

# INTRODUCTION TO RESEARCH

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# CONTENTS

- Meaning of research and scholarship
- Scientific method
- Research skills - thinking, communication, experimentation, management

# **RESEARCH AND SCHOLARSHIP**

# Degrees

- Bachelors: General education
- Masters: Possession of advanced knowledge
- Doctorate: License to teach and guide others

# *Research*

“Go back and search until we find – explore”

*Do not follow where the path may lead.*

*Go instead where there is no path.*

*Ralph Emerson*

“An objective and systematic effort to gain new knowledge”

- A UG student's learning is managed by his teachers. A research scholar, on the other hand, is the manager of his own learning; hence he must be an **independent thinker**.
- Research education, blurs the distinction between a student and his mentor.
- Unlike in an examination, in research, you do not get well-defined problems to solve. It is your job to define the problem as well as to solve it.

An example of a flawed perception about the role of a scholar and his guide.

Research entails prolonged and arduous labour  
and needs

- doubt rather than ready acceptance
- extensive reading: a researcher must be much broader than his special line.
- persistence, i.e. management of boredom and frustration
- good relations with your guide and fellow scholars

# Why research ?

- All progress is born of inquiry. Doubt is often better than overconfidence, for it leads to inquiry, and inquiry leads to invention.

*If a man will begin with certainties, he shall end in doubts.*

*But if he will be content to begin with doubts, he will end in certainties.*

*Francis Bacon*

- Research promotes the habits of logical thinking and organization.

# Why research ?

- swagruhe pUjyate mUrkhah, swagrAme pUjyate prabhuh swadeshe pUjyate rAjA, vidvAn sarvatra pUjyate.
- Service to society.
- Enhance carrier opportunities and earning.
- Not having any real aims and not knowing what to do.

Aims do not remain the same throughout the PhD duration.

# Who is a scholar ?

A greedy person can be won over by money

A proud person by cowering before him

A fool by agreeing with him, but

**A scholar** can only be won over by speaking the truth.

- *Chanakya*

## Who is a scholar ?

“We should not forget that the solution of any worthwhile problem very rarely comes to us easily and without hard work. It is rather the result of intellectual effort of days or weeks or months. Why should the young mind be willing to make this supreme effort ? The explanation is probably the instinctive preference for certain values, that is, the attitude which rates intellectual effort and spiritual achievement higher than material advantage.

- ***Gabor Szego***

# SCIENTIFIC METHOD

## Non-scientific thinking

- Authority
- Pure logic
- Intuition: spontaneous judgment not based on conscious reasoning.

common sense: practical intelligence shared by a large group of people

These are “practical” rather than theoretical.

Scientific results can be counterintuitive

# SCIENTIFIC METHOD

- Hypothesis
- Experiment

Experiment involves Measurement

Successful completion of any major project requires integrated application of multiple skills and habits.

# SKILLS NECESSARY FOR RESEARCH

- **Thinking**

Knowing

Comprehension

Problem solving

Critical thinking

Creative thinking

- **Problem finding**

Literature search

- **Technical communication**

Oral

Written

Publishing / Patenting

- **Experimentation**

- **Modeling**

- **Time / stress management**

- **Interpersonal skills**

*If you have 10 hours for chopping a tree,  
spend 5 hours sharpening the axe.*

# LEVELS OF THINKING

Low



- Knowing
- Comprehension
- Application or Problem solving
- Evaluation or Critical thinking
- Creativity

High

# INTELLIGENCE versus CREATIVITY

- Marilyn vos Savant (IQ 228 – highest ever) is merely a question and answer columnist for *Parade* magazine.
- Richard Feynman (IQ 122 - less than many run-of-the-mill physicists) is a Nobel prize winner and recognized as the last American Genius.

# INTELLIGENCE versus CREATIVITY

Intelligence and creativity are not the same things. Intelligence in a domain means the ability to function at a high level in that domain, but creativity involves asking new questions and altering the domain. One can be highly intelligent but rigid, noncreative, or lacking in the kind of single-minded passion that drives creators.

# WHAT IS CREATIVITY

Ability to look at the same thing as everyone else and think something different.

# Description of attitudes with the help of “roses” and “thorns”

Optimistic    Roses

Pessimistic    Thorns

Realistic    Roses and thorns

Stoic    Roses or thorns

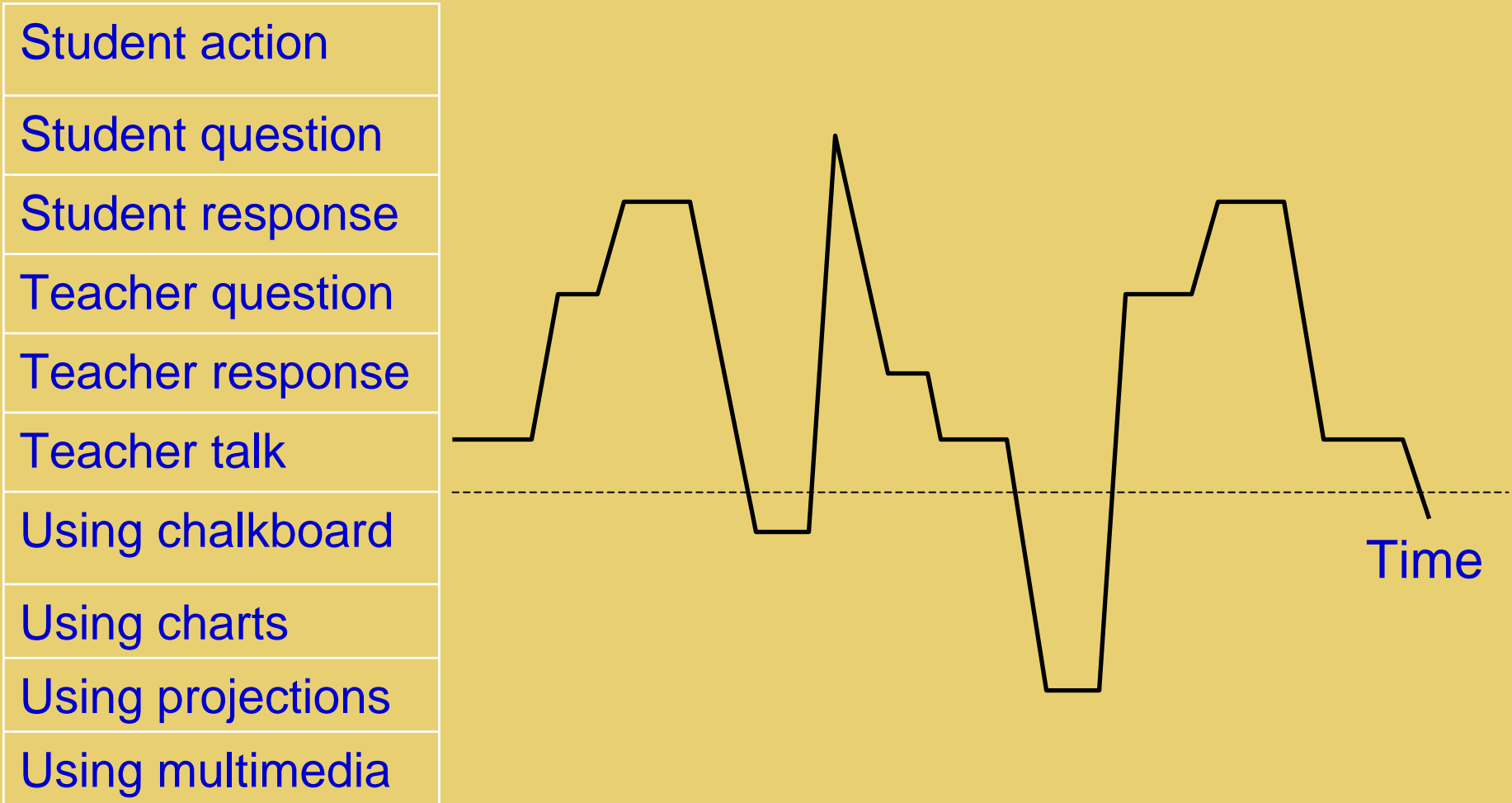
Humane    Roses for you and Roses for me

Selfish    Roses for me and thorns for you

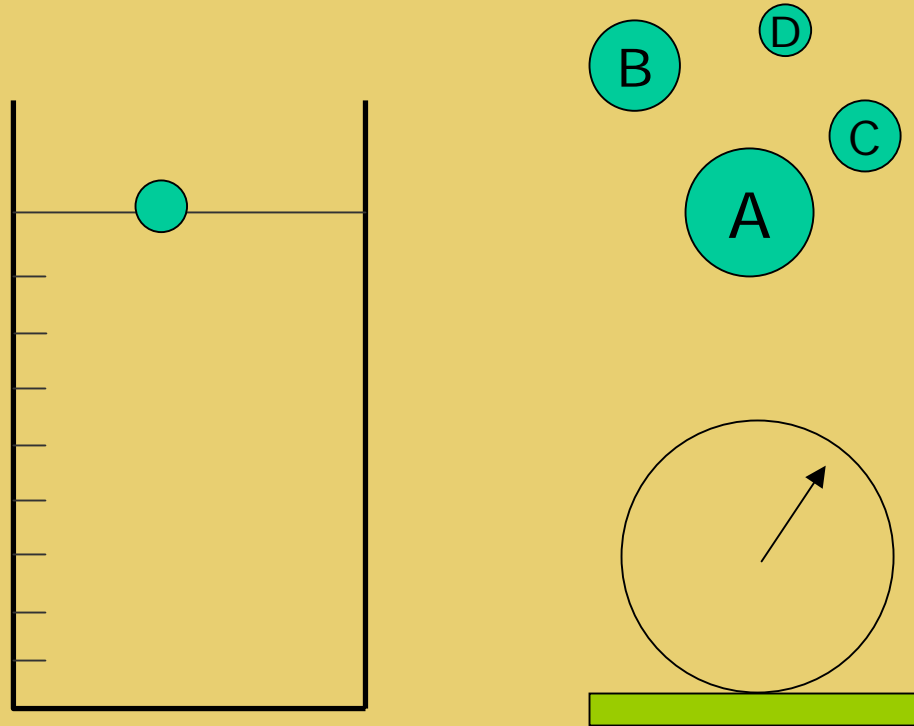
Sadistic    Thorns for you and your blood for me

Divine    Roses for you and your thorns for me

# TEACHING-LEARNING PROCESS

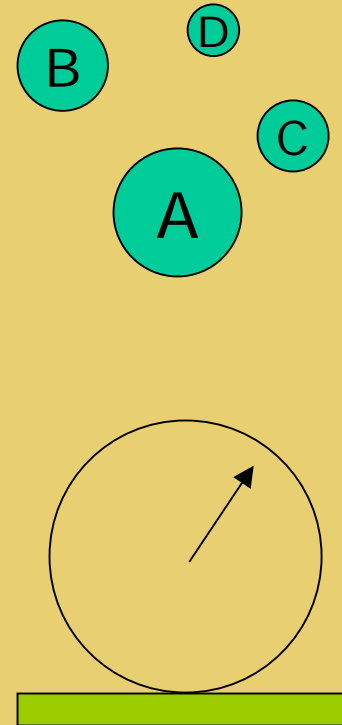
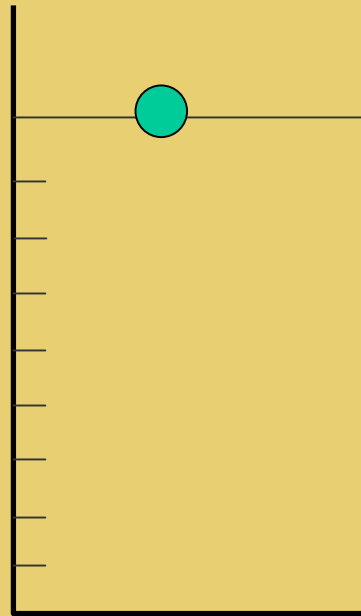


# REMOVAL OF SYSTEMATIC ERRORS



Terminal velocity as a function of the diameter

# REMOVAL OF SYSTEMATIC ERRORS

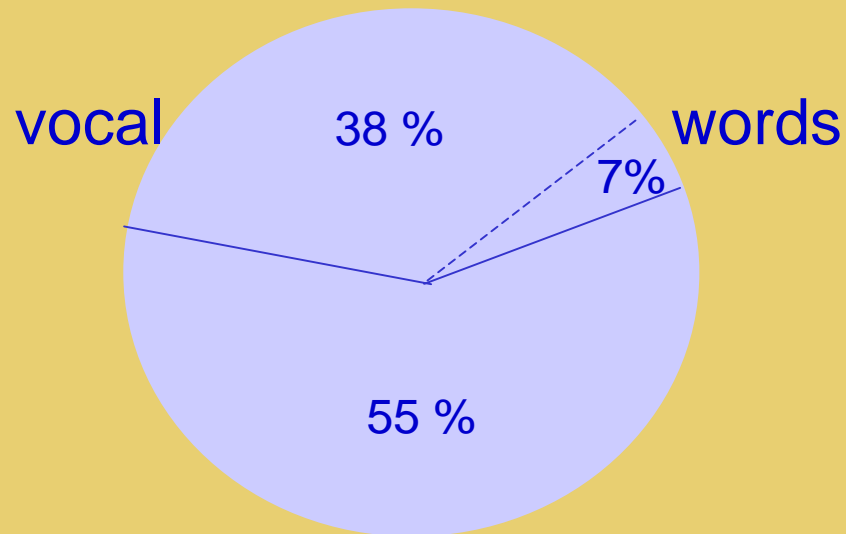


A  
B  
C  
D  
—  
D  
C  
B  
A  
—  
B  
C  
D  
A  
—  
A  
D  
C  
B

Measured terminal velocity  
=  $f$  (diameter, viscosity, clock stability)

# Oral Communication

Verbal: spoken words, pauses, stress and intonation



Non-verbal: gesture and facial expression

# Written Communication

I am writing a long letter since I do not have the time to write a shorter one. - Pascal

## Inefficient → Efficient

a considerable amount of → much

the given data → data

in the event that → if

the nature of Hoyle's work is always of a provocative kind → Hoyle's work is always provocative

# Ethics

*Research, like all good things in life, is never smooth sailing*

- Report observations truthfully
- Avoid plagiarism

# Stress management

- Persistence and the ability to manage boredom and frustration are crucial for research work.
- Monotony and repetitiveness of concentrating on the same idea for an extended period of time.  
Solution: Alternate working, standing, sitting, moving and reading, to keep fresh.
- Criticism
- Loneliness: “I work alone in a lab, full of people - all research students, all working alone.”

Skills aren't enough.

It is your attitude that makes the difference.

# THE RIGHT ATTITUDE

- If you can't do what you like, like what you do.
- Follow no one but learn from everyone, and acknowledge it too.
- Unhappiness is often caused by unjust comparison.

# THE RIGHT ATTITUDE

- Results ? Why man, I have gotten lots of results ! If I find 10,000 ways something won't work, I haven't failed. I am not discouraged, because every wrong attempt discarded is just one more step forward.
- When you ask a foolish question, you remain a fool for a few minutes, if you do not ask it, you remain a fool for ever.

# READING MATERIAL FOR DISCUSSION

## YOU AND YOUR RESEARCH

by Richard W. Hamming

Bell Communications Research Colloquium Seminar

7<sup>th</sup> March 1986

This material, whose soft-copy will be emailed to each scholar taking the course, will be the subject of the discussion session, and will also be a topic for the quiz.

# REFERENCE MATERIAL

- E. M. Phillips and D. S. Pugh, “How to get a PhD - a handbook for PhD students and their supervisors”, Viva books Pvt Ltd, (price Rs. 165).  
(with due acknowledgement to Prof. M. V. Satyanarayana)
- G. L. Squires, “Practical physics”, Cambridge University Press, (price Rs. 185).
- Handbook of Science Communication, compiled by Antony Wilson, Jane Gregory, Steve Miller, Shirley Earl, Overseas Press India Pvt Ltd, New Delhi, First edition 2005 (price Rs. 130).

# CONCLUSION

- During research, the feelings of exploration, excitement, challenge, involvement and passion are frequent, and one gets an enormous feeling of achievement on the award of a research degree.
- Research makes you an independent and organized thinker, a good communicator and stress-time manager.

*Thank you !*