

# THE LEARNING IMPACT OF SMART PENS ON STUDENTS WITH DISABILITIES

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## ABSTRACT

For the past 4 years, smart pens have been allocated to students with disabilities at Maynooth University, Ireland. Smart pens are recording devices that “resemble a normal ballpoint pen” (Hammond et al 2005) but allow writing to be synchronized with audio. Specific moments of speech can then be played back from within a page of handwriting. The audio-enriched text can be transferred to a digital platform, enabling file management and search functionality.

At third level, it is hoped that smart pens may improve independent learning, note taking, memory techniques, interview strategies and examination preparation, especially for students with specific learning difficulties or disabilities affecting motor skills or concentration.

This proposal examines the effectiveness of smart pens as a technological support to transform learning and to increase student engagement and confidence in the academic environment. It also questions the ongoing applicability of smart pens as students transition into employment.

To investigate this impact, student focus groups (comprising recent and more experienced users of smart pens) reported on their use of smart pens and any positive or negative outcomes on their learning. A subsequent questionnaire examined their experiences in more detail. The student voice was also recorded via video responses by 3 students who wished to provide feedback in this manner. Selected lecturers were also surveyed for their reactions to teaching students with smart pens in their classes.

The findings were generally positive with most students crediting the pen with increased confidence and academic performance. Most persisted in using the pens throughout their academic journeys, despite some negative aspects that may have otherwise dissuaded them. However, they did not foresee taking the devices into the workplace after graduation. This research may assist assistive technology service providers when making recommendations to clients.

## BACKGROUND

At third level, note taking support is provided for some students with disabilities who perform significantly lower than their nondisabled peers. Note taking often demands more effort than reading or learning (Piolat et al, 2005) as it requires consistent writing or typing while splitting one’s focus between a lecturer, the presentation slides and the student’s own notes, in a large lecture hall with distractions arising from other students and the environment. In conjunction with the time pressure this can have a negative impact on student learning.

Many factors can have a negative impact on the recording and reviewing of written notes. For students with a Specific Learning Difficulty such as dyslexia or a disability that can affect handwriting, they can struggle to keep up with note taking. For students with disabilities that may cause distraction or require medication, concentration is often also affected. After a lecture students often cannot make sense of what they did manage to take down.

## PURPOSE

To reduce the reliance on human note takers and to promote independence and digital literacy skills, 74 smart pens and specialized notebooks from Livescribe Inc. have been loaned out to students with disabilities over the past 4 years by the College’s Disability Office, funded by the Fund for Students with Disabilities via the European Social Fund. Both the staff in the Disability Office and the students themselves have high expectations for these smart pens. They have become a viable alternative to standalone digital voice recorders and human note takers.

Given the rapid large scale adoption of this technology solution across the education sector (Martin 2014), the purpose of this study was to provide evidence as to whether smart pens are effective at supporting student learning. The study investigated the various locations where the pen was used by students and considered the student and staff experiences when the pen is used in these contexts. The study identified if students persisted with using their smart pen over time and if students would consider using these devices in employment.

## METHOD

This study used a mixed method approach combining both qualitative and quantitative methods. Qualitative methods included conducting focus groups of smart pen users and interviews with specific students. An online questionnaire based on the study purpose was also emailed to participants and to lecturing staff who are teaching students who have used this technology in their classes. Quantitative data came from the participants' course progression metrics.

### Subjects

38 students with experience of using Livescribe pens took part in this study, across the various primary disability categories for which they were registered with the Disability Office. This comprised 14 students with a specific learning difficulty/ SpLD (e.g. dyslexia), 10 with a mental health condition (e.g. anxiety, depression, schizophrenia), 6 with a significant ongoing illness (e.g. cardiac condition, narcolepsy, haemophilia), 4 with a physical disability (e.g. tendonitis, hypermobility), 2 with ADD/ ADHD and 2 students with developmental coordination disorder (DCD/ dyspraxia).

### Set-up

A series of facilitated and recorded focus groups of up to 8 participants each were conducted over one week and consent forms were completed. A script and a range of open-ended questions were prepared and sequenced to promote discussion. Three one-to-one videotaped interviews were scheduled. Two online questionnaires were also compiled; one for participants to enable them to respond more fully if they so wished, and the other was designed for academic staff identified as having had students with smart pens in their lectures.

### Procedure

A facilitator and a note taker were present at each focus group. The same questions were posed at each focus group and the facilitator ensured that all students had an opportunity to participate. The one-to-one videotaped interviews were conducted with the three students to delve more deeply into specific identified themes.

The online student questionnaire related to student usage levels of the smart pen, the locations where they used it, their experience of operating the device, the impact it had on their note taking and on their confidence levels generally.

The questionnaire sent to academic staff queried their awareness level of these devices being used by students in their classes. It also asked their opinion on the use of such recording devices by students with disabilities in the learning environment.

Quantitative data on progression rates from participants' current year of study to their subsequent year or on to graduation was provided via the student records interface.

### Data Analysis

Analysis began immediately after the focus groups closed using the comprehensive notes taken and a summarization of the discussion with the participants. The videotaped interviews were reviewed and transcribed. The student questionnaires were also included in the overall data reduction, which extracted the main concepts and themes that emerged from the answers to each question.

The staff questionnaires were compiled into figures and a word cloud was generated of their free text response to their opinions of smart pens and their own potential usage of the technology in their teaching practice.

With their permission the progression rates for the participants were compiled and analyzed.

## RESULTS

Table 1 illustrates the quantitative feedback received from students in the focus group, the interviews and student questionnaires. The primary finding was that students felt that the positive aspects of the pen outweighed any negative associations that would otherwise cause them to discontinue its use.

Table 1: Positive/negative aspects of smart pen usage

<b>Positives</b>	<b>Negatives</b>
Improved quality of notes	Bulkiness of pen
Greater enjoyment of lectures	A noticeable support
Works well with online slides	Requesting permission
Better workload management	Multiple speakers
Increased confidence on course	Technical knowledge
Persistent use over time	Memory limits
Easy to use following training	No colored notepads
Grades have benefitted	Ink cartridge replacement

The following quotes from participants were indicative of the typical reactions on learning impact:

- "It helps greatly in note taking because it records parts of the lecture that I don't remember or miss."

- "Without the pen I would have struggled to put study notes together."

- "The only downside to using this pen is that when listening back to the recording you can hear yourself writing on the page."

Table 2 shows the various locations where students found their smart pens to be useful. Many students used their smart pens outside of lectures.

Table 2: Various contexts where smart pens were used by participants.

Location	Number of participants
Lectures	36
Library	8
Tutorials	8
Home	5
Interviews	4
Meetings	2
Labs	1

Figure 1 shows student responses to the potential use of smart pens after graduation and into employment. The most common reasons given was that there are no lectures held in offices or they may not be prepared to disclose their disability to their employers and would have to wait to decide.

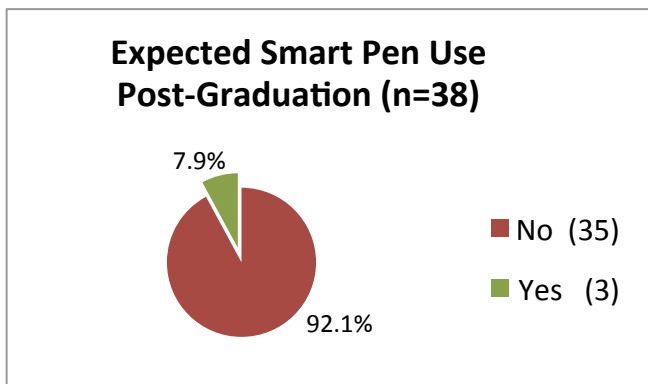


Figure 1: Anticipated smart pen use post-graduation

Looking at academic performance among the students using smart pens, Table 3 displays the progression rates of students using smart pen technology to assist with note taking and examination preparation.

Table 3: Progression data

Students using smart pens	Progression Rate
34	Progressed to subsequent year/ graduation
3	Repeated 1 module
1	Failed to progress

18 academic staff responded via questionnaire to the following question (see Figure 2): Are you aware of smart pen devices being used by your students?

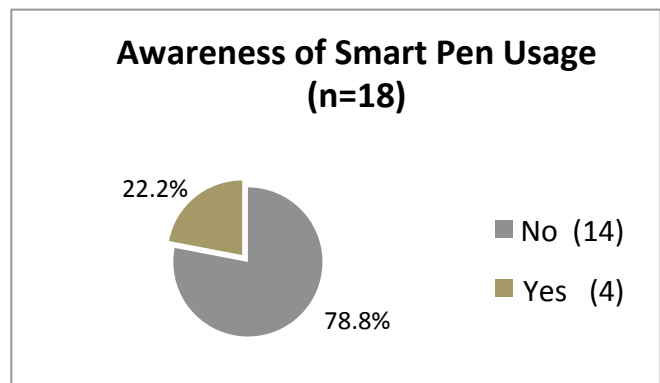


Figure 2: Awareness among academic staff of smart pen usage by their students.

The majority of academics were not aware of students using smart pen technology in their lectures, despite students being required to seek express permission in advance as part of the equipment loan by the Disability Office.

In expressing their opinions on smart pens, the academic staff most frequently used words such as "fantastic", "great" and "useful". One mathematics lecturer stated that "Certainly, the student who used it last year made significant advances, and was a completely different person than in her first year."

The cautionary words expressed by some lecturing staff included "unaware", "permission", "sensitivity" and "confidentiality". Overall, the academic respondents felt smart pens to be a "good recording technology for note taking in lectures by students with disabilities."

## DISCUSSION

There has been wide adoption of smart pen technology across Higher Education Institutions in recent years (Linenberger & Bretz, 2012, Hickman 2013, Shaffer & Schwebach 2015). However, without a strong evidence base to measure the beneficial impact, it can be difficult for an assistive technology service provider to make positive recommendations. The cost of each smart pen bundle with the accompanying dot matrix paper pads, the ink cartridges, carry case and earbuds is in the region of €200/\$220. This can become significant as the demand increases for this solution. More research is required to evaluate the transformative effect on learning that these pens are having on students with disabilities.

The lack of awareness among academic staff of the pens being used in their lectures indicates a need for additional training with students. At the time of the loan of any recording device, students are obliged to sign a Responsible Usage Agreement which states that they must seek permission from their lecturing staff before recording them for the first time. It would appear that this is not always the case and students are using the device without being granted express consent. This may relate to fear of approaching lecturing staff or stigma around highlighting an in-class accommodation.

There is also a need within the Disability Office to raise awareness of this technology in the institution, as lecturers are reportedly very receptive to it once they are made aware of its benefits and the students' obligations with regard to non-dissemination of recorded materials. Several academics also expressed an interest in utilising smart pens in their own teaching practice.

#### Study limitations

The participants on the study were likely self-selecting power users of the technology under investigation which may have skewed the findings.

It is also not possible to draw strong correlations between academic progression and usage of the smart pen.

### **CONCLUSION**

This study concluded that the impact of using smart pens on students has been overwhelmingly positive and learning has been measurably transformed. The study has shown that this technology can be effective and results in increased confidence in the academic environment by students who might otherwise have struggled.

This is an encouraging finding as the provision of this support also has an impact on the Disability Office, which manages the procurement procedure, ordering, tracking, storing, training and replacing of the ink and paper consumables.

In terms of students not envisaging their continued use these devices post-graduation after they return the smart pen to the Disability Office for subsequent lending, the students are grappling with the issue of disclosing their disability to future employers and colleagues. They may fear that a technology such as a smart pen might make them more noticeable. They often have only had experience of using assistive technology in the academic environment. Ironically,

smart pens were not designed as an assistive technology solution and are actually promoted as a workplace tool to support the taking of minutes in meetings, scheduling appointments and writing emails.

Lecturers have been shown to be favorably disposed towards smart pens, once they are made aware of them and the Responsible Usage Agreements. There is a need for increased training with academic staff on awareness, disclosure, confidentiality and dissemination policies.

Based on this study, we will continue to loan out smart pens to students with disabilities and to promote their potential use in employment.

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