Chapter 9

You're on your own now! Cultivating Curiosity to Support Self-Directed Learning by Means of a Three Dimensional Questioning Strategy

Ignatius G.P. Gous

University of South Africa (UNISA), South Africa

Introduction – Changing Educational Landscape

The many so-called upheavals, programmes, and plans currently being conducted all over the world, such as I4.0 (Industry 4.0 – Germany), AMP (Advanced Manufacturing Partnership) and IIoT (the industrial internet of things) (both from the USA), IdF (Industrie du Futur – France), MIC 2025 (Made in China 2025), S5.0 (Society 5.0 – Japan), and E5.0 (Education 5.0 – Zimbabwe), to name a few, are indictive of a changing landscape in the world of work. Change has always been part of our world, but the tempo of change is currently a disrupting factor, with people in all spheres of life having to adapt in order to attempt to keep up.

At the same time, resistance to change has also always been part of our world. The 'better the devil you know than the one you don't'-syndrome often kept people, societies, and industries in their comfort zones. Education in general and HE (higher education) in particular are prime examples (Caruth & Caruth 2013:12). The classroom of 2022 and the classroom of 1922 and 1822 looks disconcertingly similar, with the guiding pedagogies inside the classroom also fairly comparable. The availability and even use of new technologies did not fundamentally change classrooms or teaching and learning. Many novel approaches abound, but they have not become mainstream (Salmi 2001:105).

The reason why educational practices stayed very much the same, is because they were not total failures. All the current instances of progress, upheaval, and even disruption are driven by people coming from these kinds of classrooms, maybe even despite these kinds of classrooms because of the propensities of the learners and students themselves. The educational practices of the past and up to now did engender learning of some sorts, even of excellent sorts.

Even so, the *world of work* is now pleading for educational practices to be reimagined because they feel that educational institutions do not always deliver students that are well-prepared to meet the challenges of their respective industries (Boud & Rooney 2015:195).

These calls for change did not result in major modifications if anything at all. That is to be expected, as people are cautious in nature, and institutions even more so. What did lead to major changes in a very short spate of time, was the Covid-19 pandemic. According to Harari (2020), this worldwide event with its lockdown regulations and social distancing protocols necessitated, among other things the closure of educational institutions. The initial result was 'education as usual,' only at a distance, in what is commonly called 'emergency distance education.' Here lectures were provided in the same way as previously, only now at a distance by means of technology – lectures behind glass in the form of Zoom or Microsoft Teams lectures, PowerPoint and other presentations, and PDF files sent via e-mail or social media. It was still mainly based on traditional face-to-face pedagogical principles. Soon people realised that this is not only unsustainable because of teacher and learner burnout, but learning itself suffered from it (Bozkurt & Sharma 2020; Bozkurt, Insung, Junhong, Vladimirschi, Schuwer, Egorov, Lambert, Al-Freih, Pete, Olcott, Rodes, Aranciaga, Bali, Alvarez, Roberts, Pazurek, Raffaghelli, Panagiotou, De Coëtlogon, Shahadu, Brown, Asino, Tumwesige, Reyes, Ipenza, Ossiannilsson, Bond, Belhamel, Irvine, Sharma, Adam, Janssen, Sklyarova, Olcott, Ambrosino, Lazou, Mocquet, Mano, & Paskevicius 2020; Costello, Brown, Donlon, & Girme 2020; Hodges, Moore, Lockee, Trust, & Bond 2020; Peters, Rizvi, McCulloch, Gibbs, Gorur, Hong, Hwang, Zipin, Brennan, Robertson, Quay, Malbon, Taglietti, Barnett, Chengbing, McLaren, Apple, Papastephanou, Burbules, & Jackson 2020).

There is a plethora of important and complex reasons for this, such as access to technology issues, psychological matters, pedagogical aspects, and economic pressures, to name but a few. One aspect which lies at the heart of learning, however, is the learning behaviour of learners themselves. Learners who know how to learn effectively, are able to rise above difficult circumstances and are capable to circumvent problematic issues. For this reason, this chapter will focus on effective learning behaviour, and only on one aspect from this wide and complex field, namely *curiosity*, also called information seeking behaviour. The point of departure is the sciences of the brain and the mind.

The chapter will pursue the following train of thoughts: A complex and challenging world of work calls for effective learning in order to cope with the challenges. Effective learning is supported and enhanced by curiosity. Even though curiosity is difficult to define, its benefits are substantial and worthy to pursue. Curiosity originates in the brain, making it a universal human trait,

and as such needs not to be taught because all humans are inherently curious. What is required, is that it needs to be elicited by the way we teach, where we create the space to embrace ambiguity in the world and in the workplace. Even though it is difficult to define the term precisely, the working of curiosity can be described as being exploitative, in the sense of pursuing specific goals; explorative, in the sense of pursuing general goals; and u-shaped, in the sense of functioning best when it is not too hard, not too easy, but within reach, having to stretch in order to reach the set goal. A crucial aspect of curiosity is the ability to ask relevant and good questions. Focusing on entrepreneurship and some entrepreneurs, the importance of good questions is briefly discussed, ending with a suggestion to structure the art of asking questions in order to make sure we teach learners to ask good questions, thereby preparing them for the world of work as envisaged by the 4IR (Fourth Industrial Revolution) and the other descriptions of our complex world.

The Complex and Challenging World of Work

Knowledge is expanding exponentially, making it all the more difficult to master what there is to know in a discipline. According to Eric Schmidt, the CEO of Alphabet-Google, currently more information is created and been made available every two days than has been from the beginning of humankind up to 2002 (for a discussion and correction of Schmidt's statement, cf. Moore 2011). Technological and other developments are standing on the shoulders of previous developments, creating the progress that is taking place in leaps and bounds as described as, for instance the 4IR. The implications thereof is that it is challenging, to say the least, to master any field of knowledge. Learners cannot stand on the shoulders of giants in terms of mastery. Each one of them has to walk the path from not knowing to knowing, with new knowledge being merely copied into one's mind. In the quest for mastery, each learner has to master the art of mastery, and each learner has to find motivation to want to learn, and the passion to be curious about what they have to learn. These strategies and habits are seldom taught. Instead, content that has to be learnt, is taught, while the how and the why and the whereto is not often explicitly modelled or formally taught. Whether a learner develops the passion for learning, the motivation to learn, or the curiosity to seek the necessary information, is often left to the luck of the draw. Some develop it, but many despise or dislike learning and try to get away with learning the bare minimum of what is prescribed to them (Ackoff & Greenberg 2008).

The complexity of every discipline and field of work, linked with the easy access to and availability of information, calls for effective teaching and learning. Learners in all levels of teaching and training, from young to old, need to be able to master masses of work as part of a lifelong endeavour.

Learning never stops. They therefore not only have to know *how* to learn, they also have to *want* to learn – be curious, as it were, as an intrinsic motivation.

Linked to this is the sheer volume of what has to be learned. It is challenging to master a single field of expertise aimed at a specific vocation, which has been the focus of most teaching and training at institutions of learning up until now. What is changing, is that the complexity and interwovenness of realities call for people who are interdisciplinary informed. They have to be specialists in a primary field, even more than one, but also be generalists and knowledgeable in adjacent and even remote fields in order to be able to meet the demands of a complex world of work. Added to this is the fact that much of what needs to be mastered, do not exist as of yet and will have to be mastered autodidactically after formal studies have ended. Just studying what is prescribed is not sufficient anymore.

The question is, Do educational institutions cater for these realities, and more importantly, do they prepare their learners and students for it? Understanding and engendering curiosity is one way of addressing these realities.

The Positive and Negative Effects of Curiosity on Learning

Volumes of research have pointed out the benefits of curiosity in terms of effective learning (cf. Kidd & Hayden 2015). It is a predictor of success, it leads to better learning and memory, deeper understanding of learnt material, higher mathematics and literacy skills, more joy on the job, more happiness, and better social skills (Loewenstein 1994:75; Litman & Spielberger 2003:75; Collins, Litman, & Spielberger 2004:1127; Kashdan 2009:59; Kang, Hsu, Krajbich, Loewenstein, McClure, Wang, & Camerer 2009:963; Gureckis & Markant 2012:464; Gruber, Gelman, & Ranganath 2014:486; Leslie 2014:21). It also helps in closing the gap between disadvantaged and privileged students, where curious students from socio-economic disadvantaged backgrounds perform as well as students from privileged circumstances (Shah, Weeks, Richards, & Kaciroti 2018:380), while cultivating curiosity has a higher beneficial effect on students from a lower socio-economic status (Shah *et al*. 2018:385). When curiosity is leading to unfocused mind-wandering, it might have a negative effect on learning. Therefore, it is important to understand what curiosity is.

Understanding the role and Function of Curiosity in the Brain

A question about curiosity is whether it is an innate or a learned behaviour. Many studies regarding curiosity have been done on non-human species, from simple organisms like the roundworm, *caenorhabditis elegans* to more complex organisms and mammals (Hughes 1997:213; Loewenstein 1994:77;

Calhoun, Chalasani, & Sharpee 2014; Kidd & Hayden 2015:449, 451). In all organisms, there is a tendency to first seek locally, then to search generally or globally. These tendencies are therefore inborn behaviours, most likely because it provides immediate satisfaction of whatever needs, but also strategic long-term preparation for need satisfaction.

Curiosity, therefore does not need to be taught. It only needs to be evoked by the way learning experiences and opportunities are structured. When activated, curiosity plays a beneficial role in learning, memory, understanding, and the depth of knowledge. Gruber *et al.* (2014), for example, describe the mechanics of curiosity in the brain, based on functional magnetic resonance imaging techniques. Their research shows that areas of the brain known to be important for learning, memory, and understanding, such as the midbrain, the nucleus accumbens and the hippocampus, and especially the functional connectivity between these regions, become activated when learners are curious. This leads to better retention not only of material that the learner wants to learn, but also material that they are incidentally exposed to while learning. Lisman and Grace (2005) describe one such functional connection, namely the Hippocampal-VA loop. When the hippocampus detects new knowledge, it activates several areas involved in learning. In the upward part of the loop, dopamine is released within the hippocampus, which enhances long-term potential and better learning.

This is of importance to know because learners who have to learn complex material in an unstructured and unpredictable context such as the 4IR and related circumstances, will benefit from activating their curiosity while mastering what they have to.

A related aspect to the issue 'what they have to learn' is the emotional experience that learning is meaningful. Curiosity is more successfully evoked when learners see that what they do is related to real life issues, which is often the case when adult learners have to solve difficult, real-life problems, trying not to choose between existing answers, but to create answers to questions not previously posed, such as is the case in rapidly changing contexts of the current worlds of work. Research done by Gotlieb, Hyde, Immordino-Yang, & Kaufman (2016) about cultivating giftedness in STEM (Science, Technology, Engineering, and Mathematics), points to the importance of shifting education from knowledge transmission and regimented evaluation to aspects of intellectual curiosity, such as intentional reflectiveness, creative exploration, and mindful switching between task focus and imagining (Gotlieb *et al.* 2016:22).

With this being established, it is now important to enquire how curiosity functions in concrete situations, as described by researchers and practitioners.

Defining Curiosity, or at least be Aware of the Functioning Thereof

Although the worth and mostly positive effects of curiosity have been established, a precise and generally accepted definition of curiosity has still not been agreed upon. Several laudable attempts have been made, spanning over centuries (Inan 2017:1-15). What is clear from this, is that philosophers through the ages were aware of the positive effect of curiosity on mastering what is important to know for people in their contexts. In the same vein, William James (1912) describes curiosity as the desire in children to understand novel things they come across, and that this develops later in life into scientific and philosophical knowledge.

Loewenstein (1994:76, 87) postulates an influential psychological theory of how curiosity functions, called the Information Gap Theory of curiosity. According to him, people become curious when their attention becomes focused on a gap in their knowledge. This creates feelings of deprivation, which then motivate them to fill the gap by obtaining the relevant information. In this sense, curiosity is described as a powerful driving force to motivate people to choose behaviours, mostly learning behaviours, similar to other basic need-fulfilling behaviours such as hunger. This means that curiosity can be utilised to make learning more effective.

Curiosity is not a monolithic entity. Knowing the different kinds of curiosity, enables educators and learners alike to tap into specific efficacious ways of being curious. For example, Berlyne (1954, 1966, 1978, 2014) makes a distinction between types of curiosity along two dimensions, namely perceptual versus epistemic, and specific versus diversive curiosity. Perceptual curiosity is being interested in novel stimuli, but the interest wears off when someone gets used to it. Epistemic curiosity is the drive to acquire knowledge and dispel uncertainties. Specific curiosity is the drive to obtain a particular piece of information, solving a certain puzzle or answering a specific question. Diversive curiosity is a general desire to explore, for example rats that investigate the unknown parts of a maze even though they already know where the food source in the maze is to be found.

Litman and his colleagues (Litman 2005, 2009) distinguish between I-type (Interest-type) curiosity and D-type (Deprivation-type) curiosity. I-type curiosity is about positive feelings of engagement with new information. D-type curiosity is about feelings as a result of missing information from one's existing knowledge of something. This is important to know because it is easier to create uncertainty in the learning environment, namely D-type curiosity, to predict what content or stimuli will peak learners' interests (Jirout & Klahr 2012:150).

Renner (2006:305) adds a third kind of curiosity apart from epistemic and perceptual curiosity, namely emphatic or social curiosity. This kind of

curiosity stems from our interactions and relationships with people, and is therefore the drive and urge to know more about other people, what they do, think, and feel.

Linking to these characterisations of curiosity, Kidd and Hayden (2015:449-457) suggest that instead of focusing on the taxonomy and motivation of why people are curious, we should rather focus on the functioning thereof. Guided by the four questions formulated by the Dutch biologist Nikolaas Tinbergen (Tinbergen 1963:411), they researched curiosity in terms of function, evolution, mechanism, and development.

In terms of *function*, research points out that curiosity benefits learning by enhancing the encoding and retention of new material. Of particular interest is that it drives learners to want to master useful information they do not yet possess (Kang *et al.* 2009:963, 971; Pelz, Yung, & Kidd 2015).

In terms of *evolution*, they point out that information seeking behaviour is a crucial survival strategy, involving all our senses. Here we find two beneficial strategies. One is a long-term strategic benefit, when people explore ideas or information which have no apparent immediate benefit. Novel and unfamiliar ideas stimulate the brain's reward systems, driving our curiosity and regulating our exploration of the unknown. The drive is to improve knowledge in general in order to improve future choices. The other strategy is seeking an immediate short-term benefit, where people exploit ideas or information by choosing what they see as the best between known options. The drive is to immediately resolve uncertainty, even though it might preclude them from finding even better options.

In terms of *mechanism*, Kidd and Hayden (2015:453-454) point out that all forms of behaviour have their origin in the brain. Neuro-research on curiosity confirms Loewenstein's information gap theory in the sense that curiosity provokes the expectance of a reward. Further research indicates that curiosity and the curiosity state activate structures responsible for memory and learning, and even lead to better learning of things people are not interested in. Curiosity causes information to be regarded as valuable as anything else that people would dearly want.

In terms of the *development* of curiosity from childhood to adulthood (cf. Kidd & Hayden 2015:454-456), research done by, among others, Kang *et al.* (2009) and Kinney and Kagan (1976) indicates that curiosity optimises the use of cognitive resources in the sense that they focus attention on things we are moderately certain of. It prevents resources to be wasted on information that is either overly familiar or overly complex and totally unfamiliar. Learners prefer stimuli of an intermediate level of complexity, leading researchers to refer to it as U-shaped curiosity – not too easy, not too difficult, but within reach if you stretch somewhat. This is in line with the pedagogical theory of

Vygotsky about the zone of proximal development, stating that one should meet learners where they are in terms of knowledge, and invite them to develop further (Vygotsky 1997:29). Linked to this, is that children naturally structure their play and curiosity in ways that identify causal principles and structures (Gopnik, Schulz, & Schulz 2007:9).

From this cursory summary on how to define and describe curiosity, it is clear that there are differences in opinion, but there are enough known about curiosity and the working thereof to help us use it in terms of teaching and learning.

As humans, in order to survive and thrive, we want to know more about our world and environment. Ignorance creates feelings of want, while getting to know, gives rewards and pleasurable feelings. We want to know specific information about known variables in order to exploit available resources, and we also want to explore and learn about novel, unknown matters in order to broaden our horizons. Learning is adding to existing knowledge structures – not interested to add what is already in place, also not attending to matters which do not seem to fit anywhere at all, but adding what is regarded to be worthwhile stretching for to obtain and include.

Curiosity is therefore information seeking behaviour aimed at filling gaps in knowledge. We are all born with this survival ability, and it plays out in predictable ways, making use of likely sets of strategies. As such, it meets real felt needs of people, and in the process, they experience tangible rewards in their brains and body. Knowing this, makes it possible to utilise it in educational settings when pursuing teaching and learning goals.

This not only could but also should be taken into account by teaching professionals when designing courses and setting learning goals and outcomes for courses. For a long time, the prime focus in designing courses was focusing on the content that the lecturer deemed necessary to be taught, and which the learners had to master. Currently, many courses are being designed by multidisciplinary teams, considering content, context, and ways of delivery and assessment. These teams now have valuable extra strategies to make use of, which can assist learners and students to master content better, faster, and with more insight – which is important to prepare learners and students for the complex and challenging worlds of work out there.

Three aspects of curiosity merit more attention, namely exploitative curiosity, explorative curiosity, and U-shaped curiosity (Kidd & Hayden 2015:452).

Three aspects of Curiosity: Exploitative, Explorative, and U-shaped Curiosity

Exploitative curiosity is when you ask specific questions about a topic, such as what, when, where, and how to. Explorative curiosity is when you scout

the terrain of the topic wider than just getting simple answers. Here you ask questions such as, Why it is important to know this? and, How will you benefit from knowing it? Curiosity is 'U'-shaped, meaning that you will not be curious about matters that are at either end of the U – when it is too familiar ('I know that – it is boring!'), or too unfamiliar ('I am clueless about this – no use trying to understand it!'). It must be within reach, although you will have to stretch to get there, being at the bend of the 'U.'

Focusing on content and assessment, whether the content has been sufficiently mastered, was the name of the education game for centuries. On its own, it is good and necessary to focus on it because basic and available knowledge about any subject is important for expert performance. If this, however, is the be-all and end-all of education, it is insufficient to meet the challenges of our new contexts of rapid change. These contexts are characterised by posing many more unknown and unexpected questions than those whose answers could be memorised in courses. There is an anecdotal, tongue-in-the-cheek quip doing the round among scholars, stating that students have changed their ways in the recent past. Previously, it was alleged that the students came and ask if they may have the questions which were to be asked in the examination. That has changed because now they only ask for the answers to the examination questions. When everything is about content and standardised testing, the system will produce students who will look for answers to known questions. Unexpected questions will be unwelcome, and these kinds of students will be unprepared to manage uncertainty and the unknown. It is natural to be curious to get specific answers, but other natural aspects of curiosity need also be incorporated.

Explorative curiosity is about scouting the terrain wider than looking for answers to specific questions. Many studies on information seeking behaviour (curiosity) focus on primitive organisms, from roundworms in petri dishes to rats in mazes. In all of them, information seeking behaviour include exploitative curiosity such as looking for food, in other words, answers to specific demarcated questions, with explorative curiosity, namely scouting the terrain in general. The latter takes more time and energy, but it is worth the effort in cases where the food source moves.

The natural propensity to scout wider could and should be stimulated in formal learning circumstances. Just expecting learners to complete a prescribed curriculum, models the habit to look for fixed answers. Rather, as has been stated, curiosity does not need to be taught because it is an inborn survival strategy that only needs to be evoked by creating opportunities for it to be activated, and by doing this, becomes a habitual learning behaviour.

Scouting the terrain in terms of learning is self-directed learning in action, and this is the way to go in contexts of rapid change and development,

within circumstances such as the 4IR and similar, in order to prepare students for the future of work. An age-old tried-and-tested way to do this, is making use of asking questions instead of merely finding answers.

Curiosity and Asking Questions – and Entrepreneurs Asking Questions

The Socratic method – also called the elenctic method or method of Elenchus (refutation), is making use of asking and answering questions for the sake of understanding ideas and with the goal of developing dialogue and critical thinking (Oyler & Romanelli 2014:4-5 of 9; Delić & Bećirović 2016:511-514). Although this way of teaching has been around for a very long time, it is not used widely in classrooms. The reason may be that it takes more time than merely dumping content and testing the memorisation thereof. It also takes much more preparation time. There are also several challenges when using it in online distance teaching and learning. The value thereof, however, warrants attempts to not only incorporating it in teaching, but almost making it the agenda for presenting courses.

The saying 'Judge a man by his questions rather than his answers' is usually attributed to Voltaire. It is actually a version of a saying by Pierre-Marc-Gaston de Lévis (1808), 'Il est encore plus facile de juger de l'esprit d'un homme par ses questions que par ses réponses,' which can be translated with, 'It is easier to judge the mind of a man by his questions rather than his answers.' Even so, the value of giving preference to initiate information seeking behaviour by means of questions can be illustrated by the way people who are ultimately successful in not only navigating but ultimately initiating major change, use it. Being a study on its own, just one example will be provided, namely the way the most successful entrepreneur of all times, Elon Musk, is using it to understand his fields of expertise. As of October 2021, he became the wealthiest person that ever lived, surpassing Rockefeller (Warner 2021). He is therefore not only the wealthiest person in the world, but he is also the only person who started four different businesses who all reached billion US Dollar value.

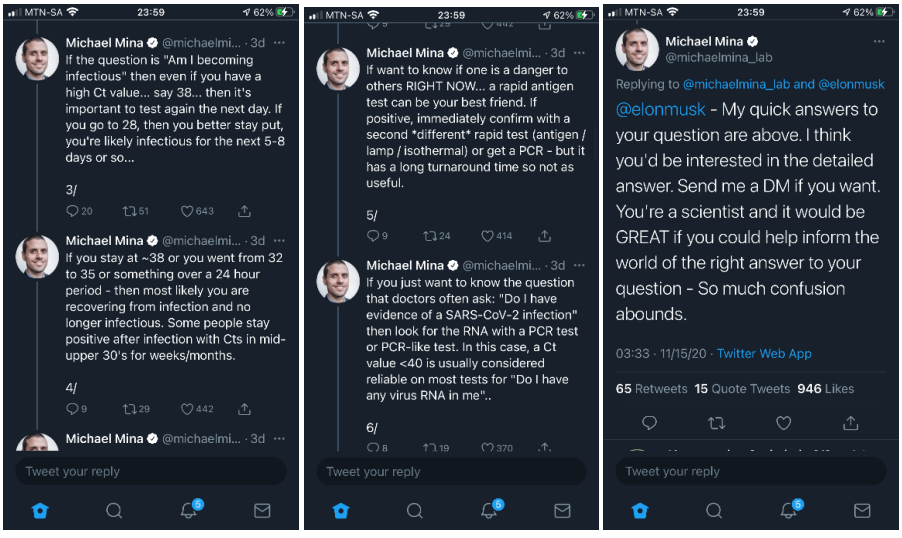
Musk already realised when he was a teenager, that 'one of the really tough things is figuring out what questions to ask. Once you figure out the question, then the answer is relatively easy' (Vance 2015:18). This way of being, caused him to eventually become the chief engineer of companies as different as SpaceX and Tesla, with all the embedded technologies in each of them.

A telling example of his habit of questioning is found in his conversation about the Covid-19 testing procedures. He had himself tested for the virus, but from the four tests that were administered on the same date at the same centre and performed by the same medical professional, two tests came back

positive while two were negative. He tweeted about it, and was lambasted on social media for sharing his experience, and accused of endangering the lives of people by casting doubt on the testing procedures and its trustworthiness. In a reaction to this, he privately contacted an expert on Covid-19 testing procedures, Michael Mina. In the discussion that ensued, Mina informed Musk about the technicalities of the procedures and how the results should be interpreted. After the discussion, Musk shared the whole discussion to all his followers, for them to share in the discussion.

What is of importance here, is not so much the outcome of the discussion, but how Musk went about when faced with a lack of knowledge in an uncertain and complex context. At some stage he wrote the following: 'In your opinion, at what Ct number for the cov2 N1 gene should a PCR test probably be regarded as positive? *If I'm asking the wrong question, what is a better question*?' (cf. Fig. 1 below).

Figure 1: Tweets between Elon Musk and Michael Mina



One goes a long way to explain the way in which his mind works and how he gets to understand a field in which he is a novice. It also explains how he managed to become an expert in the very complex industries he made a success of, as far apart from each other as space exploration, the automotive industry, green energy, and even mining and tunnelling – not to ignore brain science and artificial intelligence.

How do we teach the art of questioning in a way that will engender the skill of information seeking, both exploitative and explorative? How do we manage to do this in a way that takes into account the U-shaped character of curiosity, putting it within reach – not too near or not too far away? How do we do that in a way that is pedagogically, andragogically, and heutagogically sound, as well as feasible in a teaching and learning situation?

To my mind, this could be done by incorporating in our teaching a structured questioning strategy, which I call the 3DQS (three dimensional questioning strategy).

Curiosity as Structured Questioning: A Three Dimensional Questioning Strategy

Expecting students to ask questions about something that is new and unknown to them, is not feasible. In terms of the U-shaped character of curiosity, it is expecting them to do something that is out of their reach and will lead to dejection and self-doubt. A basic, agreed-upon foundation of knowledge needs to be provided. To do this, aspects of exploitative curiosity need to be brought into play, where specific information with intended questions and answers are provided. This should be done, however, by considering

the varying levels of expertise among the body of students. Some may have absolutely no knowledge about the discipline or that part of it which is being taught at that moment, and some might have a very good and even expert knowledge of it.

It is therefore wise to provide levels of prescribed material, with Level 1 being basic, non-negotiable material which learners need to know in order to be able to be conversant about the topic. Level 2 can be on a more advanced level, while Level 3 contains material for the budding expert. This is how, for example, Prof Tracy Tokuhama-Espinosa from the Harvard Graduate school of Education structures her *Mind, Brain, and Education* courses. In this way, she caters for both ends of the U-shaped curiosity, putting the topic within reach of the novices, but also putting it at stretch level for those who already know more or even a lot about the topic. Everyone has to stretch to reach to what is regarded by them as new but reachable knowledge and understanding.

In the discussion between Mina and Musk (cf. Fig. 1 above), the same happens. Mina provides basic information about the Covid-19 tests and testing, and then, based on Musk's questions, guides him to a better understanding of the issue at hand.

To translate this into a feasible way of teaching which will be easily memorable for learners and students, I suggest a movement-based structuring of questions that will cover all the aspects necessary to approach and eventually know and understand a new topic, field, and discipline. It is bodily movement-based, in line with the principles of embodied cognition, and as such easy to remember, freeing the mind to focus on the goal and not the strategy. Summarised, it entails looking three-dimensionally in all directions, which form the basis to eventually make a decision about the topic.

Three Dimensional Questioning Strategy

Look:

At	What is it?	Observations and analysis
Back	Where is it from?	Context and timeline
Right	How do you use it?	Use and value
Left	What else helps to understand?	Additional and collateral information
Down	How does this help *me*?	Interest, purpose, meaning
Up	Is it useful or useful enough?	Evaluation and judgement
Inside	Who am I?	Personal relevance and meaning

Then decide whether it is:

- indispensable, or
- interesting, or
- forgettable.

These sets of questions cover most, if not all aspects necessary to master a new topic or field of interest. By asking *what it is,* it focuses on observation and analysis, where basic information such as characteristics, working and constituent elements are attended to thoroughly and meticulously, with attention to detail. By asking *where it is from,* it attends to historical perspectives, such as context where it originated and functioned, as well as aspects of timelines, such as when it was first observed and what questions it attempted to answer at that time, its development, and what development or improvements might have taken place over time. Related to this are questions about *how it is used*, enquiring about the use, usefulness and value of the issue, topic, or object, thereby preventing it to be merely an abstract and disconnected idea. Embeddedness calls for questions asking *what else* could help us understand the topic, idea, or object. Additional and collateral information call for an interdisciplinary awareness, preventing tunnel vision. By asking questions about how knowing this or being able to *use this will help me*, enquires about its interest, purpose, and meaning and therefore pursues the idea of meaningful learning. By asking whether the idea, topic, of object *is useful*, it invites a critical evaluation and judgement, steering past mere acceptance of it as valid, true, or useful. Questions about *self-understanding* sensitises about subjectivity, attempting to make the learner aware of positive or negative biases towards what is being learnt. After the terrain has been thoroughly scouted in these ways, the learner is in a better position to make informed decisions about the validity and value of what has been focused on – whether to incorporate it in current knowledge structures, whether it causes current knowledge structures to be changed, or whether it can be discarded because it is outdated, skewed, or incorrect.

These questions cover the spectrum of learning, when comparing it to Bloom's knowledge taxonomy. Bloom's taxonomy (cf. Bloom, Engelhart, Furst, Hill, & Krathwohl 1956), revised in 2001 (Anderson & Krathwohl 2001) aims to describe the processes of knowledge acquisition with the goal to guide educators to set proper learning goals and objectives. According to the team led by Bloom, learning is to take place in cognitive, affective, and sensory domains. The cognitive or mental skills (knowledge) based on the domains, are described as entailing lower order thinking skills, namely knowledge, comprehension, and application, as well as higher order thinking skills namely analysis, synthesis, and evaluation (the latter two switched around in the revised taxonomy). What is interesting, is that the affective (attitude) and

the psychomotor (manual of physical skills) domains are often overlooked when the taxonomy is presented and used. For example, searches on Google Images often only refer to the six levels, as has the handout to teachers in South Africa such as the 'Be a star teacher: Bloom's Taxonomy,' provided by Macmillan Teacher Campus, guiding the CAPS (Curriculum and Assessment Policy Statement) documents.

Costa and Kallick (2008:15-41) point out habits of mind, which are a repertoire of thinking behaviours that teachers and students use to successfully manage challenges not only in the classroom, but also in everyday life. These habits cover thinking behaviours that range from the foundational mastery of learning material to an advanced understanding thereof, namely gathering data through all senses, striving for accuracy, thinking and communicating with clarity and precision, questioning and posing problems, and creating, imagining, and innovating. There are also habits necessary to guide learning behaviour, such as persisting, managing impulsivity, thinking interdependently, and remaining open to continuous learning. Contextual thinking is addressed as well, in listening with understanding and empathy and applying past knowledge to new situations. Personal meaningful learning finds a place, as in responding with wonderment and awe, taking responsible risks, and finding humour. Self-insight rounds off the set of habits, as in thinking flexibly and thinking about thinking (metacognition).

The 3D-question strategy incorporates all of the aspects mentioned in Bloom's taxonomy, namely knowledge, comprehension and application, as well as analysis, synthesis, and evaluation. It also attends to the often overlooked aspects, namely the affective or emotion-based domain as well as the psychomotor or action-based domain. The affective domain describes the involvement of the learner – from passively receiving and responding to actively participating by valuing, organising, and characterising. The 3DQS aims to involve the learner actively, and to get the learner emotionally involved in what they are busy learning by looking down and looking inside. The action-based domain is honoured by the movements and embodied cognition, by attempts to involve the person to not only learn, but also do, use, and utilise on a personal level, thereby leaving space for manual and physical skills. Similarly, the habits of mind described by Costa and Kallick are also covered by the 3DQS, from foundational mastery to personal meaningfulness.

The 3DQS could therefore be a workable, easy-to-remember-and-use strategy to guide all students, young and old, beginners and advanced, to navigate their learning terrain, ranging from initial venturing into these terrains, to an advanced mastery and elaboration thereof.

Curiosity in Higher Education

How should HE adapt to meet the requirements of the rapid changing worlds of work, with the added challenge of being in a global pandemic? According to Brink (2021), apart from the tsunami of changes within IHEs because of the Covid-19 pandemic, there is also what he calls, 'a shift in the tectonic plates of academia,' which is about the mission of HE. For a long time, everything was about academic freedom and excellence and a supply-side model of academia, based on what he calls 'curiosity-driven research.' Recently, the society 'was no longer content to hear only about what we are good at, society wants to know in addition what we are good for' (Brink 2021). Academic responsibility is necessary to augment academic freedom, and to respond to the demand side of the knowledge economy, addressing global challenges and their local variations, in what he calls 'challenge-led research.' According to him, HE has to address economic, social, cultural, and environmental challenges, seeking solutions to make society more just, inclusive, peaceful, and sustainable (Brink 2021).

Added to this is the challenge posed by the worlds of work, that the traditional three to four year residential degree is not necessarily providing the kinds of workers who cope, thrive, or excel in a rapid changing world of work. Additionally, the challenge posed by the pandemic is endangering the continued existence of both private and public educational institutions, at least in its traditional brick-and-mortar way of existence because of funding issues and dropping student numbers. Fewer local students are enrolling for reasons of health, safety, and a lack of access to funds, while political, cultural, and health issues are stemming the flow of international students and the flow of talent from east to west. Online distance and e-learning is therefore here to stay, whether for formal degree qualifications or shorter and more informal knowledge and skills-based courses, with the most important result being that students will have to be able to master this with less direct tuition and support from educators, and relying more on their own learning and mastering abilities and habits (Brink 2021).

Curiosity, or information seeking behaviour, is a natural inborn capacity for all living organisms. In humans, this need merely be given the space and opportunity to develop and thrive. Doing this in HE, entails people and a plan.

People, from educators to learners and students, need to be made aware how to harness the possibilities, power, and processes of information seeking behaviour. Many companies and industry leaders explicitly state that they are not so much interested in an applicant's formal qualifications than in their ability to master what is necessary for a specific challenge that may arise. Solid basic knowledge and understanding will always be indispensable, but which of those sets of basic knowledge and understanding will be necessary

to master at a specific point in time is what actually matters – the knowledge industry's version of the just-in-time principle. Being able to do this, calls for self-directed, lifelong learning habits and strategies for both educators and learners.

A plan to make this happen, entails institutional enabling, to start off with, but more than this, top-down intervention is a bottom-up movement where educators use the principles of structured questioning in their own research as well as in their teaching. Students at the beginning of their HE journey need to see this modelled in the way they are being taught and introduced to learning material. Learners already in the world of work will be more aware of what is needed to master, as challenges arise every day.

Curiosity, guided by structured questioning is the natural way to generate academic excellence as well as engaged responsibility in HE educators and students, responding to the challenges posed by the rapidly changing world of work.

Conclusion

The many challenges generated by the 4IR can be reduced by adding curiosity in our teaching by means of the 3DQS. Curiously – it all adds up, doesn't it?

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