The Development & Impact of Digital Notes on Students With and Without Disabilities in Engineering and Computing Courses

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INTRODUCTION

Course content plays a critical role in student success.

Students with disabilities (SWD) face numerous additional challenges compared to students without disabilities (SWOD) when digital content is inaccessible or difficult to use. Many students have a disability, but most students who self-reported a disability did not report it to their instructors or school [1][2].

Undergraduate Population Reporting a Disability [1]

19%
81%

● SWD ● SWOD
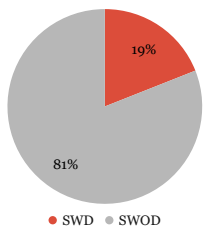
Field of Study for Undergraduate SWD [1]

28%
72%

● Science & Engineering ● Other
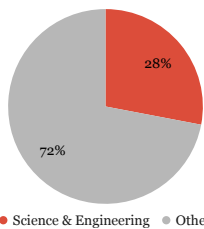
Digital note-taking has been increasingly implemented in higher education for its potential to expand universal design for learning (UDL) techniques to benefit all students, especially SWD.

METHODS

Digital Note-Based Pedagogy

Digital notes named **I-Notes** are developed through **ClassTranscribe**, an accessible video platform based on UDL principles.

Lecture videos are automatically converted into a digital book with textual and visual elements.

Survey Design

Three surveys were conducted in Fall 2022: a baseline survey and two post-test surveys following the introduction of digital notes in the classroom. Surveys explored **accessibility**, **belongingness**, and **self-efficacy**. Students' **perceived learning** and association with **low-stakes assessments** were also recorded.

Students who faced challenges that prevented them from attending class but did not have a formally recognized disability were categorized as Students with Access Needs (SWAN).

Responses from a total of 376 students (including 30 SWD) in two large math-rich engineering/STEM courses were collected and analyzed.

I-NOTES: A NEW TEXT-BASED MODE OF COURSE CONTENT DELIVERY

I-Notes Web Interface and Digital Book Features

Chapter Content Editing Interface

Chapter Structure Editing Interface
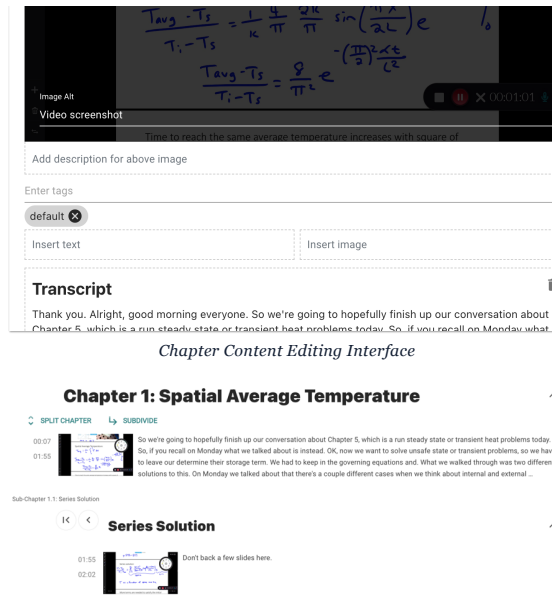
- **Alt text and image descriptions** can be added for increased accessibility

- Users can **add new text blocks and images**

- I-Notes support several export formats (**EPUB, PDF, HTML, LaTeX**, and a zip file of images)

- Users can **edit transcripts and add equations**

- Users can **create new chapters** and sub-chapters

- Chapters can be merged and subdivided

- Customization buttons, **autosaving**, and clearer navigation were added
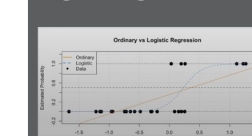
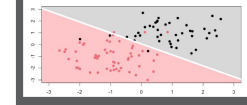*Screenshots link to the corresponding video in ClassTranscribe at the same timestamp*

Key terms are highlighted throughout the book

A table of contents with chapter previews can be generated to help readers navigate the digital notes

Glossary:
- binary classification: Binary classification is the task of classifying the elements of a set into two groups (each called class) on the basis of a classification rule. [more]
- binomial: In algebra, a binomial is a polynomial that is the sum of two terms, each of which is a monomial. [more]

A glossary of terms is automatically generated from sources such as Wikipedia

Student Opinions about I-Notes

Overall, **students who used the digital notes found them helpful**:
- Students appreciated the organized structure, searching capabilities, and embedded links to video lectures.
- The notes saved time while reviewing key concepts.
- The notes were available anywhere, anytime.

RESULTS

Low-Stakes Assessments

Scores on homework and quizzes were analyzed before and after digital notes were introduced. Some students used the digital notes (users), while others did not (nonusers).
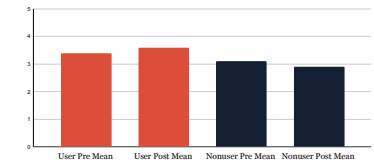
Low-stakes assessment scores for SWD

Significant differences were found between SWD users and nonusers after digital notes were introduced.

Belongingness & Self-Efficacy
- SWD felt less belonging and self-efficacy than SWOD.
- SWAN who used the notes reported higher belongingness and self-efficacy.
- Digital note users had a higher average belongingness than nonusers.

Perceived Learning
- SWD had lower perceived learning than SWOD overall.
- **SWD users reported higher perceived learning** than SWD nonusers.

CONCLUSION

The utilization of digital notes boosted students' belongingness, self-efficacy, and perceived learning. Several factors may have contributed to this improvement:
- Digital notes may have allowed students to save time when reviewing certain concepts.
- Digital notes may cater to students with certain disabilities.

Limitations
- The limited sample size of SWD.

REFERENCES

[1] K.Hamrick,"Women, minorities, and persons with disabilities in science and engineering. special report nsf 19-304," 2019.

[2] Love, Jacqueline Marie. (2017). Wording Matters: The Impact of Disability Identification in Post-Secondary Education. University of Wisconsin Milwaukee. https://dc.uwm.edu/etd/1662/.

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