

We are not robots!

Critical thinking and why young scientists
should embrace creativity

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Things I do



- ✍️ Writing and editing (books and academic articles).
- 🎥 Audiovisual documentation and the Scenoptica project.
- /copyleft Creative Commons Global Network member, contributing to open source development and free culture awareness.
- 📢 Consulting on academic journal development at UGM (and other universities).
- 💻 Design, development, and many other things at the ASEAN Journal of Science & Technology for Development.

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The world is a different place if you move just one metre to the left.

— Douglas Adams in *The Salmon of Doubt*, 2002 (paraphrased¹)



What is your heritage?

Leonardo da Vinci



- Polymath, linking science and art with the *Vitruvian Man*.
- Painted the *Mona Lisa*, *The Last Supper*.
- Invented the diving suit, tank, parachute, helicopter, and other flying machines.



1452–1519

Rene Descartes



- “I think, therefore I am.”
- Introduced skepticism to the scientific method, the basis of all modern science.
- Developed analytical geometry.
- Invented the x and y axes used in graphs today.



1596–1650

Florence Nightingale



- Revolutionised nursing and healthcare, increasing life expectancy by 20 years.
- Pioneered use of charts to present data.
- Known as the “Lady with the Lamp,” who watched over thousands of wounded soldiers.



1820–1910

Sedyatmo



- Invented the chicken claw construction method.
- His method is used in the construction of airports in Indonesia and abroad.



1909–1984

Stanley Kubrick



- Director of *Dr. Strangelove*, *2001: A Space Odyssey*, *The Shining*, *Full Metal Jacket*.
- Successfully filmed in candlelight using the same lenses that NASA used during its moon landings.
- Pioneered front projection, slit-scan photography, use of centrifugal sets.



1928–1999

BJ Habibie



- Made numerous contributions to the aviation industry.
- Ushered in the *Reformasi* era of Indonesia through a series of progressive policies.
- Relinquished his presidency ahead of schedule.



1936–2019

Steven Hawking



- Shaped our understanding of black holes and the Big Bang.
- Popularised science and cosmology.
- *A Brief History of Time, The Universe in a Nutshell.*



1942–2018

Brian May



- Co-founder and guitarist of Queen.
- PhD in astrophysics.



Born 1947

Widji Thukul



- “Menjadi diri sendiri adalah tindakan subversi.”
- Poet who challenged the New Order regime and fought for working class rights.
- Missing since 1998.



1963–unknown

Tomas Haake



- Drummer of Meshuggah.
- Employs mathematics to compose complex polyrhythms.
- Responsible (as part of Meshuggah) for inventing the “djent” musical subgenre.



Born 1971

?

What do these people
have in common?

What they have in common



1. Each of them is imaginative and creative.
2. Each of them thinks critically.

1. They are creative



- Great artists use their imagination to create works of art that have never been seen before.
- They also build on the work of their predecessors to create something new.
 - Tomas Haake explores the limits of music and existing genres.

1. They are creative



- Great scientists use their imagination to solve difficult problems.
 - They think outside the box.
 - Sedyatmo's construction method resembled a chicken foot.
- They build on the work of their predecessors; they don't copy.
 - Instead of copying his peers, Stephen Hawking looked for new problems to solve.

2. They think critically



- Great artists challenge the conventions of their time.
 - Brian May chose to pursue a PhD in science despite already being a famous musician.
- They are skeptical, open-minded, and follow evidence.
 - Kubrick explored themes outside the realm of popular cinema.
 - Widji wrote about the reality of Indonesia.

2. They think critically



- Great scientists challenge the conventions of their time.
 - Nicolaus Copernicus controversially proposed that the Earth revolved around the Sun.
 - Florence Nightingale challenged the idea that nursing was ignoble.
- They are skeptical, open-minded, and follow evidence.
 - Stephen Hawking questioned **his own work** when he found evidence against it.



Your heritage lies in
the achievements of
people like these

Your heritage

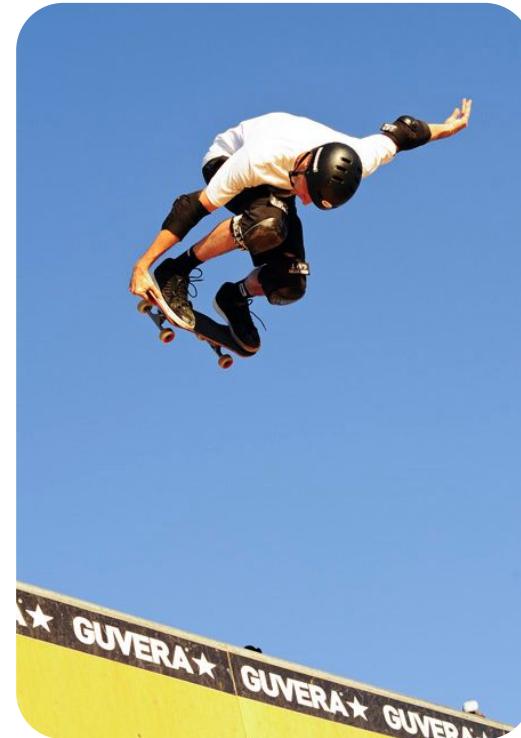


- How and what we research today is influenced by the pioneers who came before us.
- The knowledge that is given to us only exists because someone was creative enough to discover it.

Your heritage



- We only know what is possible because someone had the courage to do it first.



Your heritage



- Science and art reveal that human progress is only possible when two things combine:
 - Creativity,
 - And a willingness to challenge established norms.

Your heritage



- When you graduate, you become a peer of the greatest scientists in history.
- It is your responsibility to uphold their legacy, and to create your own path in life.
- This is only achievable if you apply creativity and critical thinking, and avoid the pitfalls of robotic thinking.



What is robotic thinking?

What is robotic thinking?



- A machine can only follow its programming; a robotic mind can only follow instructions, unable to think with originality.
- Robotic thinking is an unwillingness to ask questions.
- A lack of curiosity.
- It is being closed-minded, and refusing to consider alternative ideas.
- Following trends (in culture, on social media, and in science)

What is robotic thinking?



- Jumping to conclusions before reviewing the evidence (i.e. making baseless assumptions).
- A robotic mind accepts information without questioning its credibility first.
- It is dogmatic: unable to differentiate opinion from fact.
- Robotic thinking depends on the idea that the world is not complex and everything has an easy answer.

What is robotic thinking?



- Most importantly, a robot lacks self-awareness.
- Education is irrelevant. Whether you have a PhD degree or two; whether you are a professor, a CEO of a company, or a president of a country; this is still true.
- A person who thinks robotically does not know that they think robotically.

What is robotic thinking?



- We **want to believe** that we are open-minded, curious, and only trust facts and evidence.
- But how often do we:
 - Only listen to the same music.
 - Get our news from the same source.
 - Vote for the same politicians (even if they disappoint us).
 - Agree with someone because of their status.

Why do we fall into the trap of robotic thinking? –



- Because it's easy and convenient.
 - (In other words, we are too lazy to think.)
- Because it's pragmatic and practical.
- Because we are taught by society to think robotically.
- Because we get older.

Robotic thinking is comfortable — 😕

Which is easier and more fun:

- a. Going to the cinema.
- b. Working on your thesis or research.

Robotic thinking is comfortable — 😕

Which is easier:

- a. Sharing a Facebook post that confirms your bias and beliefs.
- b. Instead, checking the source of the Facebook post and determining if it is a hoax.

Robotic thinking is comfortable — 😕

- Life is much easier when we let other people—politicians, religious leaders, our teachers—do all of the thinking for us.
- In contrast, applying critical thinking requires effort and energy.
- The truth is that most of the time we just prefer to take the easy approach...
 - Even if it means accidentally causing damage.

We like to take shortcuts



Which is more practical to you:

- a. Copying someone else's research report so we submit our report on time.
- b. Staying up late and waking up early so we can submit our report on time.

We like to take shortcuts



Which is more practical to you:

- a. Following what other people do (and popular trends).
- b. Coming up with your own ideas.

We like to take shortcuts



- The experience of every revolutionary is almost universal:
 - They have to fight for acknowledgement.
 - They have to work harder to prove they are correct.
 - They may face ridicule from their peers and other people who are afraid of change.
- We don't want to be the first penguin to jump in the ocean.
Being the first person to do something can be scary.

We like to take shortcuts



- It is much simpler to follow someone else's path than to create your own path.



My lovely wife and I decide to cross a path. Photo: Ziar.

We are taught to be robotic



- Society forces us to conform to its rules.
- We measure success based on standards set by others.
 - “I will only be successful if I am rich.”
 - “If I do not become a lecturer one day, I will be a failure.”
- We measure happiness based on other people’s standards.
 - “I won’t be happy until I get married.”
 - “My neighbour has a nicer house than me.”

Experience tricks us



Douglas Adams summarises how we age²:

1. Everything that's already in the world when you're born is normal;
2. Anything that gets invented before you turn 30 is new, exciting, and revolutionary;
3. Anything that gets invented after you're 30 is not natural... and signifies the end of civilisation as we know it. ☹

Experience tricks us



- Which category do you fall into? Does it fit your actual age?
- Experience is valuable, but as we get older, we can become more entrenched in our ideas.
- New ideas can become unreasonable, maybe even terrifying.

Experience tricks us



- If you are over 40, how accurate is this statement?
 - The best period of music was 1985–2000.
- If you are over 30, how accurate is this statement?
 - The best period of music was 1995–2010.
- If you are around 20, how accurate is this statement?
 - The best period of music is the current period.
 - (For bonus points: BTS is the best band ever.)



A common misconception:

“I don’t hurt anyone if I
think robotically.”

Robotic thinking harms society



- Scientists must advance their field.
- Scientists must also contribute new knowledge to the world.
- If your goal is not to advance your field and make new discoveries, why do you want to be a scientist?
- In the best of cases, robotic scientists don't make significant contributions to their fields.

Robotic thinking harms society



- In the worst of cases, robotic scientists are ignorant and gullible...
- And they harm society simply by spreading their ignorance and gullibility.



Three lessons in the consequences of ignorance

1. A Bayern Munich hoax



This image is Bayern
Munich's logo from 1938 to
1945.

It proves that Bayern
Munich has always been a
Nazi and racist football club.



1. A Bayern Munich hoax



The truth:

Bayern Munich was actually targeted by the Nazis for being a “Jewish club”.

Bayern were founded in the bohemian quarter of Schwabing, and were very much a Jewish club before the second world war, with a Jewish president and a Jewish manager. As a consequence, Bayern were targeted by the Nazis but players and officials continued to defy the regime with small acts of personal courage. "All those things were forgotten in the post-war years," said Dietrich Schulze-Marmeling, the author of 2011's award-winning *Der FC*

Source: The Guardian³

1. A Bayern Munich hoax



- Maybe only fans of Bayern Munich will be offended by this hoax.
- But sharing it uncritically harms more than just football fans.
- **Sharing even an innocent lie hides a greater truth.**
 - Bayern Munich actually resisted Nazism.
 - Many Germans in WW2 were not Nazis.

2. Did he really say that?



In April 2020, Donald Trump apparently suggested injecting disinfectants to kill the coronavirus.

Did Trump really suggest something so dangerous and potentially fatal?

Trump claims controversial comment about injecting disinfectants was 'sarcastic'



Source: The Washington Post⁴

White House says media took Trump remarks on coronavirus treatments 'out of context'

BY MORGAN CHALFANT - 04/24/20 10:18 AM EDT

3,653 CO

Source: The Hill⁵

2. Did he really say that?

The truth:

Yes, Trump said it. Despite the White House's claims, a transcript proves that he suggested injecting disinfectant.

THE PRESIDENT: Right. **And then I see the disinfectant, where it knocks it out in a minute. One minute. And is there a way we can do something like that, by injection inside or almost a cleaning. Because you see it gets in the lungs and it does a tremendous number on the lungs. So it would be interesting to check that. So, that, you're going to have to use medical doctors with. But it sounds – it sounds interesting to me.**

Source: Snopes⁶

2. Did he really say that? ---



- Sometimes, allegations are hard to believe.
 - The allegation is seemingly not credible.
 - The allegation is against someone we trust.
- Other times, we automatically trust what a person with authority says... even if what they say is dangerous.
- We have to put aside our biases and prejudices, and seek out the evidence.

3. The deadliest tree in Java



In 1783, a scientist reported the discovery of a poisonous tree in Java that kills everything within a 15 mile radius.

" Jura neget sibi nata, nimil non arroget armis!"

DESCRIPTION OF THE POISON-TREE, IN THE ISLAND OF JAVA,
BY N. P. FOERSCH.
TRANSLATED FROM THE ORIGINAL DUTCH, BY MR. HEYDINGER.

THIS destructive tree is called in the service of the Dutch East-India Company. During my residence there I received several different accounts of the Bohon-Upas, and the violent effects of its poison. They all then seemed

the Malayan language, BOHON-UPAS, and has been described by naturalists. But their accounts have been so intermixed with the marvellous, that

Source: HathiTrust Digital Library⁷

3. The deadliest tree in Java



The truth:

Of course this is not true! For people living in Java, it is very obvious that there is no such tree.

The tree in question is *Antiaris toxicaria*, which does have poisonous latex, but not to such an extreme degree.



3. The deadliest tree in Java



- Something that is obvious to one person is not obvious to another.
- An ignorant person doesn't know when something is obviously right or wrong.
 - When we refuse to seek out the truth, we can end up believing stupid ideas.



Okay, Joaquim, I
know the “why”...



**But “how” do I become
a critical thinker? How
do I be creative?**

How do I think critically?



- Asking for the steps to better critical thinking is of course a very robotic thing to do, no? 😊
- As I (hopefully) have shown so far, there is no secret to it.
- Your success in breaking free of robotic thinking is determined by the amount of effort you put into doing so.

How do I think critically?



- Be skeptical. Stop and think before you agree with an opinion or share a tweet or Facebook post.
- Ask questions. If you get an answer, are you satisfied with that answer? If not, ask another question. Keep asking!
- Be curious. Explore new and unfamiliar things.

How do I think critically?



- Your values might not be the same as someone else's values, but both are valid. Be open to understanding opposing ideas, even if you ultimately don't agree with them.
- Don't take shortcuts. If the solution to your problem is too easy, look for a more difficult problem.

How do I be creative?



- The biggest step to being more creative is the simplest but also the hardest: **don't be afraid**.
- Many times, we have interesting ideas, but we're afraid of the repercussions of trying to carry them out.
 - “My supervisor will snap at me.”
 - “What if my colleagues think I'm stupid?”
 - “What if I'm wrong?”

How do I be creative?



- Don't let fear guide your career.
- **Failure is only failure if you fail to learn from it.**
- Put yourself in the state of mind to tackle the right problems, and then work from there.
- “What has someone never done before? Why not?”
- “What can I improve on, what can I do better?”

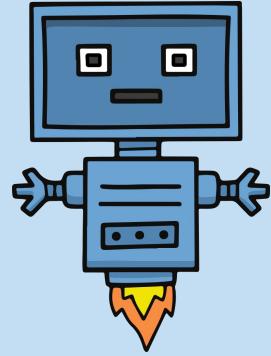


So, what will
your legacy be?

What will your legacy be?



- Are you ready to challenge your peers?
- Are you willing to tackle the difficult problems and ask the difficult questions?
- Will you take the extra steps to ensure credibility?
- Will you open your mind to different possibilities?
- Do you have the courage to find your own path?



Or will you be a robot?

Endnotes



1. The actual quote is, "He was constantly reminded of how startlingly different a place the world was when viewed from a point only three feet to the left." We must remember that a quote without context is meaningless, and one that is paraphrased potentially misleading.
2. Adams D. 1999 Aug 29. How to stop worrying and learn to love the internet. The Sunday Times.
<https://www.douglasadams.com/dna/19990901-00-a.html>.

The full quote is as follows:

- 1) everything that's already in the world when you're born is just normal;
- 2) anything that gets invented between then and before you turn thirty is incredibly exciting and creative and with any luck you can make a career out of it;
- 3) anything that gets invented after you're thirty is against the natural order of things and the beginning of the end of civilisation as we know it until it's been around for about ten years when it gradually turns out to be alright really.

Endnotes



3. Honigstein R. 2012 May 12. Bayern Munich embrace anti-Nazi history after 80 years of silence. The Guardian. <https://www.theguardian.com/football/2012/may/12/bayern-munich-anti-nazi-history>.
4. Chiu A, Shepherd K, Shammas B, Itkowitz C. 2020 Apr 25. Trump claims controversial comment about injecting disinfectants was ‘sarcastic’. The Washington Post.
<https://www.washingtonpost.com/nation/2020/04/24/disinfectant-injection-coronavirus-trump>.
5. Chalfant M. 2020 Apr 24. White House says media took Trump remarks on coronavirus treatments ‘out of context’. The Hill.
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7. Foersch NP. 1783. Description of the poison-tree, in the island of Java. The London Magazine 1:512–517.
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Credits



(in order of appearance)

1. [Hand-drawn robots], Freepik,
https://www.freepik.com/free-vector/hand-drawn-robot-character-collection_1511346.htm, Freepik license, modified to fit colours to theme.
2. [Icons], Font Awesome, <https://fontawesome.com>, CC BY.
3. “Self-portrait of Leonardo da Vinci”, Leonardo da Vinci,
https://commons.wikimedia.org/wiki/File:Leonardo_self.jpg, public domain.
4. “Portrait of René Descartes (1596-1650)”, Frans Hals,
https://commons.wikimedia.org/wiki/File:Frans_Hals_-_Portret_van_Ren%C3%A9_Descartes.jpg, public domain.
5. [Photo of Florence Nightingale], Henry Hering,
[https://commons.wikimedia.org/wiki/File:Florence_Nightingale_\(H_Hering_NPG_x82368\).jpg](https://commons.wikimedia.org/wiki/File:Florence_Nightingale_(H_Hering_NPG_x82368).jpg), public domain.
6. “Prof. Dr.(HC) Ir. R. M. Sedijatmo Atmohoedojo”, creator unknown,
<https://id.wikipedia.org/wiki/Berkas:Sedijatmo.jpg>, used under fair use rationale.

Credits



(in order of appearance)

7. "Self-portrait of Stanley Kubrick with a Leica III camera", Stanley Kubrick, <https://commons.wikimedia.org/wiki/File:KubrickForLook.jpg>, public domain.
8. [Photo of BJ Habibie], Office of the Vice President, Republic of Indonesia, https://commons.wikimedia.org/wiki/File:Foto_Presiden_Habibie_1998.jpg, public domain.
9. [Stephen Hawking in zero gravity flight], Jim Campbell/Aero-News Network, https://commons.wikimedia.org/wiki/File:Physicist_Stephen_Hawking_in_Zero_Gravity_NASA.jpg, public domain.
10. [Brian May discusses New Horizons flyby of the Kuiper Belt object Ultima Thule], NASA/Bill Ingalls, [https://commons.wikimedia.org/wiki/File:Brian_May_\(NHO201812310024\)_ \(cropped\).jpg](https://commons.wikimedia.org/wiki/File:Brian_May_(NHO201812310024)_ (cropped).jpg), public domain.
11. [Photo of Widji Thukul], Wahyu Susilo, used under fair use rationale.
12. "Tomas Haake warming up before a Meshuggah gig at Mondo, Stockholm, Sweden on the 20th of May, 2005", Valerian Noghin, https://commons.wikimedia.org/wiki/File:Tomas_Haake_2005.jpg, CC BY-SA.

Credits



(in order of appearance)

13. "Tony Hawk at the Big Day Out Festival 2012", Stuart Sevastos,
[https://en.wikipedia.org/wiki/File:BDO_Vert_Skate_Jam_%40_McCallum_Park_\(5_2_2012\)_%286971314297%.jpg](https://en.wikipedia.org/wiki/File:BDO_Vert_Skate_Jam_%40_McCallum_Park_(5_2_2012)_%286971314297%.jpg), CC BY.
14. [Photo of Joaquim and Lelly crossing path], ziarurrochman, CC BY.
15. [Bayern München logo with swastika], creator unknown, copyright unknown.
16. "Upas Tree - Antiaris toxicaria - 1887 Illustration", James William Buel,
https://commons.wikimedia.org/wiki/File:Upas_Tree_-_Antiaris_toxicaria_-_1887_Illustration.jpg, public domain.



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