

## Note on Critical Thinking

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One might visit any leading university campus in the United States and ask the graduate faculty training future researchers one question, “what is the purpose of educating students?” One of the most frequent answers is to create critical thinkers. An obvious follow-up question is, “how do you create critical thinkers?” More opinions are presented than there are graduate faculty on campus.

We live in a marvelous time where the majority of knowledge is accessible within a minute. Using a pocket computer (cell phone), we can query any question and have the answer almost immediately. We are able to create artwork, essays, poetry, and simple mathematical proofs with emergent machine learning technology.

Often today, when students are faced with problems in the university classroom such as design, mathematics, religious studies, fluid dynamics, economics, art, English, or even creating a poem, most students immediately reach for their pocket computer.

But what does the growing mind do when faced with an ill-posed problem or a well-posed one without a solution? In my experience teaching students, there is often a range of human reactions that have included confusion, frustration, anger, fear, humiliation, and others. These are emotions to be celebrated because they represent a reaction from the student of being pushed outside their boundaries and intellectual comfort zone.

Here, students are no longer in the K-12 or early university environment, which lay out lesson plans in carefully constructed curriculums where problems and answers are well-defined. Educated wise minds should

be fortunate to be in the position of not knowing or understanding something, as it represents an opportunity to define and solve a problem that challenges us as a people.

If our goal is to create a society where ideas are openly discussed, debated, and used for the benefit of our people, then training critical thinkers is essential. We cannot have a ‘mob’ mentality where ideas are repeated without being criticized.

The computer and Internet are miracles of our age. These technologies have advanced the world civilization beyond all recent predictions and comprehension. However, we have come to be addicted to these tools as a people. They have created an intellectual handicap and have limited our creativity and critical thinking. It is no wonder that in recent years scores nationwide in mathematics have dropped significantly ([New York Times, Oct. 24, 2022](#)) as students are using online groups and past homework solutions to ‘ace’ their courses.

I continually ask students in my classes to perform analyses on their own. They must close their laptop, turn off their phone, and work on their own to define the problem and attempt a solution. I ask that they write down the laws of motion and examine the variation of a physical phenomenon.

Often, a student will use every technique and manipulative emotion to not use their own mind. Instead of presenting their own ideas and analysis, they return to an unfortunate habit of seeking answers online that do not exist.

This is the core beginning of training critical thinkers—to overcome their fear of being wrong, to present their ideas with welcome criticism, and to challenge the status quo. The idea of critical thought is completely foreign to students, as no one has demanded they think critically.

Technology should allow us to enhance critical thinking, but not replace it. We must teach students to use technology in conjunction with their most useful resource, which is their own mind. The solution is simple—first, use our minds to think critically and independently without technology, and use technology for what it is—a tool. ♦

## Surfing Baby Ducks

By Ed Prior, Board Member-at-Large

There have been many Nobel prizes awarded in various fields of science since the first award in 1901, but none has ever been awarded for engineering achievements, and none for research in the fluid dynamics associated with air or water flows that we studied at NASA Langley. However the so-called “Ig Nobel” awards—though conceived as a humorous recognition of somewhat odd achievements—has been awarded to over 13 fluid dynamics research papers over the years.

One was recently mentioned in my favorite weekly science magazine ([New Scientist, 24 September 2022, p. 56](#)). The 2022 Ig Nobel was awarded jointly to biologist Frank Fish and hydrodynamicist Zhiming Yuan and his colleagues for their discovery of how baby mallard ducks are able to keep up with their stronger, faster Mother as she paddles across a pond. Fish was the first to notice this oddity and actually used an artificial Mother duck in a flow tank and studied the dynamics in the wake of the fake Mother, concluding that the swirling vortices behind her were somehow employed by the ducklings to keep up.

25 years later, Zhiming Yuan developed CFD models of the Mother and ducklings swimming together and realized that the little ones were “wave riding” behind Mom—basically surfing—to stay right behind her. I personally think this discovery deserved the real Nobel, but oh well. ♦