

**Supporting Students with  
Disabilities with Tablet PCs  
in STEM Courses**

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**Research Support**

- NEC Foundation of America
- National Science Foundation

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**Agenda**

- Rationale
- Demonstration
- Research findings
- Discussion

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### Rationale

- Text interpreting services support increasing numbers of students who are deaf and hard of hearing (D/HH) as well as students with other disabilities (SWD).
- Capturing visual or graphical (i.e., diagrams, formulas, etc.) information in conjunction with the text remains a challenge.

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### Rationale

- Multiple information channels are frequently used, especially in science, technology, engineering, and math (STEM) courses
  - Overheads, PowerPoint slides, White/Black/Smartboard displays, etc.
    - Challenging to coordinate text display with other visual information when student has to look at the multiple displays

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### Rationale

- Virtues of student notetaking controversial
  - Helps to synthesize new material (Armbruster, 2000; Meyer, 2001)
  - Mechanics of notetaking overwhelm student – not always beneficial for student learning (Kierwa, 1991)

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Demonstration

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Research Findings  
NEC Foundation of America

- Goals of the project
  - Conduct field trials of the C-Print Pro Tablet software
  - Evaluate deaf/hard of hearing (d/hh) students' experiences using the tablet C-Print technology.
- Focus on real-time experiences

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NEC Project

- Settings
  - Mid-size university in the Northeast (Model U)
  - Community college in the South (Model CC)

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**NEC Project  
Methods**

Data Collection

- Student on-line survey after trial
- Student e-mail interview after survey
- Captionist and notetaker e-mail interviews after trial

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**NEC Project Methods**

- Participants
  - Students. Deaf and Hard-of-Hearing students who attend college on mainstreamed campuses (n=11: U=7, CC=4)
  - Service providers
    - Experience range 2 -12 years; average length of service of 6.31 years (n=8).
    - (U=5 captioning only, 2 notetaking only)
    - (CC=1 both captioning and notetaking)

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**NEC Project  
Methods**

Procedure

- 5 week trials
- Captionist + Tablet notetaker (RIT) (2 person team)
- Captionist/notetaker (MDC) (1 person)
- Real-time captioning + graphics
- Student receives notes after class

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### NEC Project Results

- Model U Students (n=7)
  - Materials Science (n=1)
  - Discrete Math (n=2)
  - Organic Chemistry (n=2)
  - Programming for Information Technology (n=2)
- Model CC Students (n=4)
  - Mathematics for Liberal Arts Majors (n=1)
  - Fitness and Wellness (n=1)
  - English Composition: Writing Research Papers (n=1)
  - Psychology of Personal Effectiveness (n=1)

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### NEC Project Results

#### Service Providers (n=8)

- Captionists: RIT (n=5); MDC (provided both services (n=1)
- Notetakers: RIT (n=2)
- Range of experience, 2-12 years, average 6.31 years

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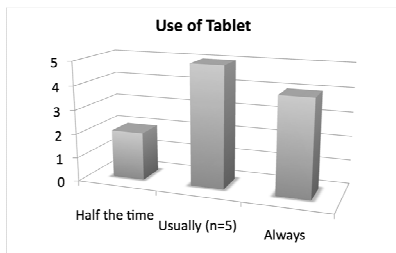
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### NEC Project Results



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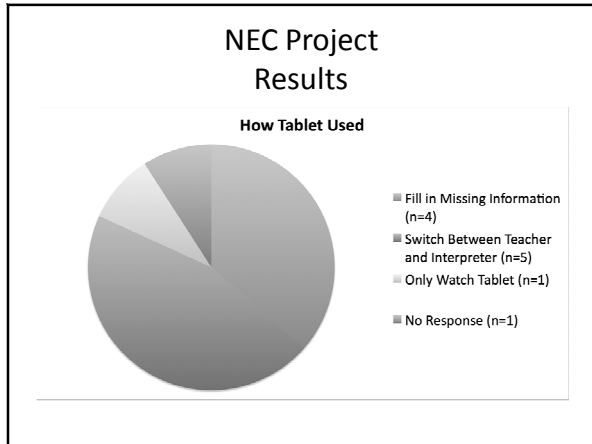
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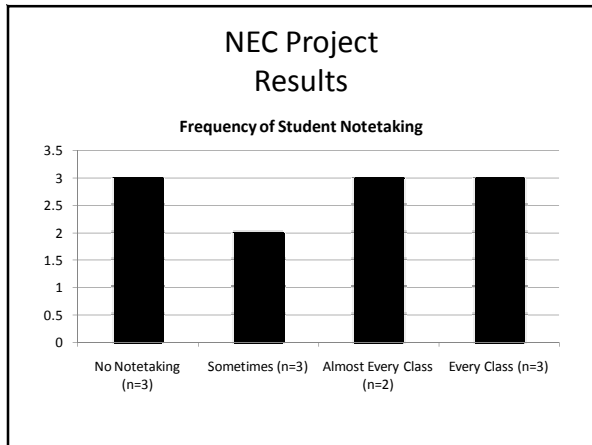
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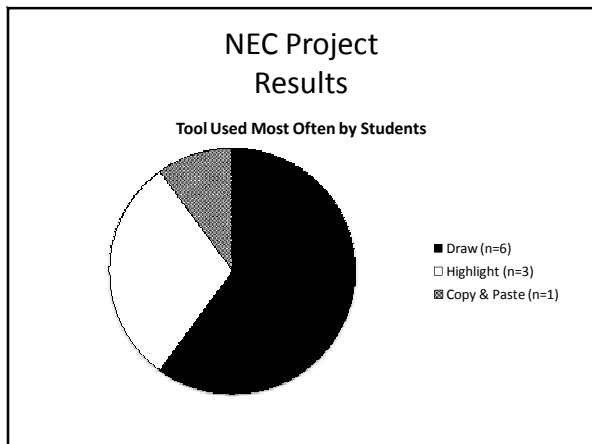
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### NEC Project - Findings

Student Questionnaire Results – Tablet Use

**Ease of use (1=very difficult, 5=very easy)**

- Draw (n=11, M=3.36, SD=1.804)
- Highlighting (n=11, M=3.27, SD=2.195)
- Write own notes (n=11, M=3.0, SD=2.098)
- Copy and paste (n=10, M=2.0, SD=2.582)

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### NEC Project Results

Helpfulness of tablet (n=11) (1=strongly disagree, 5=strongly agree)	
Recommend to other students	M=4.55 (SD=.688)
Notes helpful after class	M=4.45 (SD=.688)
Identify important information	M=4.09 (SD=1.446)
Captioning and graphics increased comprehension	M=4.09 (SD=1.446)
Learn vocabulary	M=3.82 (SD=1.401)

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### NEC Project - Findings

• Student Interviews

*I found the tablet laptop a far better approach to just using captioning on a normal laptop. It makes the course more interactive and I learn more that way.*

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*I would say, with practice student can improve their way of taking notes and understanding the material, like I did.*

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### NEC Project Findings

- Captionist/Notetaker Interviews
- 1) Benefit of technology to students  
*It can save them time because they have someone else taking down all the drawings off the board and they can just add their own comments on it. They can concentrate on the explanation of what is being drawn without missing things because they were too busy trying to get the drawing down.*

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### NEC Project Findings

- 2) *Technology well-received by professors and other students.*
- 3) *Challenges of captioning and notetaking simultaneously.*

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### NSF-CCLI Project Goals

- 1) Distribute specially produced C-Print notes that include graphics as well as text to all students (deaf and hearing) in Model U classes.
- 2) Evaluate the effect of the C-Print notes on student learning in undergraduate STEM courses at Model U.
- 3) Focus on impact of C-Print notes

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**NSF-CCLI Project  
Goals**

- Determine extent of benefit of C-Print notes for:
  - students who are D/HH
  - students with learning disabilities
  - English language learners
  - Students without identified communication or learning disability challenges

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**NSF-CCLI Project  
Methods**

- Two courses
  - Introductory Statistics, Discrete Math
- Two sections each class taught by same professor
- One section each course received C-Print notes with graphics for the entire quarter (experimental group), one section did not receive notes (control group)

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**NSF-CCLI Project  
Experimental Design**

Course Name	Experimental Class	Control Class
Introductory Statistics	Fall 2008	Spring 2008
Discrete Mathematics	Winter 2008-09	Winter 2009-10

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### NSF-CCLI Project Methods

- Pre-test, post-test, attendance
- Student questionnaire about note usage
- Interviews with faculty after experimental group class

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### NSF-CCLI Project Results Introductory Statistics Classes

Student Characteristics	Experimental Group (n=31)	Control Group (n=24)	X <sup>2</sup> (df=1)
Sex	F=16; M=14	F=10; M=14	.727 (n.s.)
Year in School			
First	n=0	n=2	2.744
Second	n=13	n=1	10.683 (p=.01)
Third	n=8	n=13	4.461 (p=.05)
Fourth	n=6	n=6	.139
Fifth	n=2	n=1	.183

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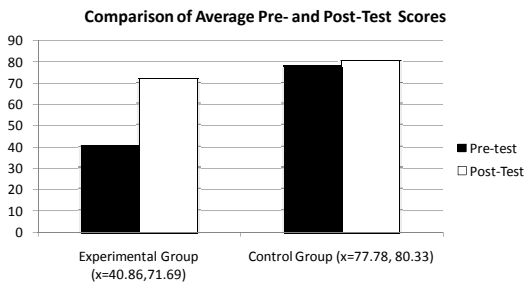
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### NSF-CCLI Project Results




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NSF-CCLI Project  
Results

- Final Grade
  - No significant differences between groups
- Attendance
  - Experimental group 15.90 class sessions
  - Control group 17.04 class sessions
  - $t=2.682$  ( $df=52, p=.01$ )

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NSF-CCLI Project  
Results

Deaf/Hard of Hearing Student  
*Absolutely wonderful. If I missed something in my own notes I referred back to the C-Print notes to see what I missed.*

LD Student (ADHD):  
*Loved them! They were so helpful.*

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NSF-CCLI Project  
Results

English Language Learner Student (ELL)  
*Very useful especially if I missed something in my notes. I can always refer back to C-Print notes.*

Student with no identified disabilities or communication challenges  
*Very, very helpful!*

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### Contact Information

- Lisa Elliot: [lisa.elliott@rit.edu](mailto:lisa.elliott@rit.edu)
- Pam Francis: [pggnpc@rit.edu](mailto:pggnpc@rit.edu)
- C-Print research website:
  - [http://www.ntid.rit.edu/research/cprint\\_home.php](http://www.ntid.rit.edu/research/cprint_home.php)

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