

ScienceTalk

# Time to augment toolkit beyond the 3Rs

**Growing role of data, algorithms should be reflected in school, training programmes**

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For The Straits Times

Humans are good at giving names to ages.

Our technological prehistory is divided into the Stone Age, Bronze Age and Iron Age.

How will our age be characterised by denizens of the future, as they dig the digital detritus of these times?

Education seeks to impart a set of facts, perspectives and skills that allow people to survive, appreciate and thrive.

The three Rs – reading, writing and arithmetic – have long held sway as foundational elements of education. They allow us to find our way around in specific situations – reading a signboard, drafting a memo, performing a quick back-of-the-envelope calculation.

But they also serve as basic building blocks of a deeper understanding of the world. Recognitions of the three Rs as key life skills came about at the cusp of the 18th and 19th centuries. It is time to augment our toolkit.

## **DATA, ALGORITHMS AND INFORMATION**

Data dominates our lives today like nothing else.

The contrails of our daily activities are rich with details about who we are and whom we connect with.

Concerns about how such data is used, and misused, have come to dominate public discourse across the globe.

Hopefully, such discourse would help shape public policy towards equitable digital ecosystems for all.

But we will not revert to a state of the world where data is produced or consumed any less.

Data has no value by itself.

Stored as myriads of 0s and 1s somewhere deep inside some digital storage system, data is endowed with meaning only when it is processed to serve some purpose.

Algorithms feed on data to produce information.

Algorithms and information have come to influence our lives today like never before. But they are underpinned by deceptively simple – yet powerful – ideas.

Simply put, an algorithm is a recipe. When we make a cup of tea, we follow a sequence of steps that transforms tea leaves, water and optional other ingredients such as milk and sugar into a refreshing drink.

The sequence of steps for tea making typifies an algorithm.

The order of the steps is crucial, so are the ingredients that must go into the process that has clearly defined start and end points.

All around us, algorithms are already producing information from data.

As we search for the best route from point A to point B on our handheld devices, algorithms are sifting through large volumes of disparate data such as weather forecasts, road conditions, real-time updates on emergent traffic situations and so on, to identify the most optimal way to reach the destination, often on multiple criteria such as time, distance and road tolls.

The purveyors of fake news closely follow our digital footprints to understand our preferences and prejudices, and then serve us the “news” that we are most likely to believe and propagate.

These are just two examples from the innumerable ways our daily lives are being influenced by the information generated by algorithms from data.

## **NEW Rs FOR THE NEW AGE: ALGORITHMIC THINKING AND INFORMATIONAL AWARENESS**

Algorithmic thinking is about devising sequences of instructions to solve specific problems.

With clearly defined start and end conditions, the instructions need to be clear enough such that anyone – even a computer – can unthinkingly execute them.

Even for those who will never need to write computer programs, algorithmic thinking can endow a valuable understanding of how algorithms make many of the decisions that shape our lives today.

For instance, resumes submitted for job applications are often short-listed using algorithms tuned to filtering criteria that fit the hiring organisation's needs.



Algorithmic thinking and informational awareness should be included in school curricula and in training courses for working professionals, says the writer. Algorithmic thinking is about devising sequences of instructions to solve specific problems, while informational awareness is the ability to extract the essence from different types of data, often by applying appropriate algorithms. PHOTO: REUTERS

Being aware of this process and tailoring the resume accordingly can enhance an applicant's chances of being interviewed for a job.

Many of the advertisements we see online are specially targeted on the basis of individual browsing habits.

Algorithms decide what we are most likely to buy, and serve the most promising advertisements.

Knowing this dynamic can save us from binge buying, at best, and falling for online scams, at worst.

Algorithmic thinking is not about understanding every single step of all algorithms that affect us.

Indeed, details of algorithms for even something so seemingly mundane as route-finding in city traffic are complex enough to be tractable only to the specially-trained.

However, algorithmic thinking can help us sense some of the predilections and biases that are inherent in many algorithms so that

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**Educators are grappling with the challenge of preparing today's students for tomorrow's world. The challenge is exacerbated by the fact that tomorrow is almost upon us. It is high time elements of algorithmic thinking and informational awareness were introduced in the curricula for school and college students, as well as in refresher programmes for working professionals.**

we are able to leverage them in some situations, and be wary of them in others.

Informational awareness is the ability to extract the essence from different types of data, often by applying appropriate algorithms.

The larger the data, the more likely it will be “noisy”, containing elements that can make it difficult to interpret the data unambiguously.

So the need for informational awareness gets stronger.

It allows us to perceive what a given data set can tell us, and very importantly, what it cannot.

Algorithmic thinking and informational awareness go hand in hand, one complementing the other.

Algorithms get more effective by being applied repeatedly, with their parameters being tuned on the basis of how close expected and actual outcomes are.

This “training” of algorithms is vitally dependent on data.

If a self-driving car runs into a pedestrian instead of stopping, it is quite likely the algorithms controlling the car had not encountered features that are specific to the particular pedestrian in that context; perhaps the colour of clothes, use of assistive devices such as a walker, or level of street lighting.

Being cognisant of how reliant the performance of algorithms is on underlying data is becoming increasingly important in our lives.

Powerful algorithms are commensurately complex, so that they can process large-scale data to delineate useful informational patterns.

Algorithms are already analysing the deluge of data in our lives, and generating information, which many of the decisions directly impacting us are based upon.

These decisions concern our education, health, employment, communication, entertainment and nearly all else we are concerned with. And such trends are only going to amplify.

Thus, algorithmic thinking and informational awareness are becoming essential life skills.

Educators are grappling with the challenge of preparing today's students for tomorrow's world.

The challenge is exacerbated by the fact that tomorrow is almost upon us. It is high time elements of algorithmic thinking and informational awareness were introduced in the curricula for school and college students, as well as in refresher programmes for working professionals.

The prerequisites do not involve anything substantially beyond the mathematics and statistics already being taught in school, along with some basic familiarity with computers. The key theme would involve an appreciation of how these fit together in the context of what could one day be called the algo-informatic age.

This is essential in ensuring that technology touches all lives for the better, not just those of the privileged few.

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