Creative Learning in Calculus

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Computer can help us learning

• It make abstract mathematics concept much more easier to be understood by plotting the function and zooming it in or out on computer.

• Encourage student to learn new computer technique, new software.
Example:

• Definition of limit – the first concept in Calculus.
• Difficult to describe in math.

\[
\lim_{{x \to 2}} x^2 = 4
\]
Zooming

Plot[f[x], {x, 1.75, 2.25}, PlotStyle -> RGBColor[1, 0, 0], PlotRange -> {-8, 8}]
Zooming Again

`Plot[f[x], {x, 1.95, 2.05}, PlotStyle -> RGBColor[1, 0, 0], PlotRange -> {-8, 8}]`
Example 2: \( \lim_{x \to 0} \sin \left( \frac{\pi}{x} \right) \)

It is difficult to imagine the result.

h[x_] = Sin[Pi/x]
Plot[h[x], {x, -1, 1}, PlotRange -> {-2, 2}]
Zooming in

\[\text{Plot}[h[x], \{x, -0.1, 0.1\}, \text{PlotRange} \to \{-2, 2\}]\]

\[\text{Plot}[h[x], \{x, -0.001, 0.001\}, \text{PlotRange} \to \{-2, 2\}]\]
Compare functions

$\sin x$ and $x$ when $x$ close to 0.
Computer does not always good

$$\lim_{x \to 0} \frac{\sqrt{x^2 + 9} - 3}{x^2} = \frac{1}{6}$$
Zooming in

Confuse!
Zooming in again

Plot[y, {x, -0.000001, 0.000001}, PlotRange -> {-0.001, 0.5}]

Even confuse!!
Zooming out

Very different!!! Why?
Zooming in again

• It is crazy! What happened???
Mathematics theory VS computer

• We can not trust computer all the time?
• We can not trust what we saw all the time.
• We need to study mathematics theory.
• We need to consider problems logically.
• More and more......
Thank you.