A Low-Cost Transmission line experimental setup – A practical implementation for Active Student, understanding and experimentation.

Progress Update

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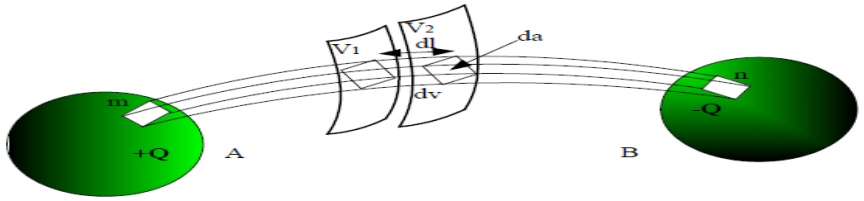
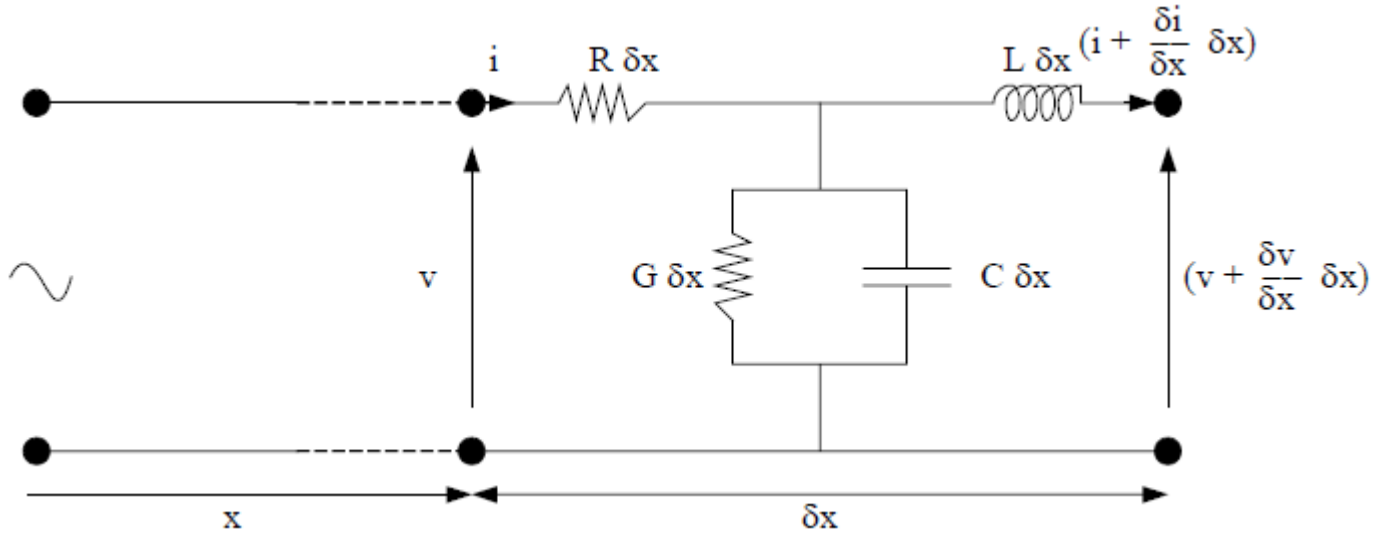
Background of the Electromagnetics module performance.

- Electromagnetic courses are typica¨



  - Derivation Driven,
  - Equation heavy, $E_x = E_m Cos(\omega t - \beta z) - E_m Cos(\omega t + \beta z)$
  - Frequently disliked by students,
  - Typically be at the lower end of the grade averages.
  - Little in the way of good experimentation.

Transmission Lines Theory [TEM]

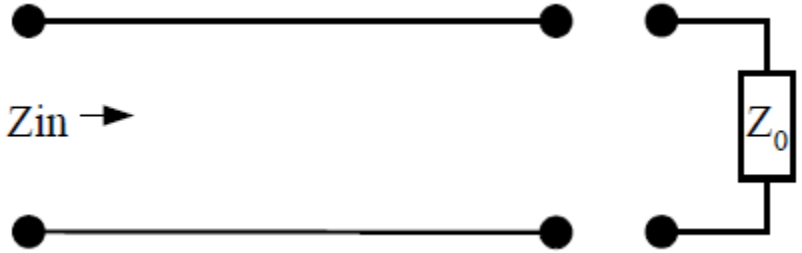


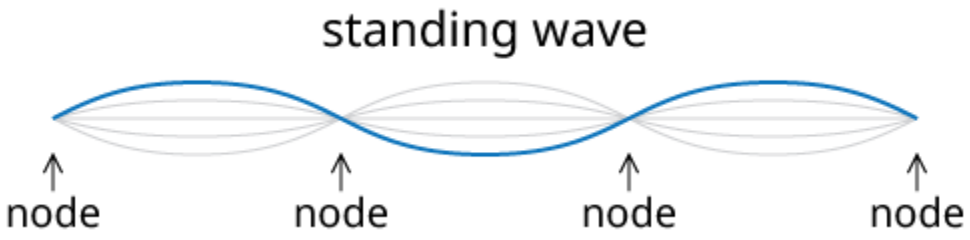
$$v - \left(v + \frac{\delta v}{\delta x}\delta x\right) = \left(R + L\frac{\delta}{\delta t}\right) i\delta x$$

$$V_x = V_s cosh\gamma x - I_s Z_0 sinh\gamma x$$

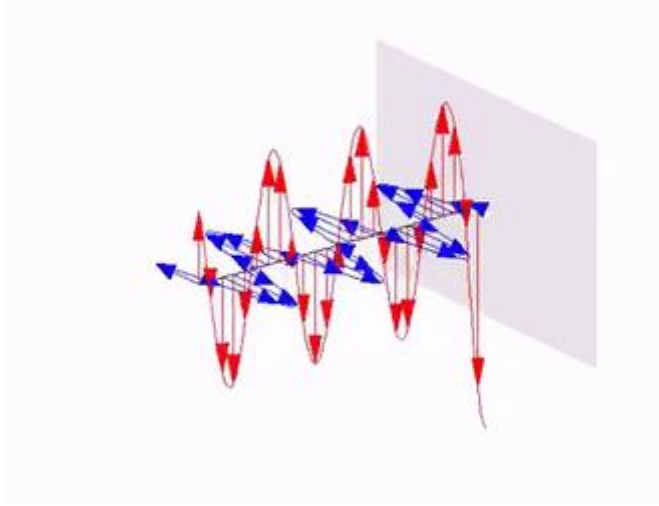
$$\alpha = \sqrt{\frac{1}{2}\sqrt{(RG + \omega^2 LC)^2 + \omega^2(RC - LG)^2} + \frac{1}{2}(RG - \omega^2 LC)}$$

What do we want do with TEM?

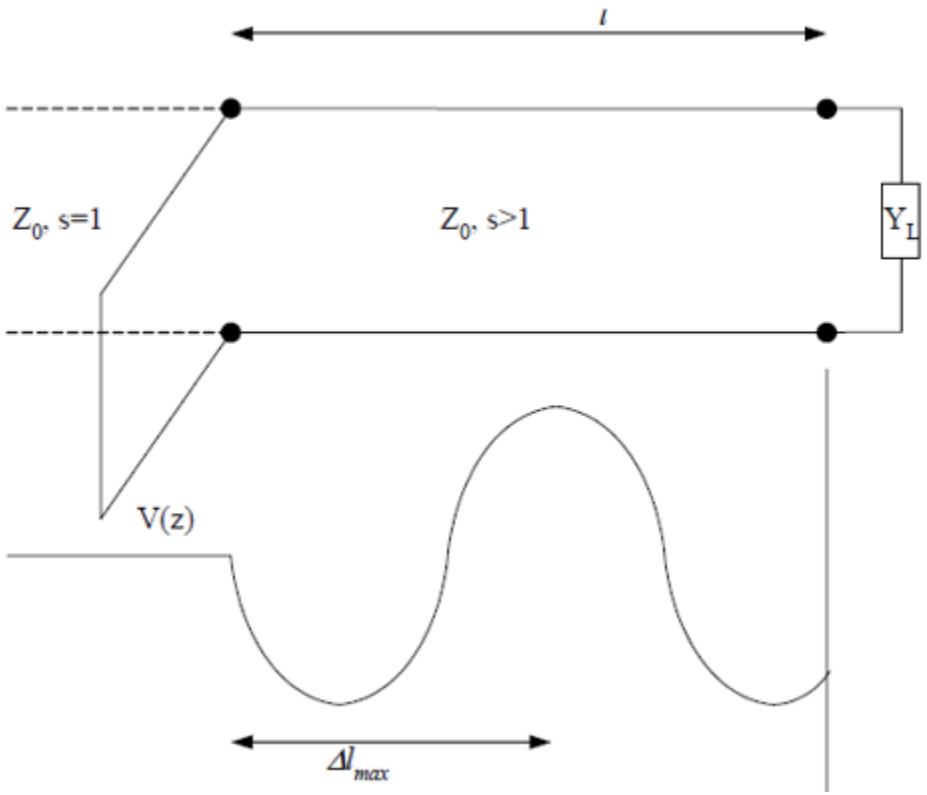


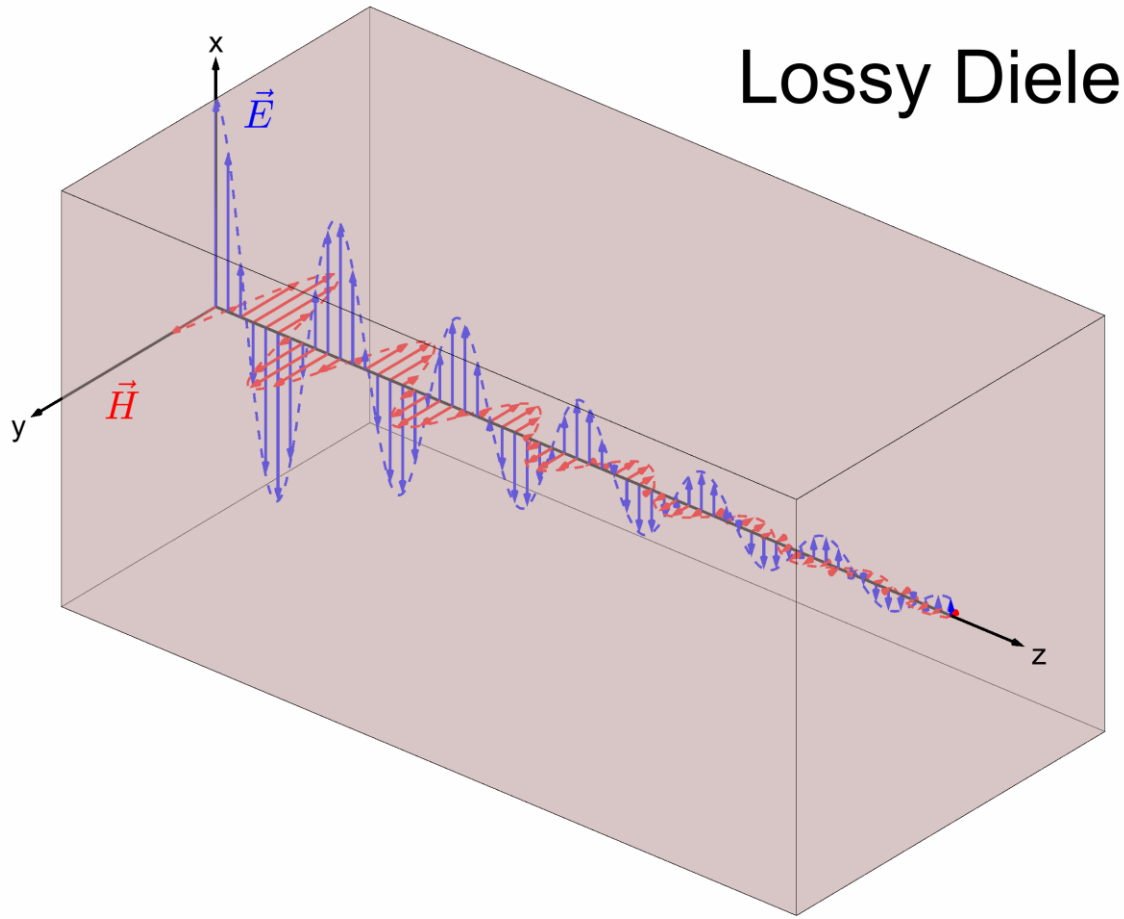


For a signal this perfect! All it ‘see’s’ is a line.
Thus infinite propagation without signal Loss.



What typically happens



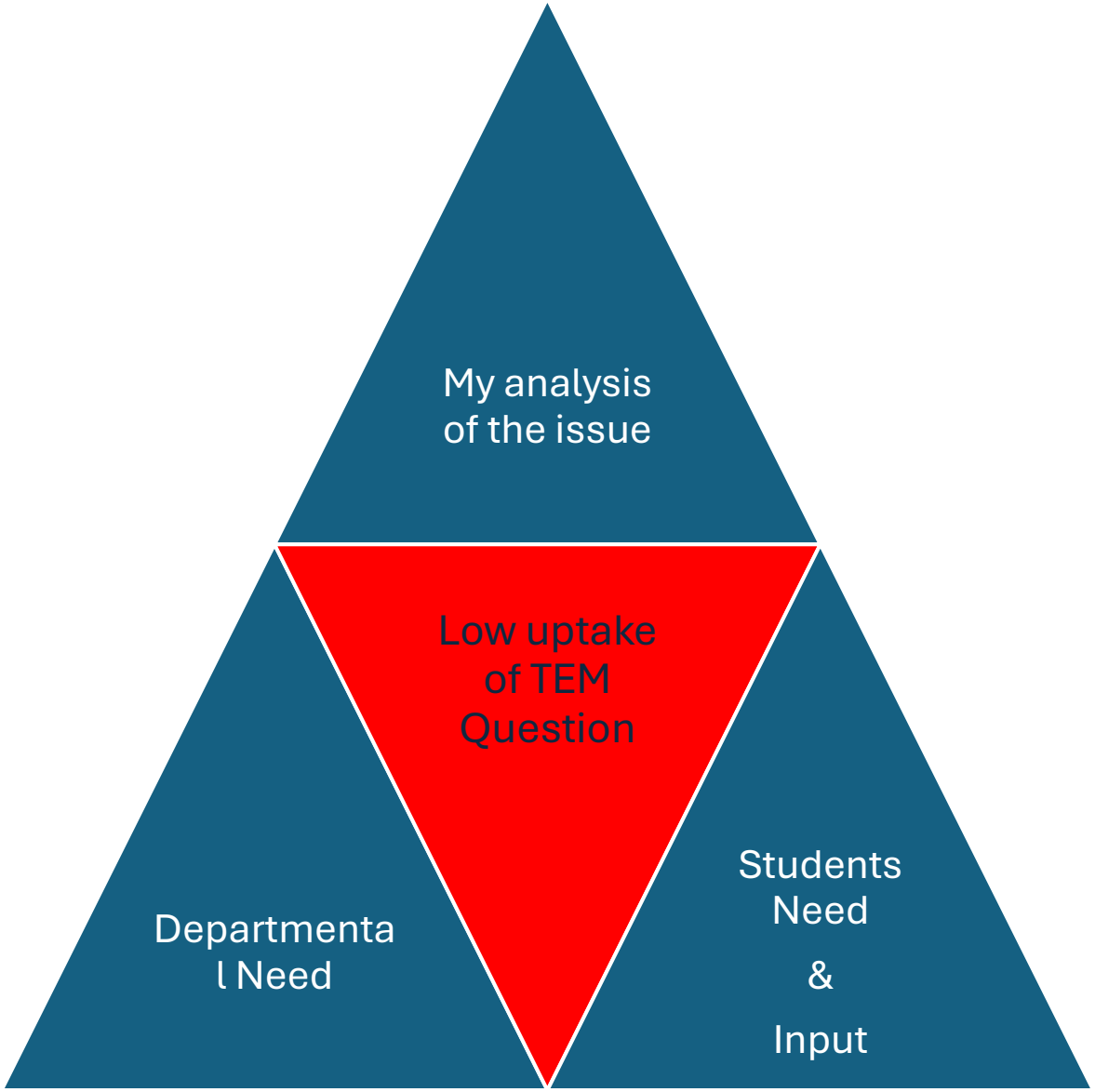


Lossy Dielect

Long process to calculate what is needed to fix these.

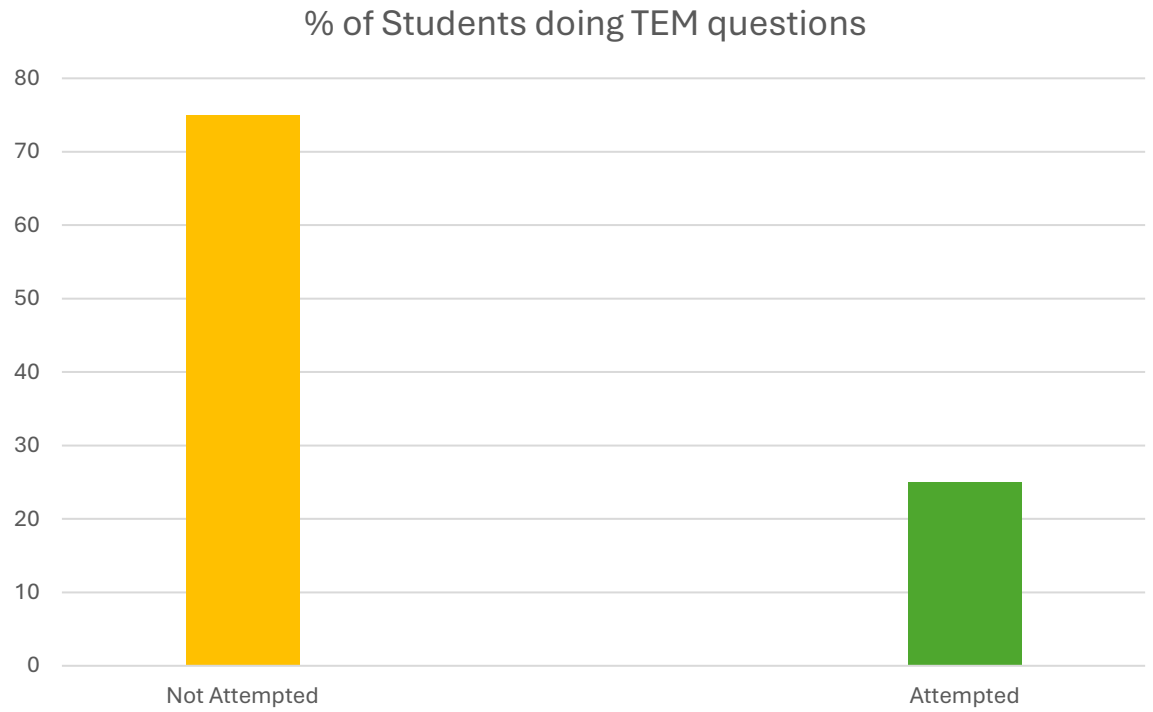
Project Journey thus far

- The problem that I thought I had to solve
- The problem that syllabus changes dictated
- The problem that the students wanted solving!
- Where the project is at now

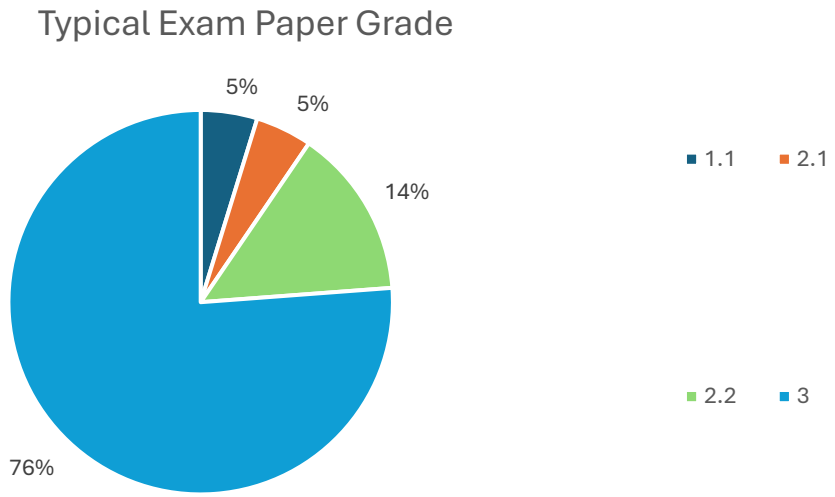

My analysis of the issue
Low uptake of TEM Question
Departmenta l Need
Students Need & Input

Low uptake of TEM Question

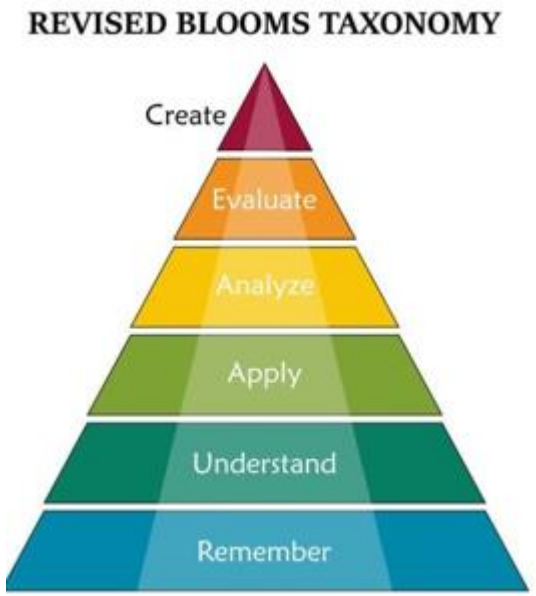
My analysis of the issue



TEM in multiple Section
Can't be avoided!

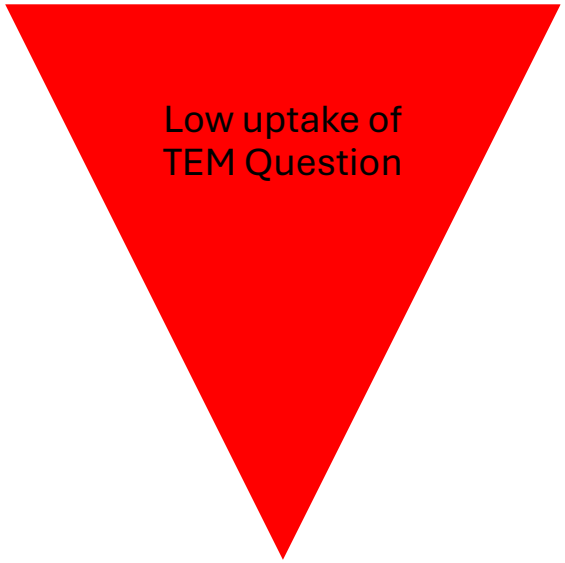


What does this mean for the students re TEM?



We want them in the Apply Level , or above

Down at the Remembering level



No additional budget for RF equipment

Already a large amount of simulation work

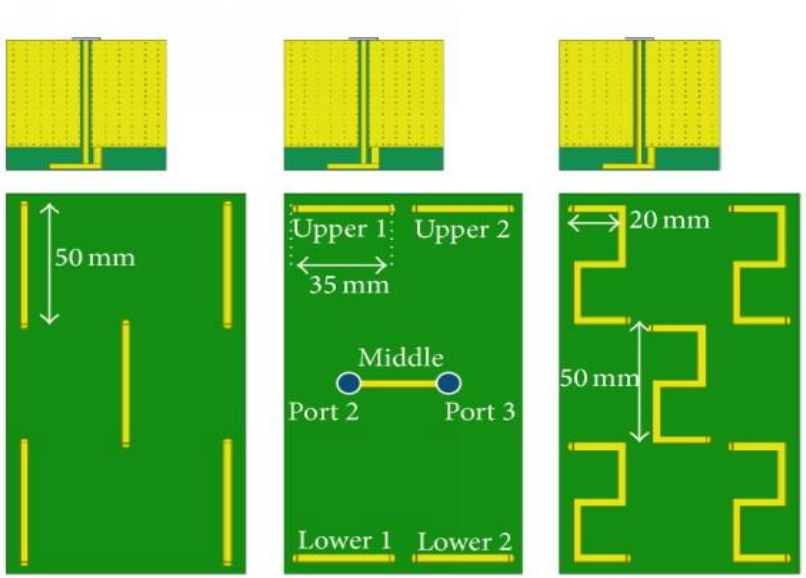
Need for low cost multi experimental projects

More TEM needed for RF and Advanced RF Systems Modules

Low uptake of TEM Question

Students Need & Input

First experiments



Etched microstrips

Allowed for matched and

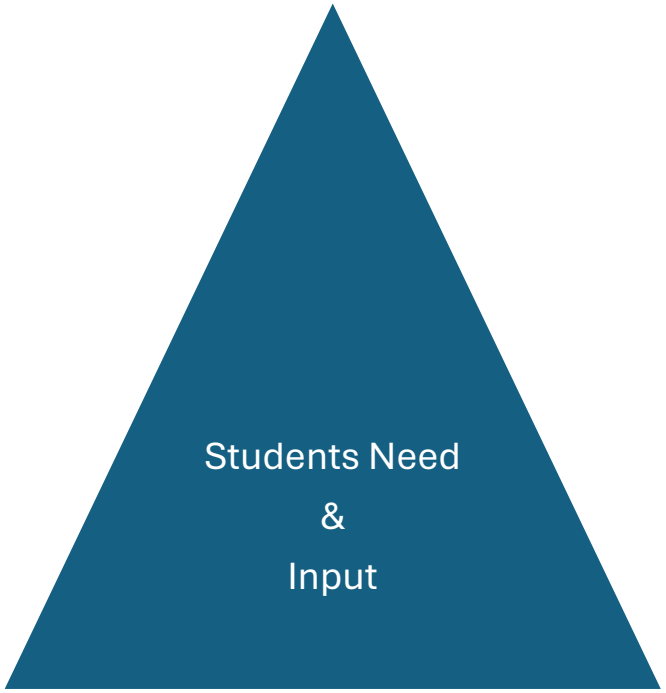
Unmatched lines

Sustainable as

Used scrap copper board

&

Student milling project



Focus Group Post Experiments
4th and 5th year EE and ME students

Nice to do ☺

Complemented the theory ☺

But wouldn't encourage students to do the question ☹

Couldn't get more detail on why this was the case

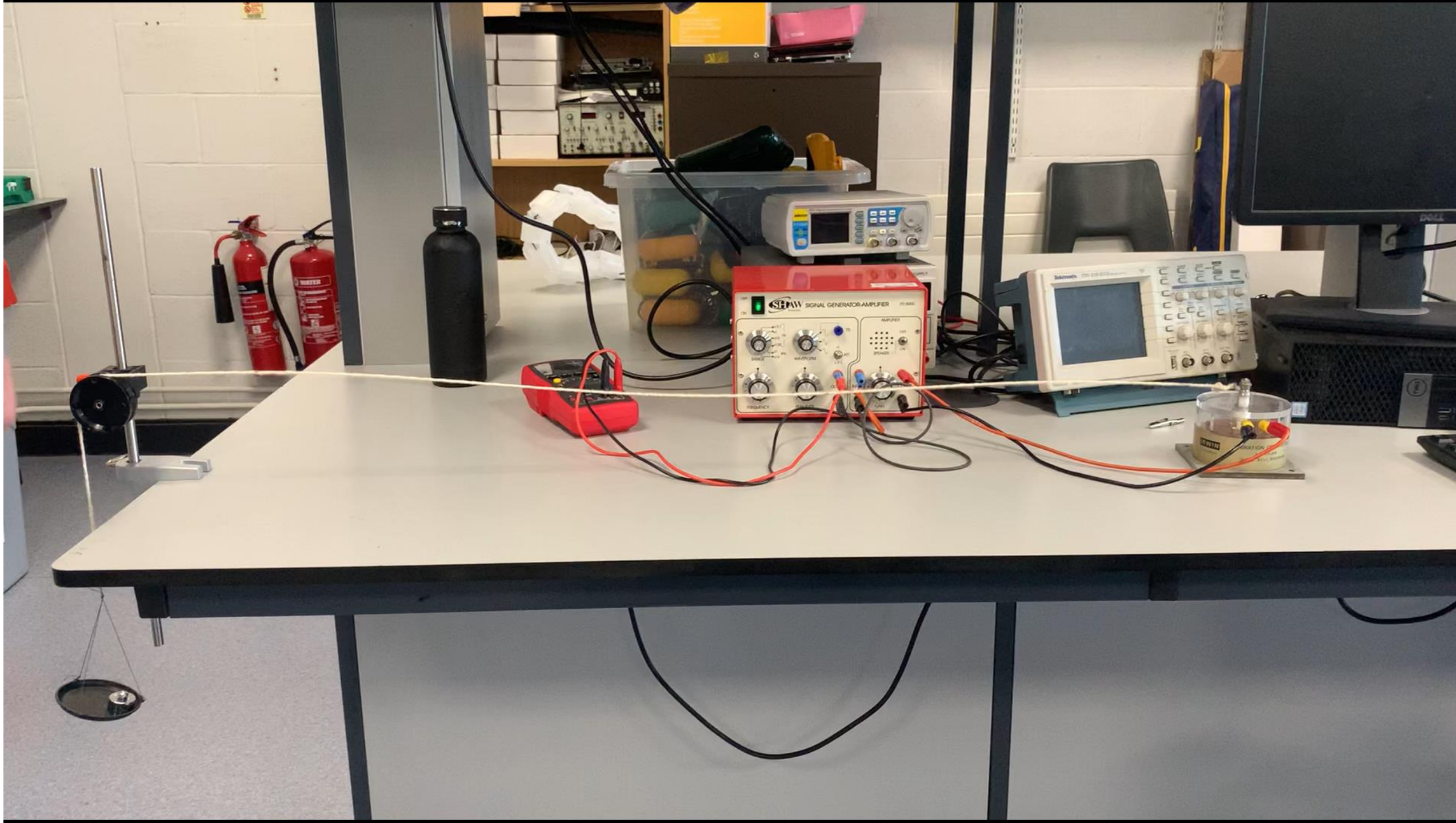
Students Need
&
Input

Needed more in-depth answers!

Unleased the

Why?

- Now needed a
  - Big visual & physical setup
  - Something could show a Standing Wave
  - A disturbed wave
  - A return to Standing Wave configuration
  - Lets raid the Physics labs!


SIGNAL GENERATOR-AMPLIFIER

Learnings so far

1. General or open questions did not give me good responses
2. Students can be very reluctant to give deep feedback
3. There is a mismatch in students understanding why TEM is important
4. My frame of reference, compared to the students are massively different ie past experiments done in 2nd'ary school, previous courses, even the toys that I played with!

Next Steps

- Bring in a Standing Wave demo / short practical lab
- Build a bigger suite of microstrip devices for more testing
- Build in a set of practical lab experiments & exploration for EM

Final Slide Thank you for your Attention

- A massive Thank you to T&L for the chance to do some Teaching research
- To my 4th and 5th year students who gave up their time to help
- To the EE department for their input