

Difficulties in teaching fluid mechanics (ME 363) using the necessary mathematics

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Following are some examples of “horrors” I have seen over the years while teaching ME 363. They can serve only to convey a sense of the main and most serious deficiencies.

1. No idea of how to write the equation of a **straight line** going through two assigned points.
2. No idea how to differentiate $f(x)g(x)$.
3. No idea of what a **power series expansion** is, what its usefulness and limitations are.
4. Very often, write an equation with a **finite quantity** on one side and a **differential** on the other.
5. No idea of difference between **linear and non-linear** equations or differential equations. No idea that linear is easier than non-linear.
6. No idea of what the **order** of a differential equation is.
7. When solving an integral, no idea that the **differential** represents an element of the integration domain small enough that the integrand can be considered constant over it.
8. No idea how to integrate $\int \sqrt{h-z} dz$ with $h = \text{const}$.
9. No idea how to calculate dw if $w = \sqrt{h-z}$ with $h = \text{const}$.
10. No idea how to integrate $\int \frac{a}{R_0^3} r dr$ with $a, R_0 = \text{const}$.
11. No idea how to separate $dh/dt + f(h) = 0$.
12. No idea how to differentiate dh^2/dt with $h = h(t)$.
13. Never know how to set up a 2-D integral.
14. Major confusion among **scalars, components, vectors and unit vectors**. Vector signs showered unevenly and nonchalantly on either side of an equation with no understanding whatsoever of what they mean.
15. No idea of what a **gradient** is.
16. No idea about a **cylindrical coordinate system**, its unit vectors and the relationship between that and a cartesian system.
17. No idea how to write a **unit vector** in a given direction in any coordinate system.
18. Severe difficulties in solving problems in symbolic form, using letters (L, \mathbf{V}, p, ρ) to indicate physical quantities.