Using "Touch" in Touchscreens for Teaching STEM to Blind and Visually Impaired Students

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Assistant Professor, Mechanical Engineering
Saint Louis University
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NSF I-CORPS L #1505361
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$$n! \approx \left(\frac{n}{e}\right)^n \cdot \sqrt{2\pi n}$$

$$A_n^k = \frac{n!}{(n-k)!}$$

$$P_n = \frac{n!}{(n-n)!} = \frac{n!}{0!}$$

$$A_n^k = n \cdot (n-1) \cdot (n-2) \cdot \ldots \cdot (n-k+1)$$

$$\widetilde{A}_n^k = \underbrace{n \cdot n \cdot \ldots \cdot n}_{k} = n^k$$

$$\widetilde{P}_{n_1, n_2, \ldots, n_k} = \frac{(n_1 + n_2 + \ldots + n_k)!}{n_1! n_2! \ldots n_k!}$$

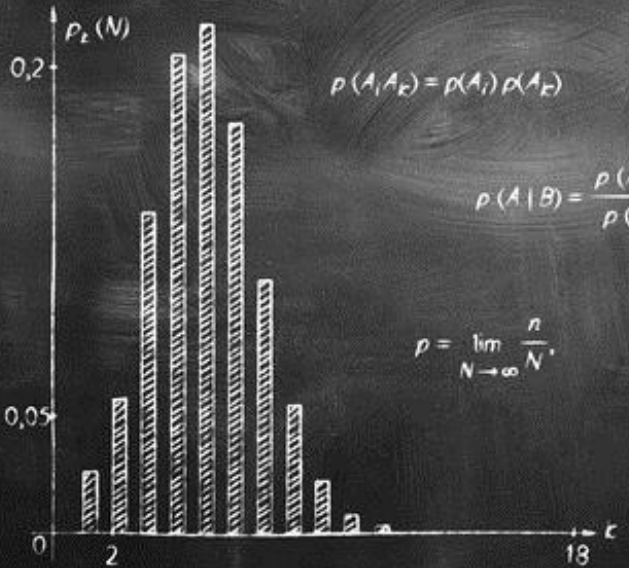
$$C_n^k = \frac{n!}{k!(n-k)!}$$

$$\widetilde{C}_n^m = P_{m, n-1} = \frac{(n+m-1)!}{m!(n-1)!}$$

$$(a+b)^n = C_n^0 a^n + C_n^1 a^{n-1} b^1 + \ldots + C_n^{n-1} a^1 b^{n-1} + C_n^n b^n = \sum_{k=0}^{n} C_n^k a^{n-k} b^k$$

$$p(B) = p(B \mid A_1) p(A_1) + p(B \mid A_2) p(A_2) + p(B \mid A_3) p(A_3) + \ldots + p(B \mid A_k) p(A_k)$$

$$p(x) = \frac{p(B \mid A_1) p(A_1)}{p(B \mid A_1) p(A_1) + p(B \mid A_2) p(A_2) + \ldots + p(B \mid A_k) p(A_k)}$$



$$p(A_i A_k) = p(A_i)\, p(A_k)$$

$$p(A \mid B) = \frac{p(AB)}{p(B)}$$

$$\sigma_n = \sqrt{\frac{\sum_{k=1}^{n} (x_k - \bar{x}_n)^2}{n}}$$

$$D_x = \sigma^2 = M_{x^2} - (M_x)^2$$

$$p = \lim_{N \to \infty} \frac{n}{N},$$

$$p_k(\lambda) = \frac{\lambda^k}{k!} e^{-\lambda}$$

$$C = \frac{\varepsilon \varepsilon_0 S}{d}$$

$$p(x_1 \le x \le x_2) = \int_{x_1}^{x_2} \varphi(x)\, dx$$

$$M_x = \sum_{i=1}^{k} p_i x_i$$

$$D_x = \sum_{i=1}^{k} p_i (x_i - M_x)^2$$

$$\varphi(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-a)^2}{2\sigma^2}}$$

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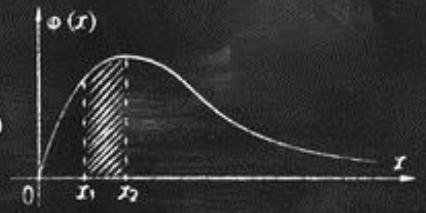
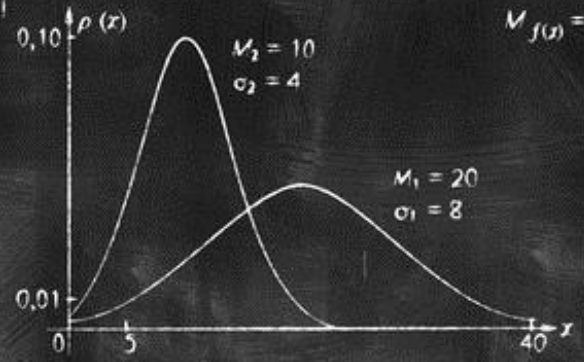
$$\varphi(v) = 4\sqrt{\frac{k^3}{\pi}}\, v^2 e^{-kv^2}$$



$$D_x = \int_{-\infty}^{+\infty} (x - M_x)^2 \varphi(x)\, dx$$

$$M_x = \int_{-\infty}^{+\infty} x \cdot \varphi(x)\, dx$$

$$M_{f(x)} = \int_{-\infty}^{+\infty} f(x) \varphi(x)\, dx$$



$$S = v_0 t + \frac{at^2}{2}$$

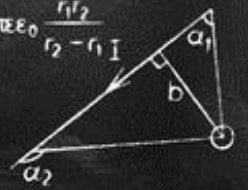
$$F = G\frac{m_1 m_2}{R^2}$$

$$f(v) = 4\pi \left(\frac{m_0}{2\pi kT}\right)^{3/2} v^2 e^{-\frac{m_0 v^2}{2kT}}$$

$$\varphi(\ln x)\, d(\ln x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(\ln x - a)^2}{2\sigma^2}} \quad d(\ln x) = \frac{1}{\sqrt{2\pi}\sigma x} e^{-\frac{(\ln x - a)^2}{2\sigma^2}}\, dx$$

$$\langle r \rangle = \frac{\langle v \rangle t}{n\sqrt{2\pi} d^2}$$

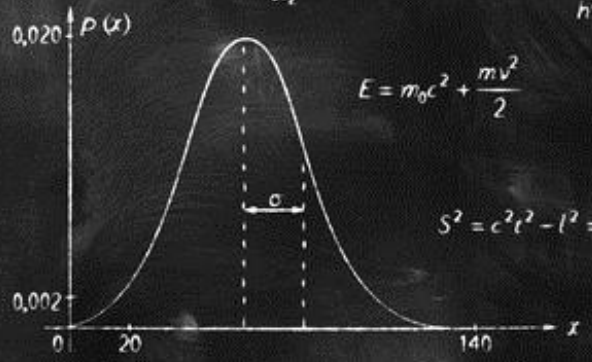
$$C = 4\pi\varepsilon\varepsilon_0 \frac{r_1 r_2}{r_2 - r_1}$$



$$B = \frac{\mu_0 I}{2\pi D}(\cos\alpha_1 - \cos$$

$$A^2 = A_1^2 + A_2^2 + 2A_1 A_2 \cos(\varphi$$

$$h\nu = A + \frac{mv^2}{2}$$



$$E = m_0 c^2 + \frac{mv^2}{2}$$

$$m = m_0 / \sqrt{1 - \frac{}{}}$$

$$S^2 = c^2 t^2 - l^2 = inv$$

$$r_n = \frac{4\pi\varepsilon_0 n^2 \hbar^2}{mZe^2}$$

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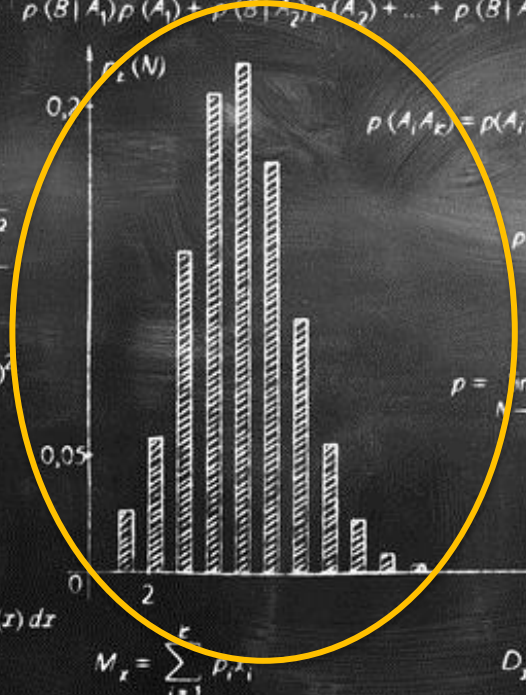

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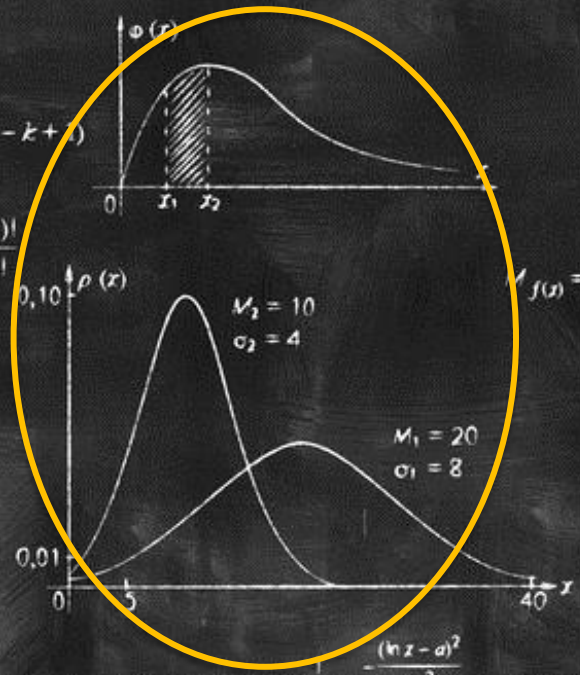

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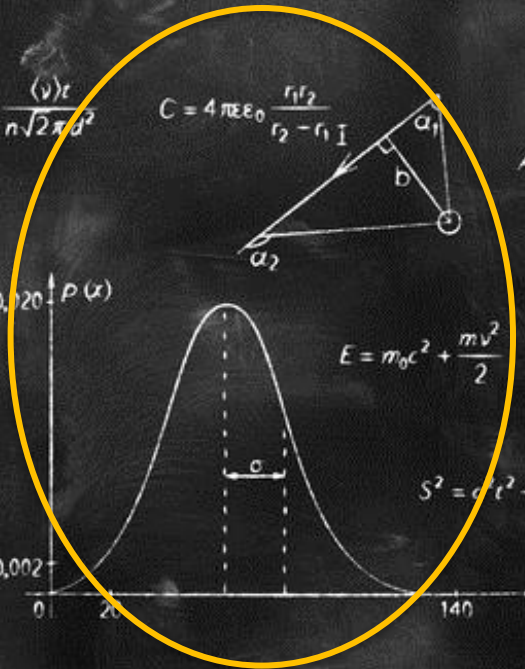

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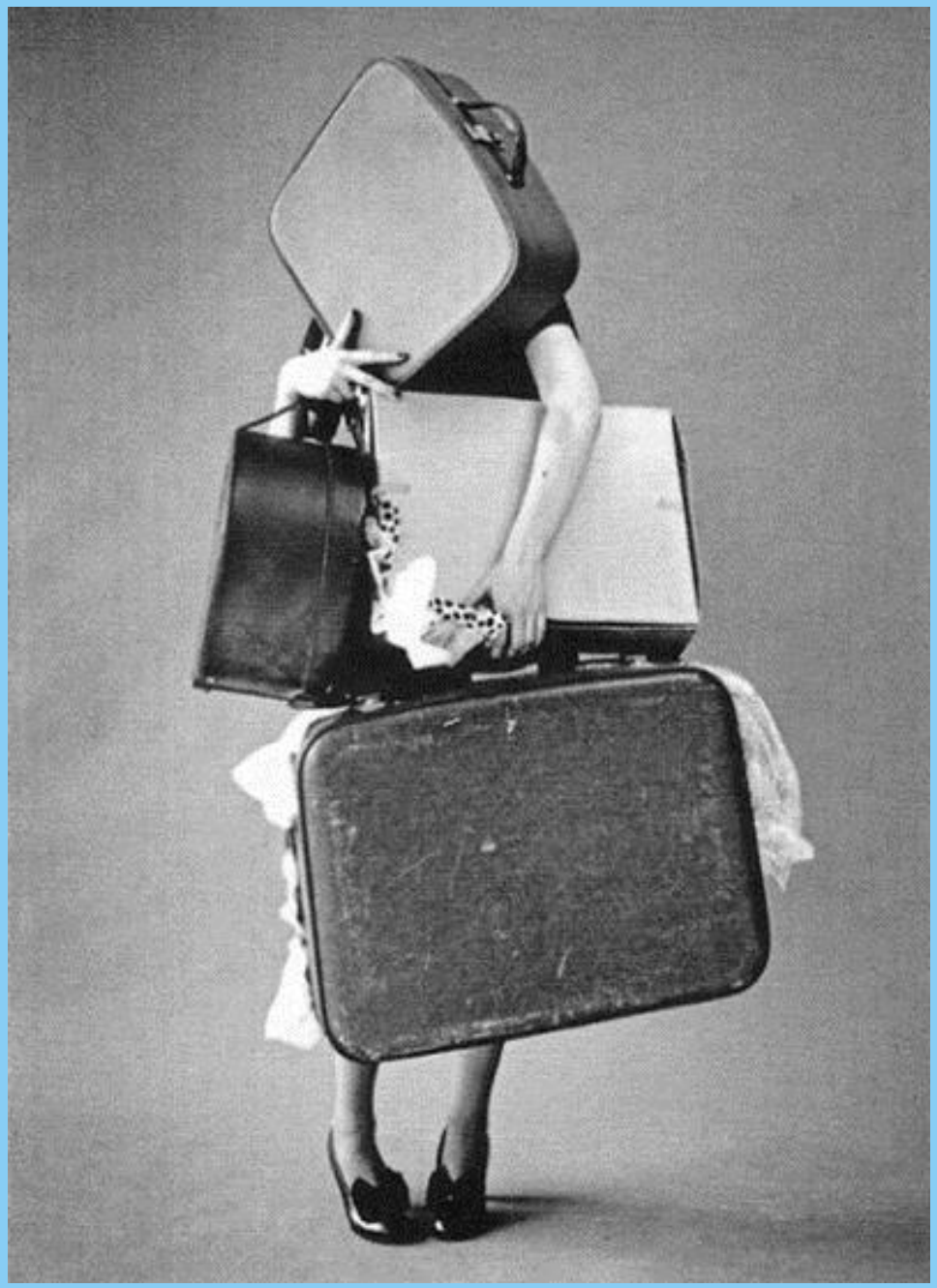
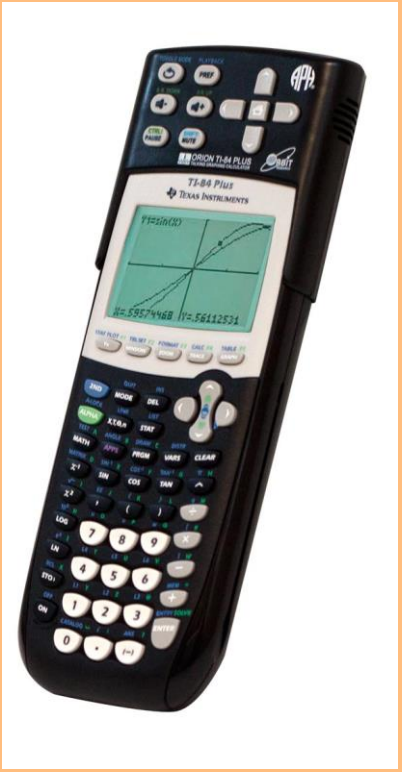
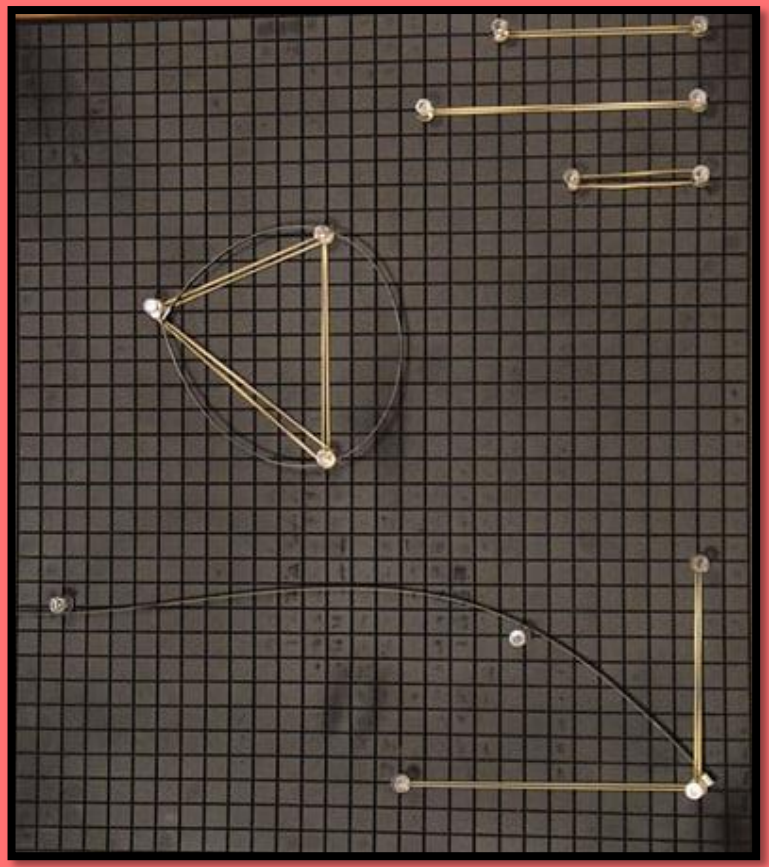
Accessibility Looks Like…

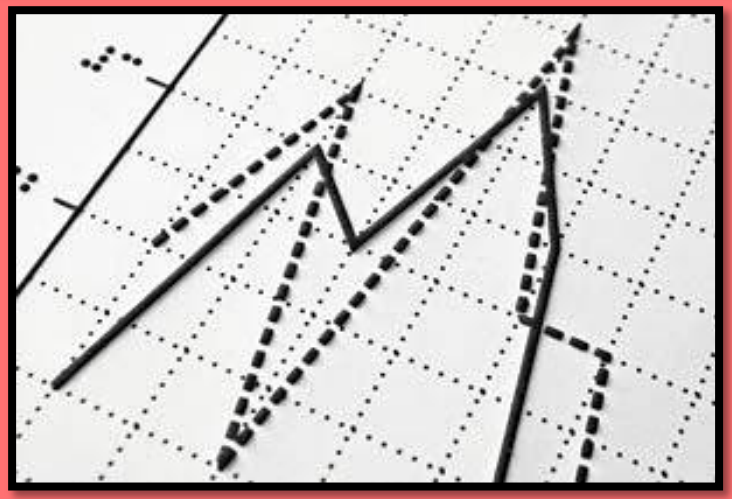


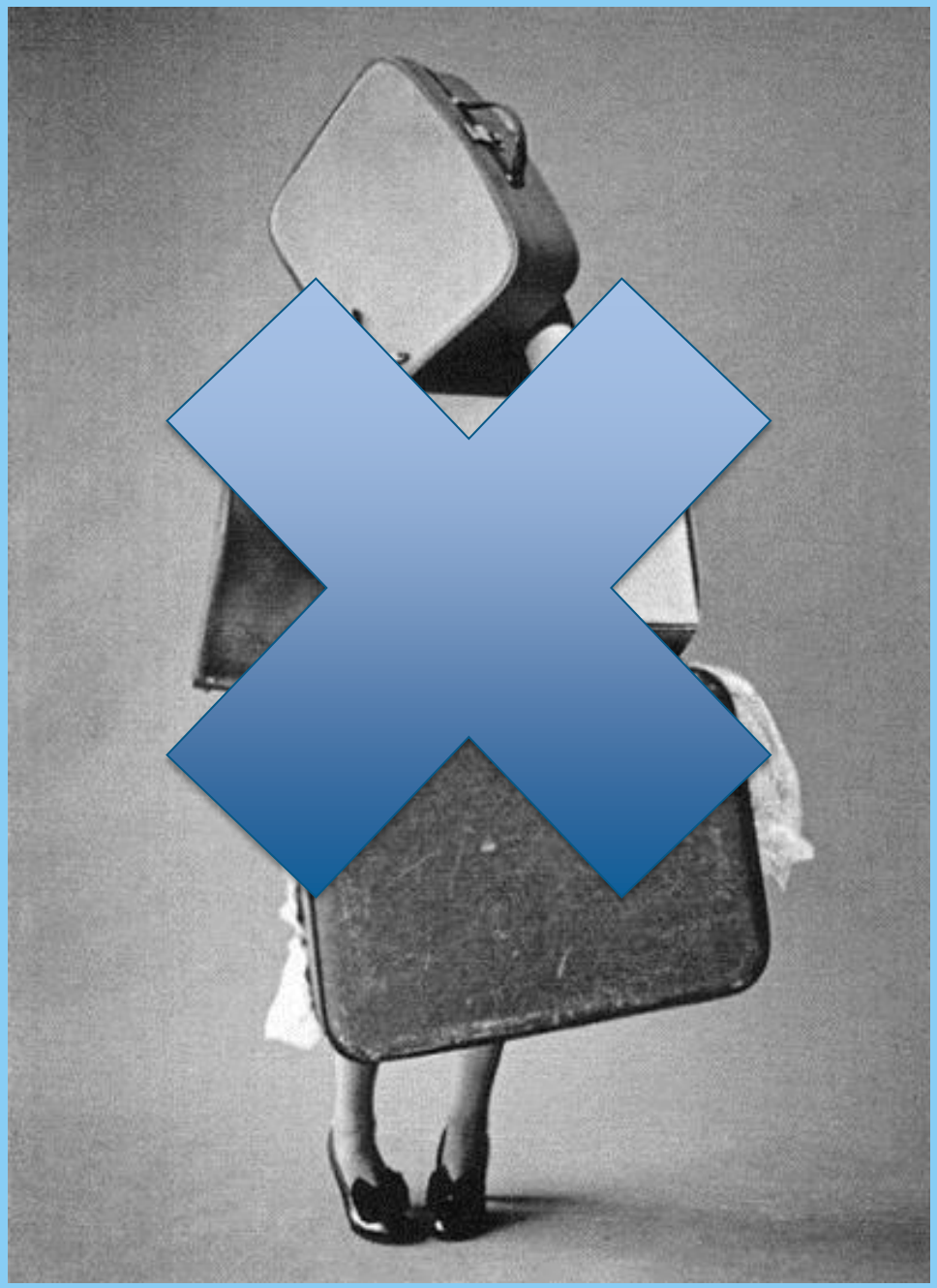


MathHear for Windows




Zyfuse



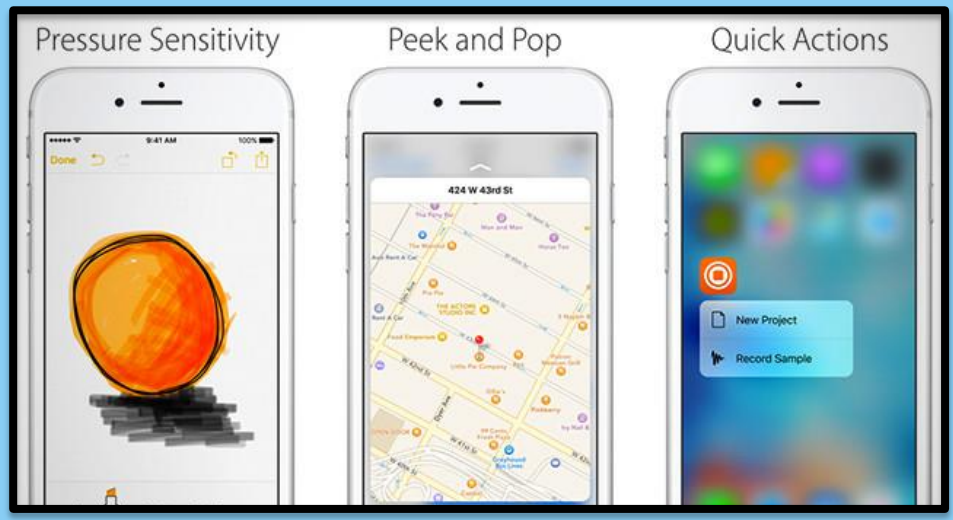


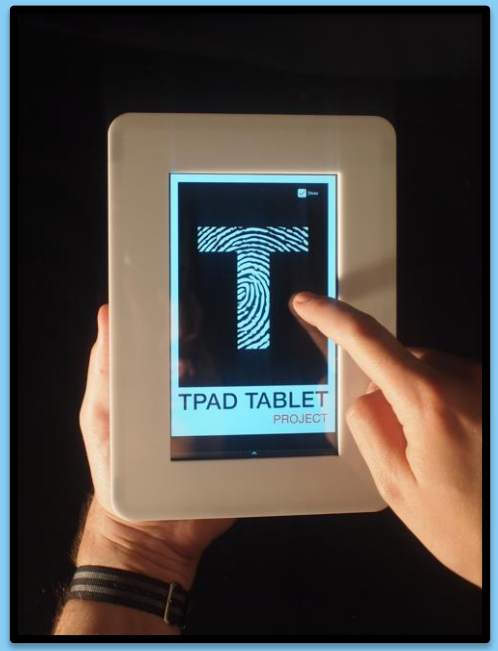

SAMSUNG
05:14

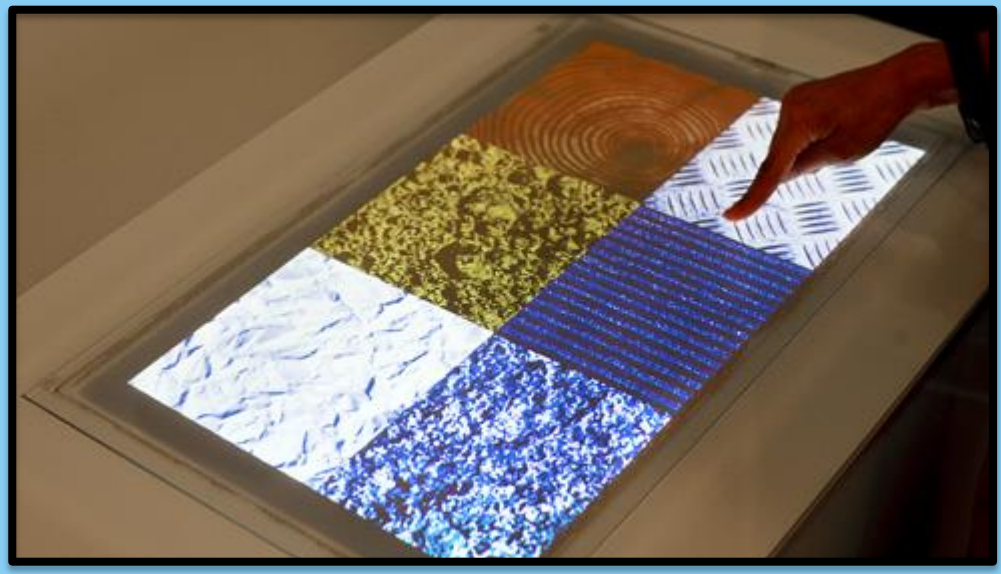
But touchscreens are highly visual!

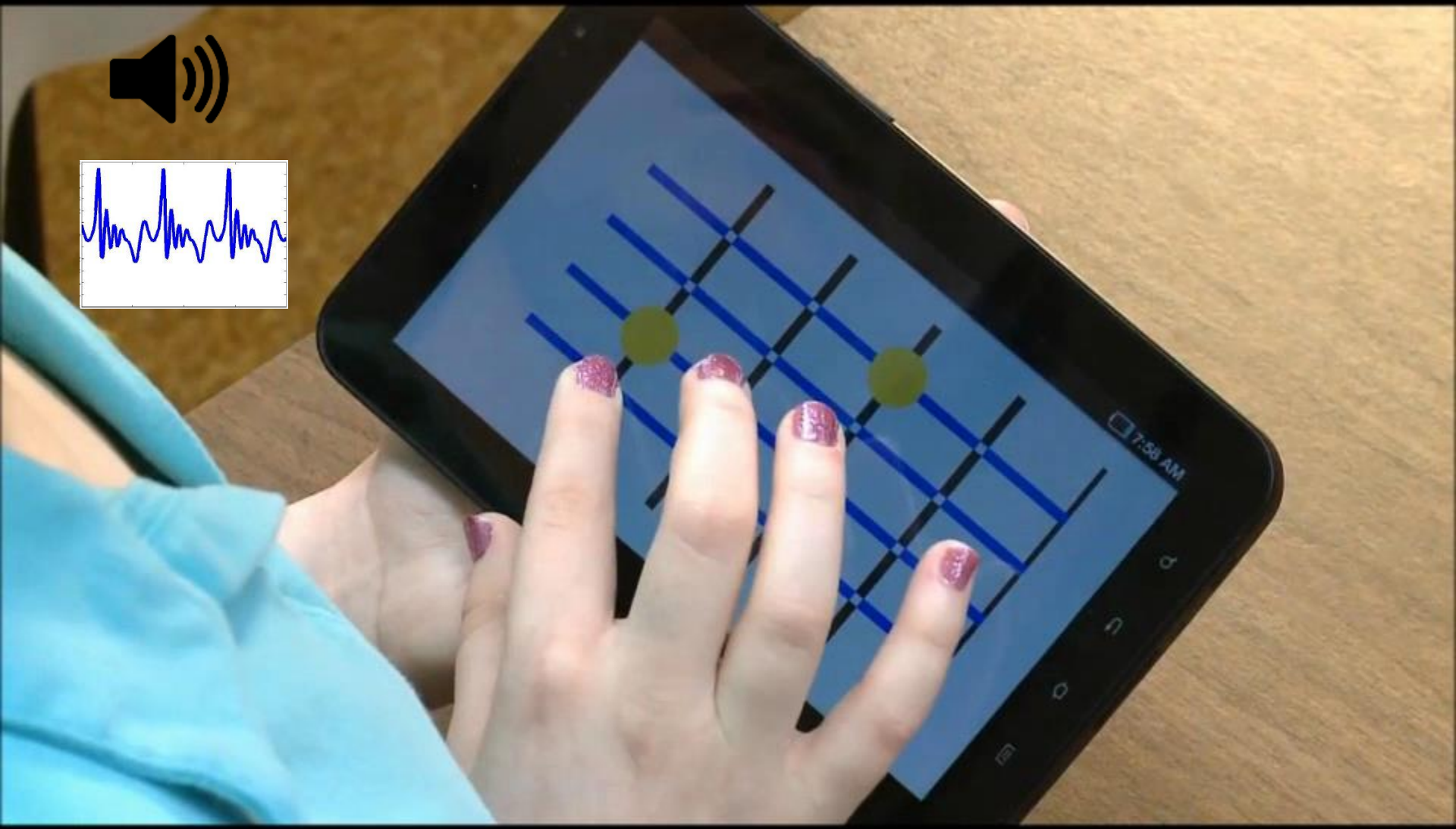
Not Anymore…

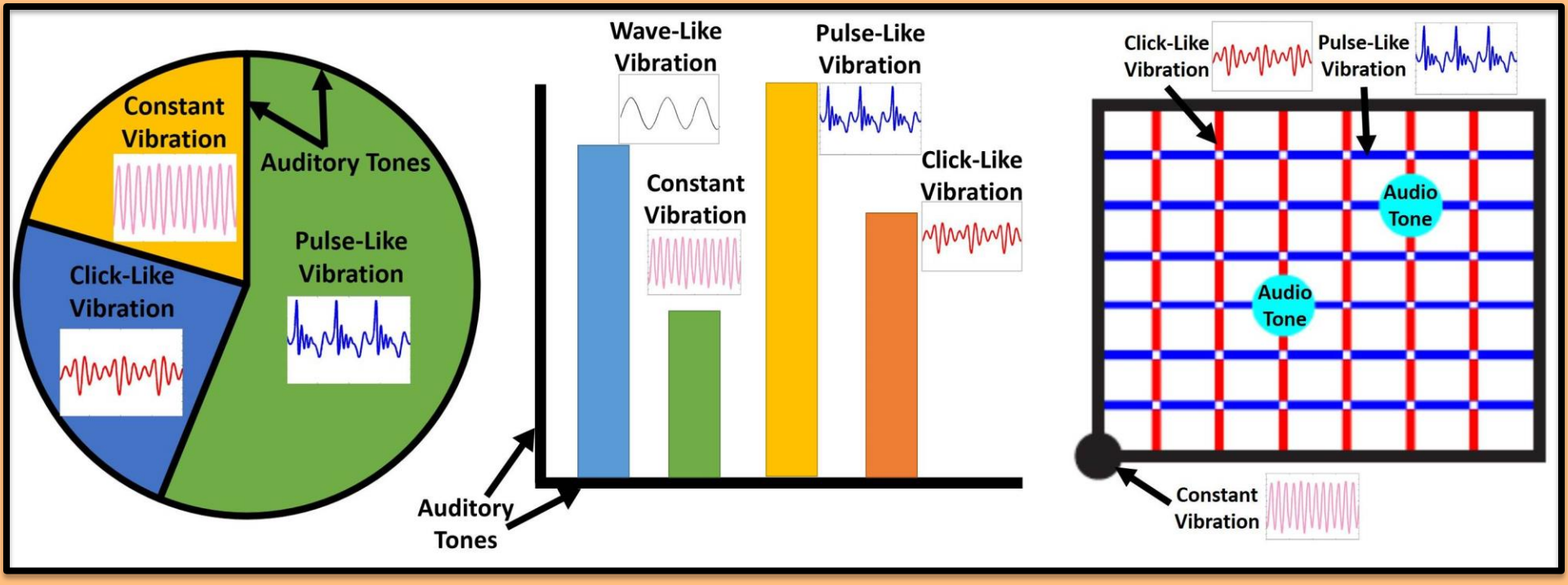

Verizon
10:43 AM
92%
Cancel
New Vibration
Save


Pressure Sensitivity
Peek and Pop
Quick Actions
Done
424 W 43rd St
New Project
Record Sample

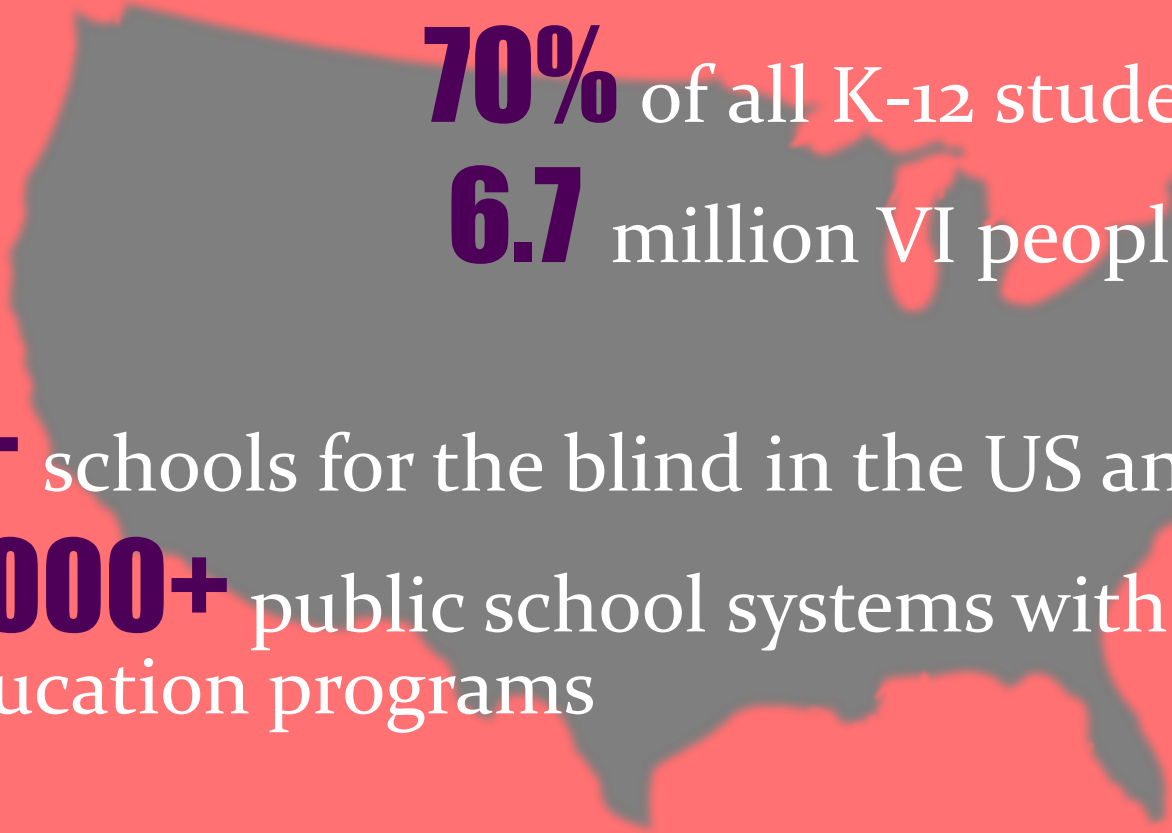

TPAD TABLET
PROJECT




7:58 AM


Constant Vibration
Auditory Tones
Pulse-Like Vibration
Click-Like Vibration
Wave-Like Vibration
Pulse-Like Vibration
Constant Vibration
Click-Like Vibration
Auditory Tones
Click-Like Vibration
Pulse-Like Vibration
Audio Tone
Audio Tone
Constant Vibration


9:15 AM
SciApp
SCIENCE ROOM 04
BRIDGE THE GAP
Mr. Rubio
Question of the Day
Calendar
Class Resources
Announcements
Class Dates



656,000 school-aged visually impaired individuals

70% of all K-12 students (49 M)

6.7 million VI people in the US

50+ schools for the blind in the US and

98,000+ public school systems with special education programs

The Challenge is Real and the time is now!

The stage is set for…

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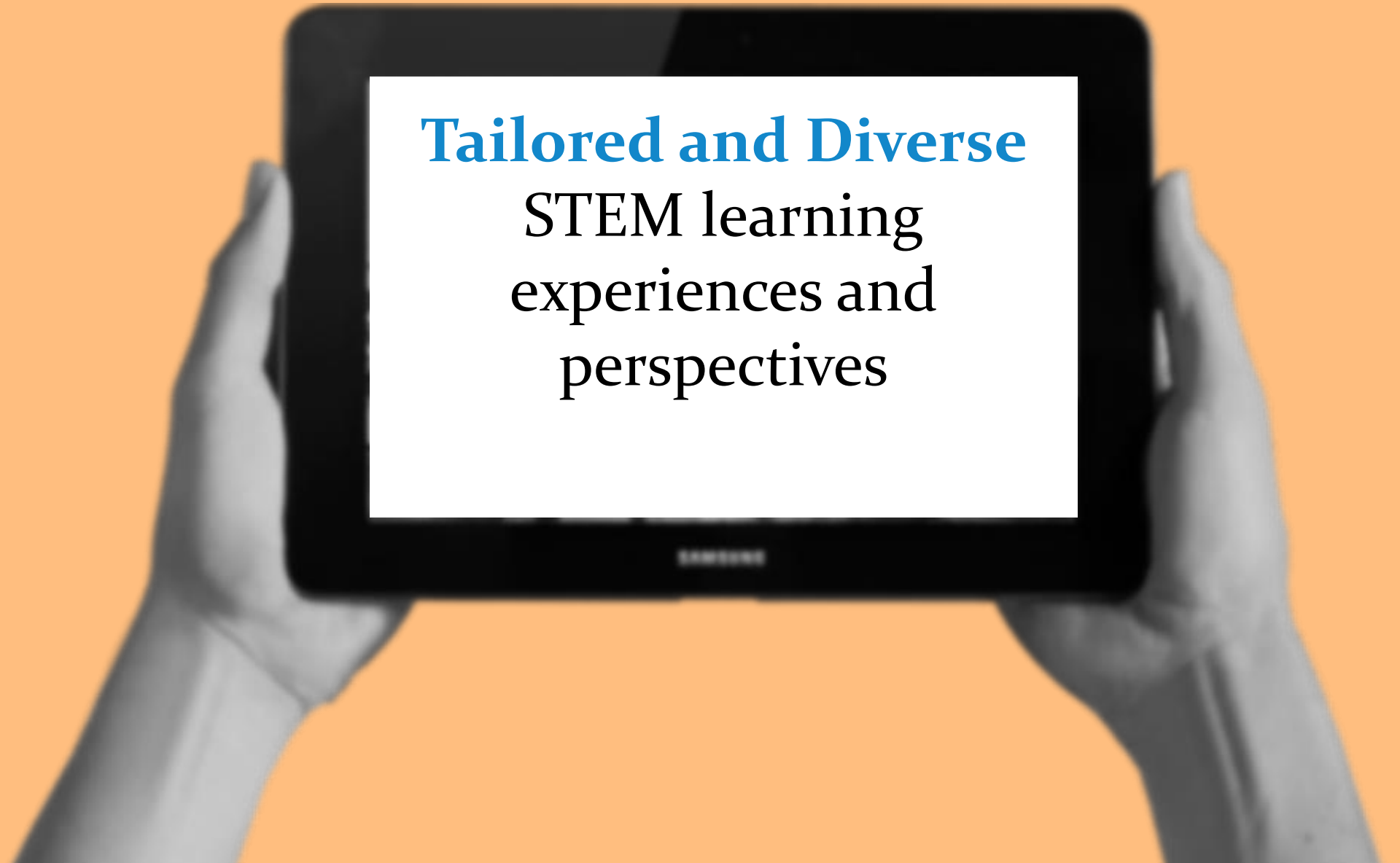

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