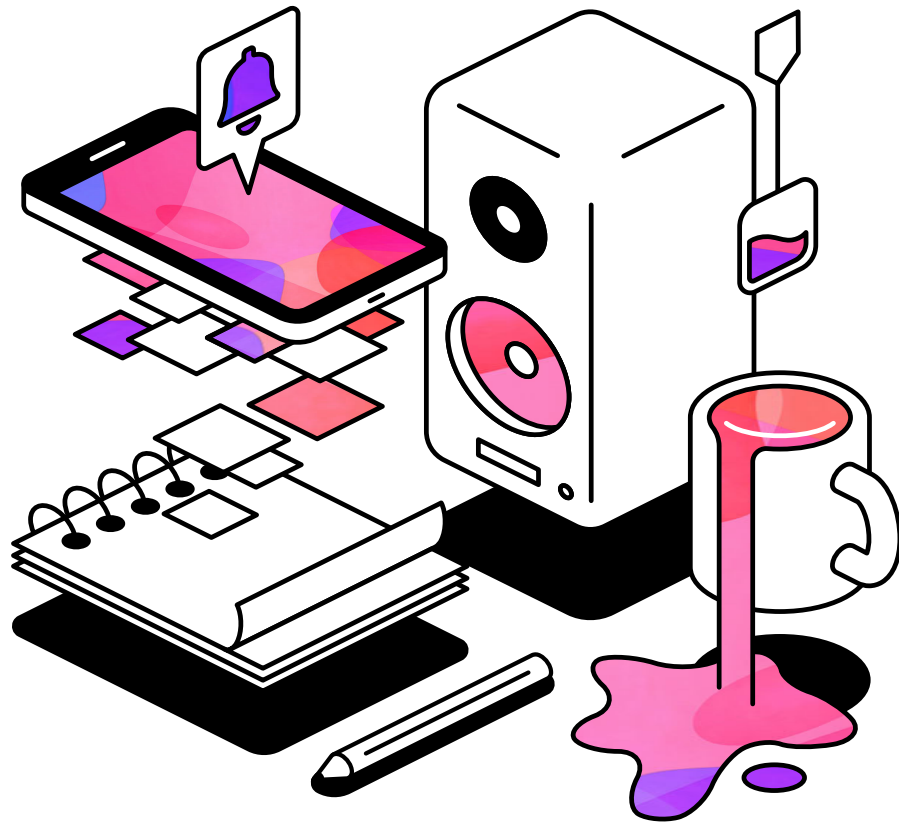
- Dave Tucker, CEO & Co-Founder of Glean.
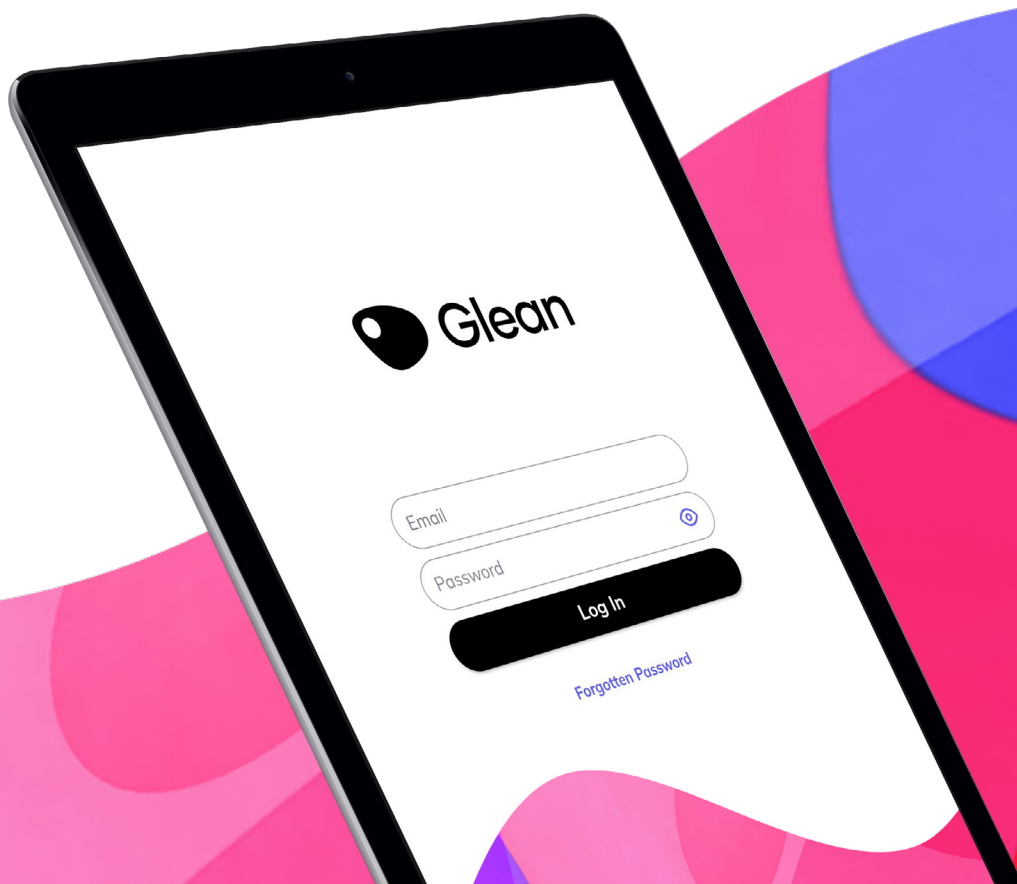
Contents

Note taking: a critical but complex skill

A critical skill

Note taking has a direct impact on course outcomes and GPA

Better notes lead to better grades. Since the advent of serious academic research into note taking in the 1970s, numerous studies have highlighted the strong correlation between quality of class notes and student achievement. Likewise, the research attests to the fact that students who struggle with note taking in class have lower GPAs, may be more likely to enter academic probation, and are at increased risk of retention failure *(Titsworth & Kiewra, 2004; cf. Boyle, 2001; Lipsky & Ender, 1990; Mann et al., 2004).*

Many students lack note taking skills

Lectures are still the primary means of information delivery in postsecondary contexts, so note taking in lectures is a fundamental study skill for college students. Students and educators alike often assume that note taking is an "intuitive" skill that students either have or will learn through "trial and error" over the course of their education *(Friedman, 2014; Van der Meer, 2012).* However, numerous studies indicate that this is far from the reality: note taking is an acquired skill, that students often do not have when they arrive on campus *(Al-Musalli, 2015; Friedman, 2014; Kiewra, 2002).*

> **"Many college students are poor note takers and review activities focused on the resulting incomplete or poorly structured notes suffer as a consequence."**
> (Grabe, 2005)

Note taking is a complex cognitive activity

Note taking in lectures requires "meticulous processing of complex input" *(Al-Musalli, 2015)*. Lecturers speak at a pace of approx. 2 - 3 words per second, while the average student can only write about 0.3 - 0.4 words per second *(Piolat et al., 2005)*. In addition, students must typically process visual input in the form of lecture slides, images or lecturer annotations on a whiteboard or smartboard.

Students report adopting widely differing approaches to cope with this complexity: some will frantically attempt to write or type verbatim what is said; others will seek to summarize the key points; yet others abandon the notebook altogether in the hope that by actively listening and engaging with the content they will be able to commit the key points to memory.*

Note-taking guides aimed at students almost universally recommend summarizing lecture content as " best practice". And, naturally, educators and skills advisors aspire for each individual to leave class with a concise, personally meaningful outline of the lecturer's most important points. But this is no mean feat - summary note taking involves a range of "higher-order cognitive skills" including decision-making, interpretation, evaluation, and summarization *(Gur et al., 2013; cf. Al-Musalli, 2015)*. For many students, this is just too much to do at once within the time-pressured setting of the lecture hall.

For this reason, research studies tend to present a more nuanced view of what might be considered 'optimal' or 'effective' note taking.

*Self-reported student behaviour gathered through 1-on-1 interviews with 21 undergraduate students at UK universities conducted by Sonocent Ltd. between May-June 2018. These findings are supported by the literature, e.g. Bui et al., 2013; Chen, 2013.

> **"Note taking and review are positively related to academic achievement, but many students record too few notes to benefit fully from these activities."**
> (Kiewra, 1987)

The tradeoff of traditional note taking

Research identifies that lecture note taking serves two core, but competing, functions: "encoding" and "external storage" *(Di Vesta & Gray, 1972)*. The "encoding" (or "process") function refers to the act of taking notes as a method by which students translate information into their understanding. This function is best served by a summarizing approach.

The "external storage" (or "product") function refers to the process of capturing information for later study and review. This function is best served by a transcription approach - capturing as much information as possible.

Studies show that both the process of recording notes and the production of notes for subsequent review are positively related to student achievement *(Bui et al., 2013; Luo et al., 2016; Kiewra, 1989)*, and that "utilizing both aspects of note taking in conjunction provides a more potent learning tool than either aspect on its own" *(Kiewra, 1985)*.

However, given the cognitive complexity of coordinating these two functions, researchers recognize that there is almost always a tradeoff between comprehension and the production of notes: students must strike "a balance between listening, processing, and note taking" *(Williams & Eggert, 2002; cf. Piolat et al., 2005)*.

Unfortunately, students often struggle to find this balance. **The notes taken by college students typically include just one-third of important ideas** *(Friedman, 2014; Bui et al., 2013; Titsworth & Kiewra, 2004)*.

Consequently, students are often left with insufficient material for effective further study -limiting their learning outcomes and academic achievement *(Baker & Lombardi, 1985; Crooks et al., 2007; Lou et al., 2016)*.

> **"Note taking is a fundamental knowledge management system ... enabl[ing] us to extend our abilities by offloading information from our mind to external devices."** (Dror et al., 2011)

A tilted playing field

This tradeoff between comprehension and note taking is further amplified by a variety of factors, including: subject-area knowledge, learning style, language proficiency, working memory capacity and other individual differences *(Grabe, 2005; Kiewra, 1989; Leadbeater et al., 2013; Nordmann & McGeorge, 2018).*

For example, note taking depends enormously on working memory - the ability to temporarily store, manipulate, and transform incoming information. Learners with limited working memory capacity -including students with learning disabilities -struggle to hold and manipulate lecture information simultaneously, so by trying to summarize as they listen, they end up with poor quality notes *(Boyle, 2015).*

Instead, research suggests these students should aim for "note completeness", i.e. capture as much information as possible in the classroom, to study from later at their own pace *(Bui et al., 2013; Friedman, 2014).*

However, this approach introduces multiple points of risk in the students' learning process: firstly, as they forgo encoding to focus on transcribing lecture content, and again when they study their own inaccurate or incomplete notes after class.

Note taking in lectures is a complex activity, the output of which directly impacts students' grades. Learning outcomes suffer when students resort to zero-sum compensatory strategies: transcribing everything while understanding nothing; or focusing on listening and understanding, whilst taking no record of the class for later study. Clearly, there is no "one-size-fits-all" strategy for taking effective notes - so how can institutions better support learners to maximize their academic success?

> **"The potential productivity of reviewing notes is often limited by the quality of the encoding function."**
> (Grabe, 2005)
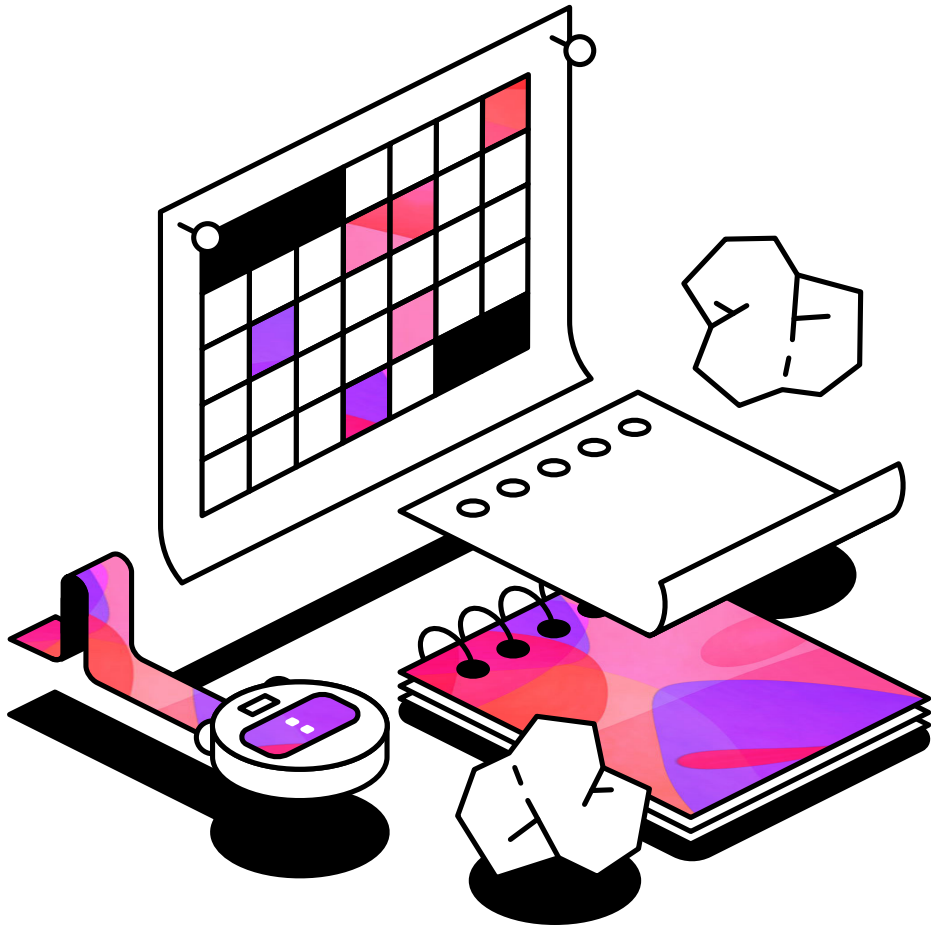
Common barriers to traditional note taking

Note taking barriers

Mental health and anxiety

Psychological distress is widespread among college students: at any given time, **31% of undergraduates are dealing with a mental illness** *(Eisenberg & Lipson, 2017)*. These conditions are linked to impaired concentration, memory, and mental stamina - making it difficult to attend to lectures and take notes.

> **"Students [with mental health issues] may have particular problems receiving, processing, and recalling information. Side effects from medication may also impact attention, memory, alertness, and activity level."**
> (DO-IT, n.d.)

Learning/modality preference

The lecture format is at odds with **the information processing preference of at least 30% of learners,** meaning they can struggle to take meaningful notes. E.g. reflective learners need time to process lecture content, whereas visual learners are prone to disengage *(Felder & Spurlin, 2005; Gysbers et al., 2011; Miller, 2001)*.

> **"[Where the lecture format is mismatched to learner preferences], students become bored and inattentive in class, do poorly on tests, get discouraged about the courses ... and in some cases ... drop out of school."**
> (Felder & Silverman, 1988)

Content and procedural novelty

The university lecture format is an unfamiliar learning context for many first year students. Their classes are often content-dense, introducing new concepts and terminology. Students often struggle to make sense of lectures, and to identify the main points to note down *(Nordmann & McGeorge, 2018)*.

> **"[Lecture note taking presents] a range of challenges for many, if not most, first year students. To process lecture information and make meaning of this, students have to understand not just the lecture content but also the structure of lectures."**
>
> Van der Meer (2012)

Language proficiency

Lecture note taking places a considerable processing burden on learners studying in a second language *(Al Musalli, 2015)*. **This impacts around 9% of undergraduates**, including international students, American ESL students, and deaf students whose first language is ASL (American Sign Language) *(Reetz et al., 2016)*.

> **"[Non-native speakers] face the task of interpreting in real time a monologue which is both linguistically and cognitively demanding."**
>
> (Teng, 2011)

Concentration and executive function

Many students have difficulty sustaining concentration during lectures. Students with neurological disorders such as ADHD, and those on the autism spectrum in particular, struggle to filter out external stimuli, cope with sensory sensitivities, and avoid distractions *(Rodden, 2017; Vekaria, 2011)*.

"[Postsecondary students with executive function deficits struggle with lecture note taking] because of the huge burden [involved in] inhibiting other distractions not directly related to the lecture, and maintaining attention for the entirety of the lecture."
(Vekaria, 2011)

Physical impairments and chronic illness

A wide range of physical impairments and chronic illnesses impact the mechanical aspect of note taking.

Mobility or dexterity impairments, as well as issues with pain or physical endurance, limit students' note taking speed and stamina. This in turn negatively impacts note completeness and legibility.

"Adequate handwriting (or typing) speed [is] a necessary condition for skilled note taking."
(Peverly et al., 2014)

Learning disabilities

Learning disabilities (LD) such as dyslexia affect the way information is received, organized, and remembered. Students with LD typically have limited working memory capacity, making it very hard for them to encode information and take notes. Difficulties with word recognition and poor spelling further hamper the production of notes.

"Students with learning disabilities are often unable to identify the important information to note; are unable to write fast enough to keep up with the lecturer; and, even when they do record notes, are frequently unable to make sense of their notes after the lecture."
(Boyle, 2001)

Sensory impairments

If not impossible, note taking is extremely cognitively demanding for students with sensory impairment.

Hearing impaired (HI) students often rely on visual input such as lip reading, or following an interpreter or transcript; whereas visually impaired students may need to access visual information via a screen reader whilst listening to the

"[Hearing impaired students must] "lip read and be attentive ... processing and constructing meaning out of half-heard words and sentences. It's like doing jigsaws, Sudoku and Scrabble all at the same time."
(Noon, 2013)
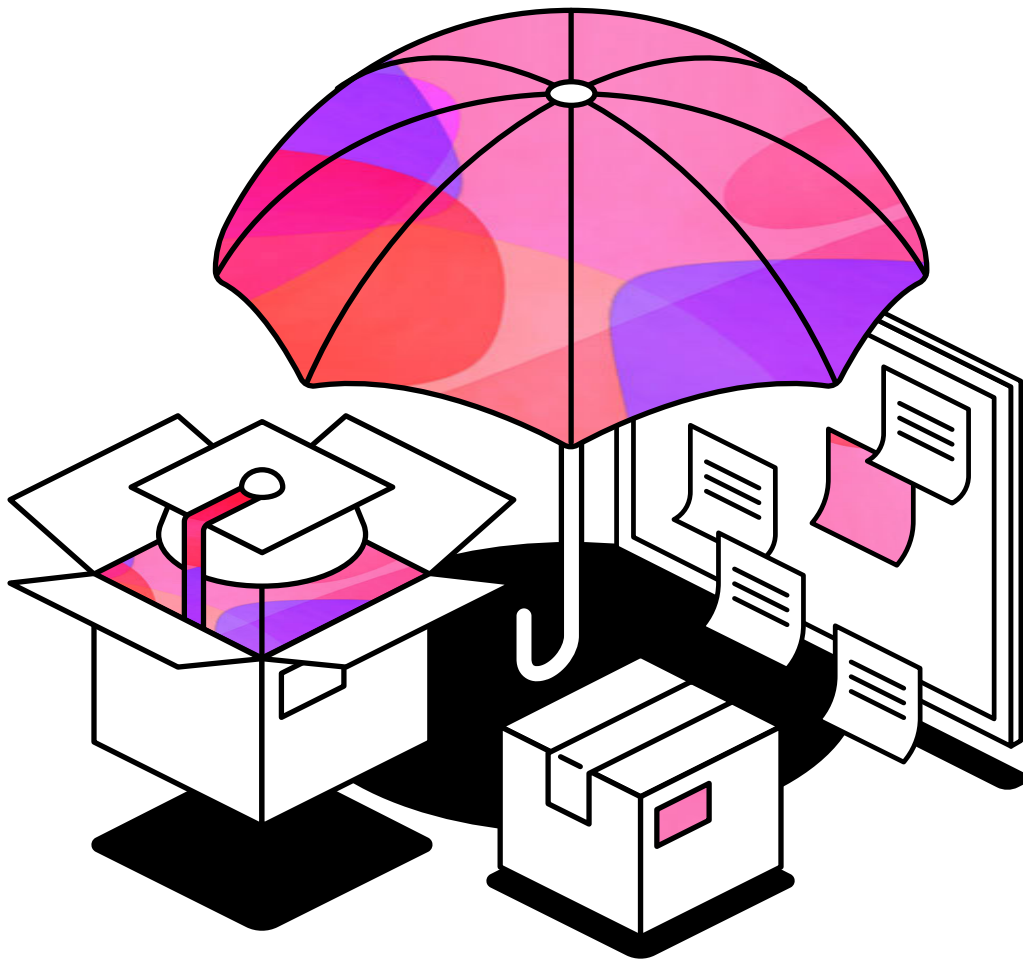
Note-taking interventions

Strengths and shortcomings

Postsecondary institutions have a legal obligation to ensure equal access to the curriculum for students who disclose a disability *(APA, 2017)*. Students who experience cognitive, mechanical or sensory barriers are likely to need note-taking accommodations. Typically, they will be assigned a note taker to take class notes on their behalf, or may be provided with a recording device to make their own audio recordings of lectures.

These accommodations aim to enable students to focus on "understanding ideas as they are presented ... without worrying about recording information" *(Grabe, 2005)*, and to provide an accurate record of lecture content so that students can access their teaching later, at a pace and duration appropriate to their abilities.

Additionally, institutions may implement Universal Design for Learning (UDL) approaches to note taking provision, such as making instructor-generated notes or centralized lecture-capture recordings available to all students. Such approaches minimize the need for individualized accommodations, recognizing that adjustments in curriculum delivery can benefit a wide variety of students *(Meyer et al., 2014; cf. Roberts et al. 2011)*.
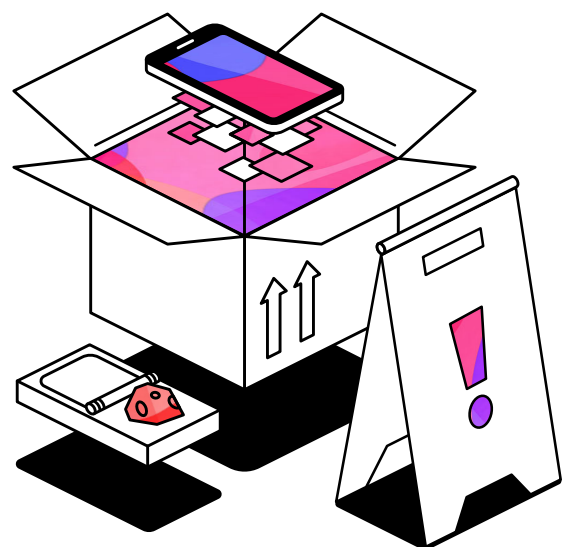
For some students, especially those with complex or profound disabilities, these accommodations are essential to accessing the curriculum. Many more students report that these provisions relieve the 'strain' of having to take written notes in class. Lecture recordings, in particular, are considered an "important pedagogic resource" for many students who are disadvantaged by traditional note taking, as well as offering "more general cohort benefits" *(Nordmann & McGeorge, 2018; cf. Leadbeater et al., 2013).*

However, research suggests that note taking accommodations "can inhibit learning for students with disabilities" *(Boyle et al., 2015).*

Firstly, significant additional effort may be required of the student to achieve equitable access. For example, accessing third party notes may create a further hurdle for students with disabilities.

Likewise, students with a learning disability "may need to view a recorded class multiple times to develop a functional set of notes" *(ADCET, n.d.)* impacting the time they have available to dedicate to other forms of independent study, as evidenced by student comments recorded by Leadbeater et al. (2013): *"[Lecture recordings are] very time consuming... it could take time off researching by yourself, like going to textbooks."*

"Students with learning difficulties are often passive learners; combining passive notes and passive learning strategies poses serious negative educational consequences." (Ritter, 2013)

Student engagement & efficacy

Beyond this impact on student workload, researchers highlight that both notetaker support and centralized recordings can hinder learning, since they allow students to "assume a passive learning mode … thereby missing the benefits of active participation in the lecture" *(Boyle et al., 2015, cf. Brazeau, 2006)*. This is reflected in student experiences reported by Lux (2016): *"It allows me to doze off in class … I know someone is taking notes for me, so I don't really have to [pay attention]."*

Rather than enhancing a student's ability to encode information, delegating the production function of note taking to a scribe or recording device can cause students to 'zone out'. Consequently, they miss out on the critical active learning that comes from processing information, evaluating importance, and synthesizing with other course material. Clearly the perceived benefits of such accommodations need to be weighed up against the potential for diminished student engagement.

Learner independence

Finally, traditional note taking accommodations do little to foster learner independence, skill-building or self-efficacy. As ADCET (n.d.) state: *"note taking is a crucial study skill outside of the lecture room, but primarily honed within the lecture room"*. 'Outsourcing' of the note taking process deprives students of the opportunity to "develop their own strategies for organizing information in their own cognitive perspective" - an important element both for academic learning and the development of transferable lifelong skills *(Brazeau, 2006; cf. Chester et al., 2011)*.

Dedicated note taking technology can address many of these issues: empowering students to take effective notes independently, by reducing barriers to classroom engagement and enabling them to balance both the 'encoding' and 'external storage' functions of note taking.
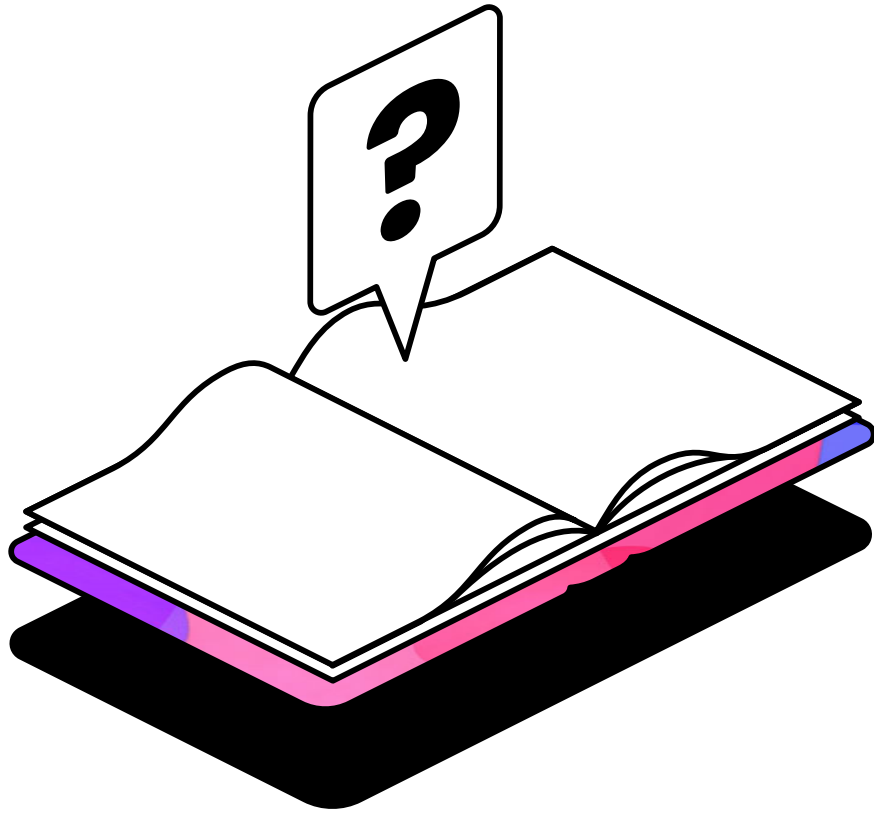
Faculty FAQ

How does recording impact students' rights and privacy?

Instructors, understandably, may have concerns about privacy or intellectual property (IP) rights relating to the recording of lectures. The information below is intended to advise faculty how institutions can meet their obligations to make reasonable adjustments for disabled students, or implement campus-wide UDL recording policies, without compromising the rights and privacy of staff or students.

U.S. copyright law

Under U.S. law, copyright protection applies to any 'original work' in a 'tangible medium'. So when an instructor prepares teaching materials, such as written lecture notes or presentations, these materials are covered by copyright. Depending on the IP policy of the institution, the content of a lecture is therefore either the property of the institution or the instructor.

In addition, the instructor typically retains performance rights for the live delivery of a lecture *(Carlson, 2016)*. If a student distributes lecture notes in any format (whether as text, photographs, or an audio recording) without permission from the IP owner, they are in breach of copyright and could be liable for civil and criminal penalties *(Leytes & Weller, 2017)*.

'Fair use'

From a legal perspective, capturing audio or images of a lecture for personal, educational purposes (better note taking) would most likely fall under 'Fair Use', regardless of whether or not the student has permission to record as an accommodation under the ADA or whether the instructor's consent has been sought. *N.B. This only applies where a student uses the recording exclusively for their own purposes, and not where they distribute it for any reason (Ricci, 2016).*

Student rights to privacy

If a recording of a class includes students asking questions, or revealing any personally identifying information, this raises a data protection issue: these portions of the recording constitute 'protected educational records' under FERPA (the Family Educational Rights and Privacy Act). Distribution of such recordings without written consent from the affected student(s) may have serious repercussions *(Leytes & Weller, 2017)*.

Institutional policies

Most post-secondary institutions will have some form of recording policy which sets out the circumstances in which recording of teaching sessions are permitted, the responsibilities of those involved, and the implications of breaches of policy.

In some instances, this will be limited to students who receive note-taking accommodations via Disability Services.

Typically, the student will be required to sign a contract under which they agree to protect the rights and privacy of faculty and fellow students, and to share this agreement with their instructors. The onus is then on the instructor to inform the class that a recording is being made.

Campus wide recording policy

Many institutions are also adopting campus-wide lecture recording policies. There is significant demand from students to be able to make recordings *(Ibrahim & Howarth, 2014)*, and institutions increasingly recognize that recording lectures and other teaching sessions can support learning across the undergraduate cohort (e.g University of Oxford, 2015).

Campus-wide policies help address the pedagogic issue of ensuring equal treatment for all students: lecture recording as a note-taking accommodation is intended to level the playing field for students with disabilities. However, it may be argued that this unfairly disadvantages the larger population of students who have only a single opportunity to hear the lecture *(Wightman, 2010)*.

Moreover, given the prevalence of smart mobile devices, institutions are acknowledging the likelihood that students are already recording lectures and establishing policy guidelines which define the limits of acceptable behaviour and the penalties for misuse *(Ibrahim & Howarth, 2014).*

Policies are typically outlined within the institution's student code of conduct, or other agreement entered into at the point of enrollment. Permission is usually predicated on recordings being made **exclusively for a student's personal use** in relation to their studies, within a limited time frame, and provided that all present (staff and students) are **made aware that recording is taking place** *(Ibid.).*

A UDL policy might grant blanket permission for students to make recordings. Otherwise, permission for the general cohort to record typically remains at the discretion of the instructor. However, under the ADA, it is unlawful for a lecturer to prevent a student who is eligible for note-taking accommodations from making a recording for personal use.

How should I notify students that lectures may be recorded?

Where a conditional recording policy applies, it is best practice to announce at the beginning of each class that recording is permitted, and that students must abide by your institution's policy on recording of lectures. Announcements should not identify any students in receipt of note taking accommodations.

With a campus-wide recording policy, permission and consent may be implicit. However, the institution might display signs in teaching spaces to remind staff and students that recording may take place.

It may also be helpful to include your institution's recording policy on your syllabus, so that all members of the class are aware that classes may be recorded, the conditions under which recording is permitted, and the penalties for infringement.

How do I balance students' rights to record with individuals' rights to privacy?

A robust recording policy should clarify that permission to record cannot infringe individual privacy rights. Individual students have the right to request recording to stop if they do not want their personal contribution recorded. This request applies to all students, including students in receipt of note taking accommodations.

Where students do object to being recorded, you may wish to state a version of the following: *"To protect the privacy of your classmates, please refrain from recording student contributions"*. If the student's contribution or question may benefit the whole class, you may want to repeat the information for those who wish to record it, as long as this will not personally identify the student.

Additionally, teaching spaces may incorporate designated "recording-free zones" to accommodate students who wish to opt-out of third-party capture.

How should I handle situations where recording would be inappropriate?

In order to ensure equal treatment of all students, this is best approached from a standpoint of "note taking appropriateness", rather than focusing specifically on recording as a means to capture lecture information.

Institutional policies or codes of conduct should clarify that lecturers retain the right to instruct note taking, including recording, to stop during teaching sessions where sensitive or personal topics are being discussed, or client/ patient confidentiality is implicated.
To restrict all note taking for a portion of class, you may wish to state a version of the following: *"The note taking portion of this class is over. Please turn off recorders / recording apps, and refrain from taking written or typed notes"*.

Isn't technology a distraction in the classroom?

A number of recent studies have explored the impact of technology use on student engagement and performance *(e.g. Hembrooke & Gay, 2003; Kuznekoff & Titsworth, 2013; Rosen et al., 2011; Sana et al., 2013)*. These studies are unanimous in their findings that "distractions from in-class multitasking correlate with decrements in learning" *(Sana et al., 2013)*, and that students who spend more time 'on task' tend to perform better on tests.

Crucially, though, these studies recognize that the core issue is not access to technology per se, but rather lack of engagement with the primary task (attending to the lecture). When students are 'off task' they suffer "multitasking deficits" in learning performance *(Ibid.)*. As Hembrooke & Gay (2003) note, "distraction in the lecture hall … is nothing new; note passing, doodling, talking, completing other class assignments, and even taking notes on the current lecture are all familiar forms of low-tech distraction".

Technology and Engagement

Regardless of whether or not they are using technology in the classroom, students are prone to "attention failures". Indeed, research has shown that **"mind wandering in classrooms occurs 30-40% of the time"** *(Varao-Sousa & Kingstone, 2015). Hence Sana et al. (2013)* conclude that students "need to work hard and stay focused to keep classroom learning at an optimal level", while emphasizing that technology in the classroom "foster[s] positive learning outcomes when used appropriately".

Tech-etiquette

Sana et al. (2013) suggest that instructors discuss technology use with their students at the outset of a course. By outlining the benefits of appropriate use of technology, including dedicated note taking tools such as Glean; highlighting the negative impact of technology misuse; and establishing class "tech-etiquette", instructors can empower their students to make informed choices *(cf. Hembrooke & Gay, 2003)*. It may also be useful for institutional policies and/or course syllabi to specify that in-class use of laptops / phones / tablets for any purpose other than that which is related to the lecture is prohibited.
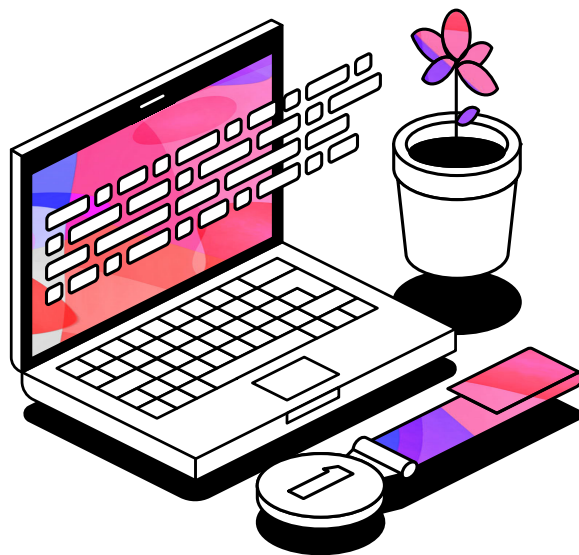
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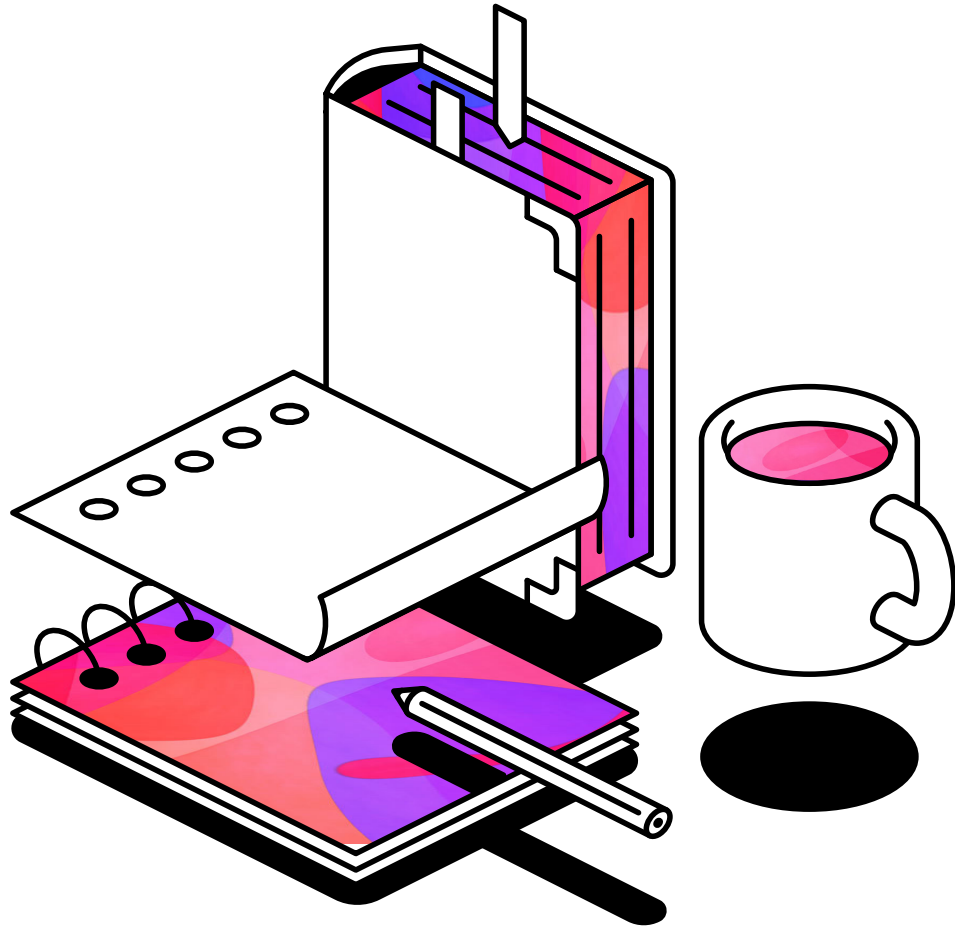
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