Questions and Appraisal of Curiosity

Melvin Freestone(✉) and Jon Mason

Charles Darwin University, Darwin, NT 0909, Australia
saorcloc45@gmail.com

Abstract. Questions not answers drive innovative thinking. Yet pressure to produce answers often obscures the need to find questions that generate inquiry. To overcome this paradox practicable ways to make questions and questioning central to learning in educational and community settings are explored. A three-fold model for enactment of question-led learning is presented within a 'big ideas' frame of mind. Means for appraisal of inquiries steered by curious questions are articulated by drawing on well-established educational concepts and practices. These means have potential to integrate question-led learning and appraisal as interdependent partners in inquiries as well as in the acquisition and creation of knowledge. Question-led inquiries have profound implications for innovation and creativity as well as for the design, development, and implementation of educational practices.

Keywords: Questions · Curiosity · Appraisal · Pedagogy · Curriculum · Change

1 Introduction

1.1 Educational Context

Questions and curiosity generate knowledge, understanding and capability across the gamut of human endeavour. While the journey embodies a life-long dialogue with experience (Freire 1970; Dewey 1997; Vogt et al. 2003), questions often get lost in a maelstrom of answers. They become swamped with the intention to seek clarity, insight and innovation becoming a supreme irony (Haeleli 2016; Spencer 2017 and 2019). The questions teachers and educators ask are important, but learner questions are key (Chin 2002; Murdoch 2013 and 2018).

Questions and questioning drive thinking and innovation (Ram 1991; Chappel 2008; Thomas and Brown 2011; Project Zero 2015; Doherty 2018; Gregersen 2018; Sanitt 2018; Bouygues 2019; Classroom Nook 2020). TeachThought Staff (2019) put the issue succinctly. *'Questions are more important than answers because they reflect both understanding and curiosity in equal portions. … To ask a great question is to see the conceptual ecology of the thing'.*

Curious questions are the heart of intelligence and key to generating wise answers (Schank 1991). They connect us to phenomena of the life-world (Hood 2018) often provoking creativity and imagination that opens new possibilities or different ways of

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seeing the world. Asking questions enables people to direct their learning and engage in knowledge construction (Chin and Chia 2004; Chin and Osbourne 2008; Scardamalia and Bereiter 2010, Tawfik et al. 2020). The process is integral to sensemaking (Weick 1995).

1.2 Curious Questions

Different kinds of questions can be distinguished by their intention (Fig. 1).

- *Generic generative questions* (GGQs) have the potential to be applied across all areas of human knowledge, experience and endeavour. These questions direct inquiries.
- *Consequent questions* (CQs) emerge when GGQs are translated into the content of specific subject matters. These questions shape agendas capable of investigation
- *Pointed questions* (PQs) are designed to elicit defined responses. These questions address specific contextual issues within inquiries.

The GGQs in Fig. 1 expand those identified in the International Baccalaureate's Primary Years Program (IBO, 2000). Each of them has a label and a brief description which differentiates their strategic direction. The Covid-19 pandemic is used to indicate what translation of three selected GGQs into CQs and PQs might look like. The shaded areas indicate the overall 'movement of thinking' as an inquiry unfolds. Situated challenges together with prior knowledge sharpen the selection of appropriate GGQs. While 'answers' that emerge may address the initial challenge, they also open-up understandings for future application or inquiry. The whole process is iterative, not lock-step.

The unfolding of questions embodies three interdependent processes – a cognitive search to make connections (Chiu and Linn 2013; Manogue et al. 2014; Maloney 2015), an argumentative dialogue to construct and critique explanations (Berland and Reiser 2011; Ford 2012), and framing to synthesise thinking with prior knowledge and extant personal understanding (Danielak et al. 2014; Kapon 2016). A mix of convergent (Sternberg 1986) and divergent thinking (DeBono 2007) as well as metacognition (Wellman 1985; Click 2020) is often in play, with tensions kindling imagination and inventiveness (Bailin 1987; Bolger 2018). The implied dissonance creates a sense of instability that promotes continual internalization of understanding, sometimes producing an 'ah-ha' effect (Conlin 2013).

As an inquiry progresses, initial questions are often revisited. Indeed, these recurrences may have a vexing dimension that keeps sensemaking going (Odden et al. 2019). Addressing the subsequent puzzlement can be self-motivating, analogous to pleasurable discomfort derived from the pursuit of difficult or challenging questions (Jaber and Hammer 2016).

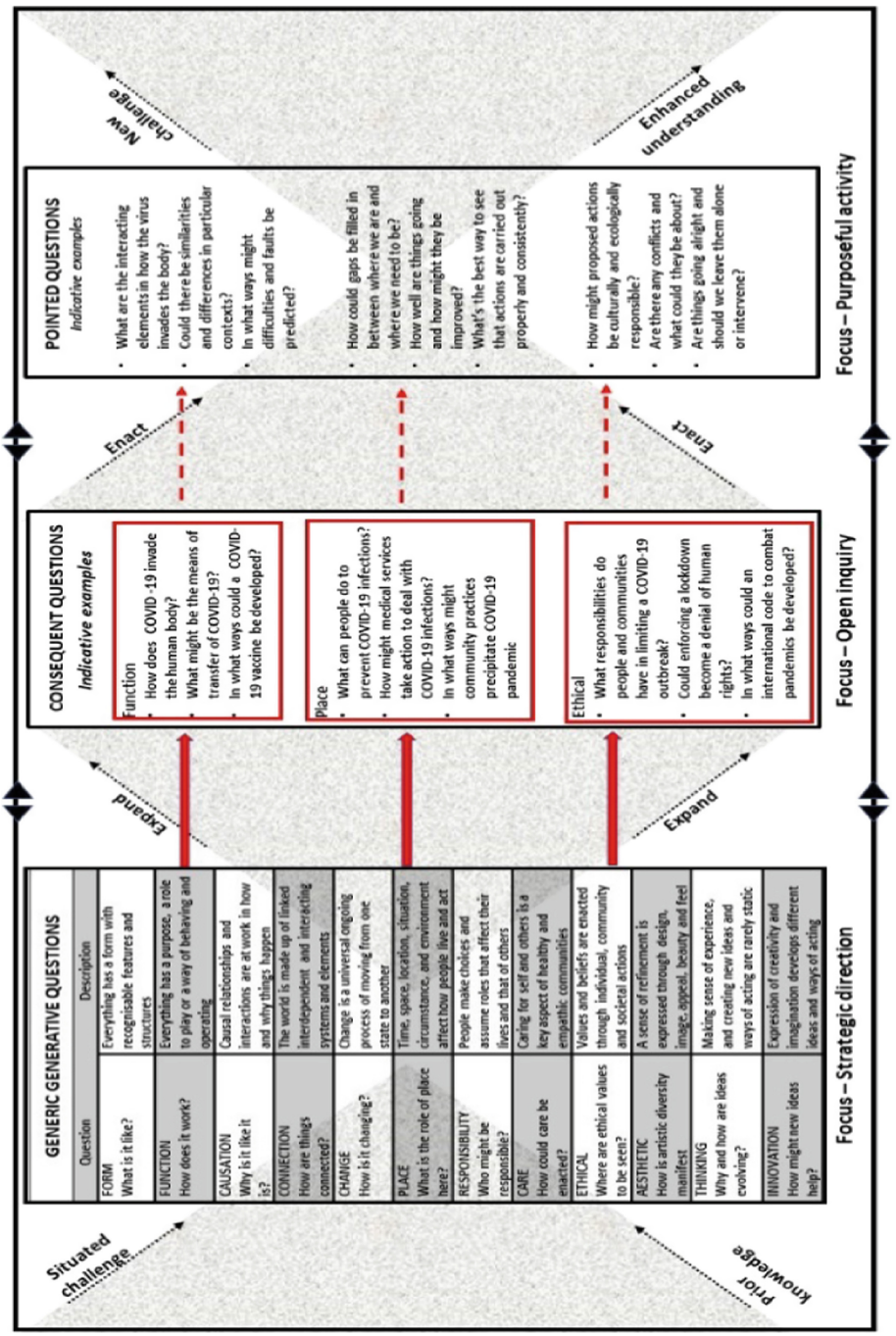

Fig. 1. Different kinds of questions.

The questions in Fig. 1 are open-ended. They provoke interpretations and explanations, ideas and possibilities, alternatives and speculations, and sometimes insightful decisions and actions (Delgado 2019; Goodwin 2019). The process is one of 'sensemaking' through which insights into what has happened or is happening, and possibilities for action, are generated (Weick et al. 2005; Mason 2014; Colville et al. 2016). In so doing, people:

- Construct unique interpretations of experience with no two people so doing in the same way or at the same rate (Fosnot and Perry 1996; Pritchard 2009).
- Generate multiple realities of experience that echo combinations of personal assumptions and aspirations (Lidsky 2016).
- Produce diverse answers to the same question derived from different functioning, structures and perceptions in the brain (Balkenius and Gärdenfors 2016).
- Employ metaphorical images to explain perceptions of experience and explore theories for action (Lakoff 1993; Kosecki 2011).

While asking questions and questioning share semantic roots, they are different (Koshik 2015). Questions are strategic means of directing and shaping inquiries whereas questioning focuses on process and action: one is directional and the other an issue of tactics (Table 1).

Questions direct searches for evidence and perspective, cause and effect relations, explanations and justifications, assumptions, and uncertainties. As well, they guide strategic generation of transformative ideas, hypothetical possibilities, and evaluative procedures (Corley and Rauscher 2013). The reflective thinking evoked goes beyond entanglement with experience or inquiry to solve pragmatic problems of the moment (Turnbull 2004; Klein and Moon 2006; Chater and Loewenstein 2016). In contrast, questioning employs focussed processes like - querying, clarifying, predicting, speculating, synthesising, view-pointing, contradicting, and challenging - to explore questions posed (Lewis and Smith 1993; Palincsar 2011; Peterson and Taylor 2012).

Strategic questions and tactical questioning are typically in a synergistic state of harmony and dynamic contention. 'Argument' between them engages established and alternative perceptions of experience, as well as different conceptualizations, mental images and imaginative possibilities (Donaldson 2010; Brogaard and Gatzia 2017; Gideonse 2019). 'Playful dialogue' does much to help resolve tensions between personal and situated dissonance and generate connections from critical and creative thinking (Wegerif 2007).

Curiosity is energized through questions and questioning (Oppong 2019). The diversity of sensemaking engendered reflects personal perceptions intertwined with the ecology of extant connections formulated from them. Practical problem solving may be part of the process but the whole widens outlooks into the unknown and towards possibilities for the expression of personal talents. With potential to know going beyond logic to create intuitive and imaginative thoughts, and actions (Dalsgaard 2014).

Table 1. Questions and questioning.

Feature	Questions	Questioning
Intention	Determining directions for personal and collective inquiries in real-life contexts	Engaging in processes and actions to explore different aspects of challenges
Concept	Shaping inquiries to focus on issues, ideas, problems, and alternatives	Executing inquiries guided by strategic directions and possibilities for exploration
Emphasis	Focusing on design, purpose, scope, and forward-thinking possibilities for inquiry	Concentrating on performing investigations, tasks, actions, and their practicability
Orientation	Exploring challenges, understandings, contradictions, feasibilities, problems, possibilities, and novelties	Tackling investigations in the context of needs, demands, situations, circumstances, and conditions
Essence	*Strategic intention*	*Tactical action*

Figure 2 represents evolving relationships outlined in Fig. 1. Each of the four elements combine to form a propositional framework for inquiries built around questions. The features identified for each element distinguish their roles and functions. GGQs represent 'starting blocks' with CQs and PQs connecting them with life-world action. Enactment of these questions often benefits from structured processes such as 'action research' (Kemmis and McTaggart 1998), especially if they are appreciative of current conditions yet mindful of future possibilities (Shuayb et al. 2009; Cooperrider 2016).

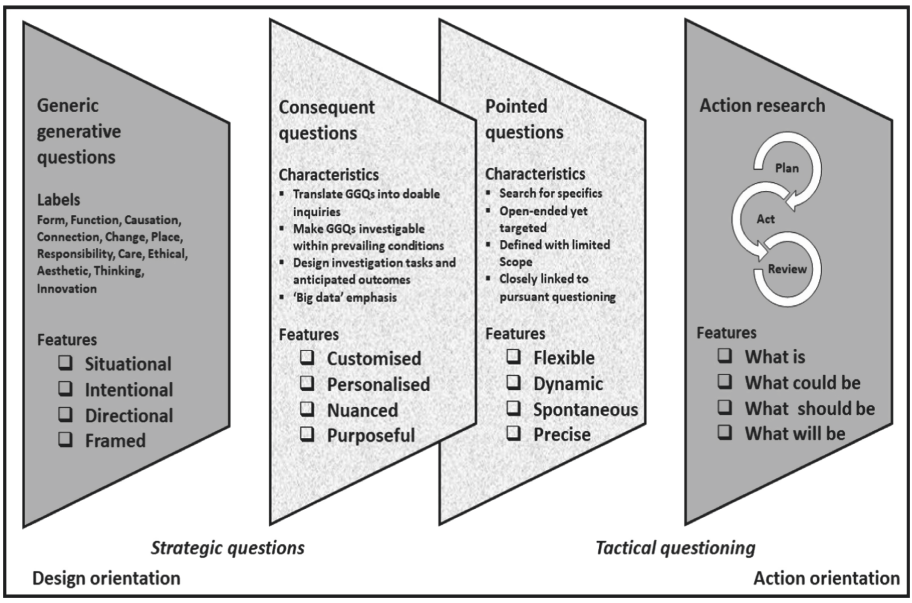

Fig. 2. Strategic questions to tactical questioning.

Assigning a pivotal role to GGQs creates a means to add coherence, consistency, and purpose to inquiries (Freestone 2018). Indeed, the ability to apply them in multiple contexts and for diverse purposes could provide a life-long resource for question-led learning. They create an innovative mindset that promotes design, insight and practicability.

1.3 Intentional Exploration

Establishing an inquiry begins with analysis of the situational features and socio-cultural practices in play. Once a clear picture is to hand two or three GGQs can be selected. A few that best reflect the needs and intentions behind a prospective inquiry is advisable, as too many can become unmanageable. With chosen questions in mind, investigative processes can be devised; although, sometimes disordered thoughts, even confused or messy thinking may instigate inquiries (Gregoire and Kaufman 2015; May-Li Khoe 2016).

A central intent is to perceive and construct connections that have value (Odden and Russ 2018). The inherent complexity is seldom satisfied by investigating narrow or detached sets of variables. Instead, an array of interrelated aspects are involved (Madsjberg 2017).

- Exploring cultures – not just individuals or isolated events
- Investigating in depth – not just thin data or simplistic variables
- Focusing on real life – not just a smorgasbord or issues detached from experience
- Highlighting creativity – not just manufacturing or assembling thinking
- Building vision – not just searching for destinations or reputable endpoints.

Mental images are modified in the light of emerging experience (Frank and Scherr 2012; Danielak et al. 2014; Kapon 2016). Of necessity much of the thinking is imaginative, often tacit, and beyond extant silos of understanding. In the process, subtle combinations of 'wonderment' questions (Aquiar et al. 2010; Perin 2011) and 'vexing' questions are helpful (Odden and Russ 2019). The whole is enhanced when people are engaged in constructive learning communities (Eteläpelto and Lahti 2008), especially where a tenor of improvisation and innovation prevails (Corbett et al. 2016).

Voltaire (1694–1778) posited: *'Judge a man by his questions not by his answers'*. The limitless horizon of questions and questioning bespeaks the enormity of the challenge, which is accentuated by the scope of the indicative 'curious relations' related to each GGQ in Table 2. Each 'curious relation' counterpoints related concepts for exploration (Erickson et al. 2014). Within this milieu, questions around facts and procedures generate little discussion whereas questions that evoke wonder provoke more thoughtful and deeper conversations (Zambrano 2019).

This scenario is too multidimensional to be amenable to standardized testing. Even tests like PISA, which purport to ask questions around concepts (NSTA 2009; OECD 2018), often evoke responses that are based on memory (Bennett 2016). As well, much controversy exists around the capacity of multiple-choice testing to reveal deep learning due to guessing or choices being made on what appears to be 'correct' with little thoughtful consideration (Biggs 1973; Beard and Senior 1980; Entwistle and Entwistle

Table 2. Curious relations. (modified from Freestone 2018).

What is it like? **FORM**	**How does it work?** **FUNCTION**	**Why is it like it is?** **CAUSATION**	**How is it connected to other things?** **CONNECTION**
Systems/Processes	Designs/Intentions	Consequences/Impacts	Circumstances/Conditions
Mechanisms/Operations	Effectiveness/Efficiency	Contexts/Situations	Initiatives/Opportunities
Materials/Properties	Power/Energy	Motivations/Inspirations	Networks/Relationships
Performance/Functionality	Processes/Mechanisms	Causes/Effects	Powers/Motivations
Structures/Purposes	Roles/Elements	Patterns/Sequences	Intentions/Benefits
Wholes/Parts	Systems/Maintenance	Theories/Explanations	Interoperability/Sustainability
How is it changing? **CHANGE**	**What is the role of place here?** **PLACE**	**Who might be responsible?** **RESPONSIBILITY**	**How could we care for each other?** **CARE**
Adaptability/flexibility	Cultures/Backgrounds	Citizenship/Rights	Empathy/Understanding
Factors/Influences	Features/needs	Justice/Prejudice	Friendship/Compassion
Growth/Development	Histories/Circumstances	Opinions/Decisions	Needs/Support
Movement/Flow	Interactions/Relations	Participation/Exclusion	Teamwork/Collaboration
Cycles/Sequences	Resources/Infrastructures	Individual/Community	Appreciation/Respect
Transformations/adaptations	Sites/Locations	Personalities/Affinities	Rights/Responsibilities
Where is the ethical reasoning? **ETHICAL**	**How is aesthetic sense manifest?** **AESTHETIC**	**How is the thinking evolving?** **THINKING**	**What might innovation add?** **INNOVATION**
Beliefs/Traditions	Appeal/Attraction	Alternatives/Possibilities	Creativity/Improvisation
Outcomes/Benefits	Designs/Structures	Dependent/Independent	Flexibility/Adaptation
Equity/Equality	Images/Messages	Critical/Creative	Innovative/Pragmatic
Justification/Rightness	Perceptions/Interpretations	Imaginative/Inventive	Ideas/Actions
Diversity/Difference	Relationships/Linkages	Issues/Problems	Prototypes/Products
Values/Moralities	Style/Flair	Reflections/Contradictions	Research/Trial

1992; Dulger and Deniz 2017; Weimer 2018). Differences in the values and cultural backgrounds of responders are also overlooked.

Traditional means for assessing knowledge are based on demonstration of increasing conceptual sophistication. Bloom's taxonomy (1956) or variations of it are widely used. Yet the scope and complexity of GGQs and their associated CQs makes dependence on one, or even a few, means for appraisal problematic. Pictures of personal and collective learning often become skewed by the means with important aspects of performance omitted. A more authentic picture might be derived from profiling experience and performance around observed realities, as distinct from a proxy sequence of preordained levels or perceptions of expected performance.

1.4 Continuous Appraisal

In addition to issues of authenticity and reliability, appraisal of inquiries and questions need to be comprehensive. Earl (2013) distinguished three kinds:

- Process orientated appraisal as learning
- Progress orientated appraisal for learning
- Achievement orientated appraisal of learning

A balance between the three is integral to question-led inquiries. A strategic possibility to meet the criteria of authenticity, reliability and comprehensiveness might be to profile questions asked and enacted (Broadfoot 1987a and 1987b). The process could take place in three stages.

Stage 1 – Profiling Possibilities. With the GGQs selected in mind, consider the possibilities embedded within the content and context of inquiries. What opportunities might be available or created to explore – situated, conceptual, hypothetical, known and unknown features? Exploration of these investigative possibilities might also reveal other latent questions nested within those already identified.

Stage 2 – Collecting Evidence. To be authentic, not contrived, evidence needs to be comprehensive and collected over the life of an inquiry. In so doing, it needs to encompass as many aspects of the investigative processes as possible. A diverse repertoire of strategies is available.

- Portfolios of work
- Data from conferencing
- Peer feedback
- Performance results
- Anecdotal records
- Discursive writings
- Conferencing feedback
- Photographic records
- Multimedia presentations
- Metacognitive perceptions
- Talents required
- Story telling or retelling
- Multimedia storyboards
- Self-assessment

Portraits of individual progress gained through an inquiry are enhanced when several of these means are employed. Once a volume of evidence is to hand it can be culled to select the most representative or indicative samples.

Stage 3 – Profiling Performances. Sensemaking performances can be appraised in terms of the depth and breadth of curiosity. Analysis of the evidence collected against specific criteria or backtracking to the goals behind an inquiry would expose:

- the sophistication of thinking, different kinds of thinking, integration across different disciplines of knowledge and experience, and consistency of performance.
- the breadth of thought and action reflected in the organisation of tasks, the diversity experiences encountered, and the opportunities created for cooperative or collaborative activity.

'On balance', judgements across the range of evidence collected tend to provide a more dependable assessment of the knowledge, capability, and innovative thinking exhibited than attempts to identify the best or worst within the material that has been accumulated.

A summary record of development (James et al. 1988) could be distilled from evidence of progress revealed through profiling processes. In so doing, a visual representation (Fig. 3) of the quality of question-led learning could be built around markers like - depth of thinking, scope of subject matter, consistency of performance, collaboration with others, and organisation of investigations. Such visualizations would be enriched by illustrative samples of individual and collective work or annotated snapshots of activity.

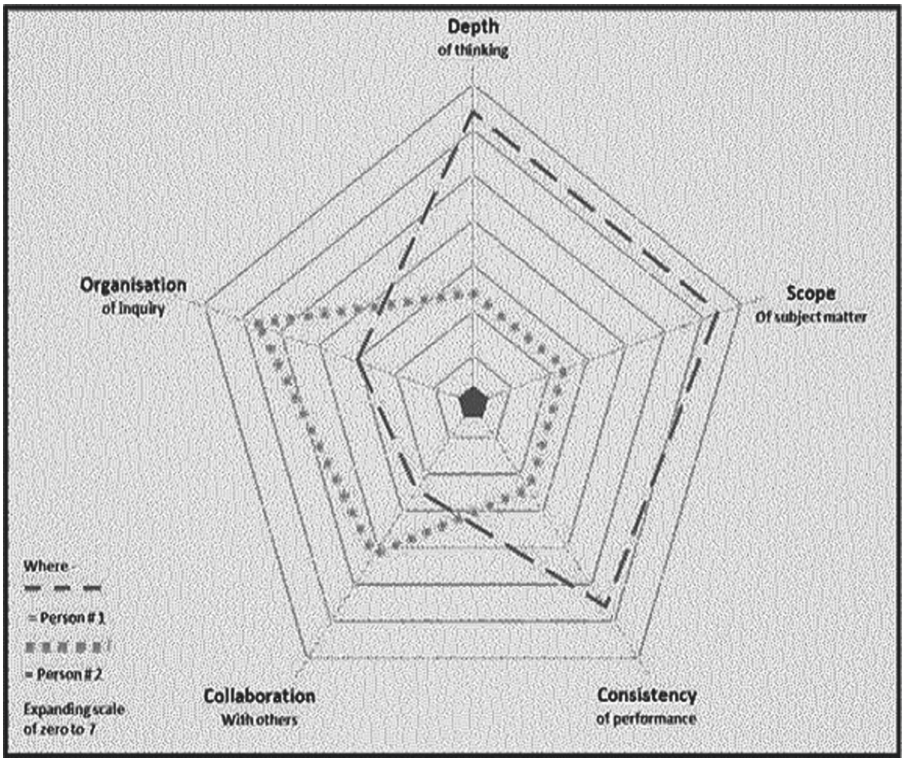

Fig. 3. Visual record of development (indicative example).

If keeping records of development is to be doable, each person or group needs to take responsibility for maintaining, and where necessary culling, their own record of development. This process promotes reflection on the relative worth of ideas developed and achievements accrued.

To gain maximum benefit from profiling a means of interpretation is required. Figure 4 which draws on established theories of learning put forward by Vygotsky (1978), Biggs and Collis (1982), and Bruner (1966) creates a possibility. The cascading movement upwards through zones of proximal development (ZPD) bespeaks internalization of intelligence. Increasing depth of learning through four levels of sophistication labelled – descriptions, explanations, interrelations and extrapolations – can be observed along the lines of the SOLO taxonomy (Biggs and Collis 1982). The horizontal spiral at each level of sophistication describes movement from enactive or action-based to iconic or image-based to symbolic or language-based activity.

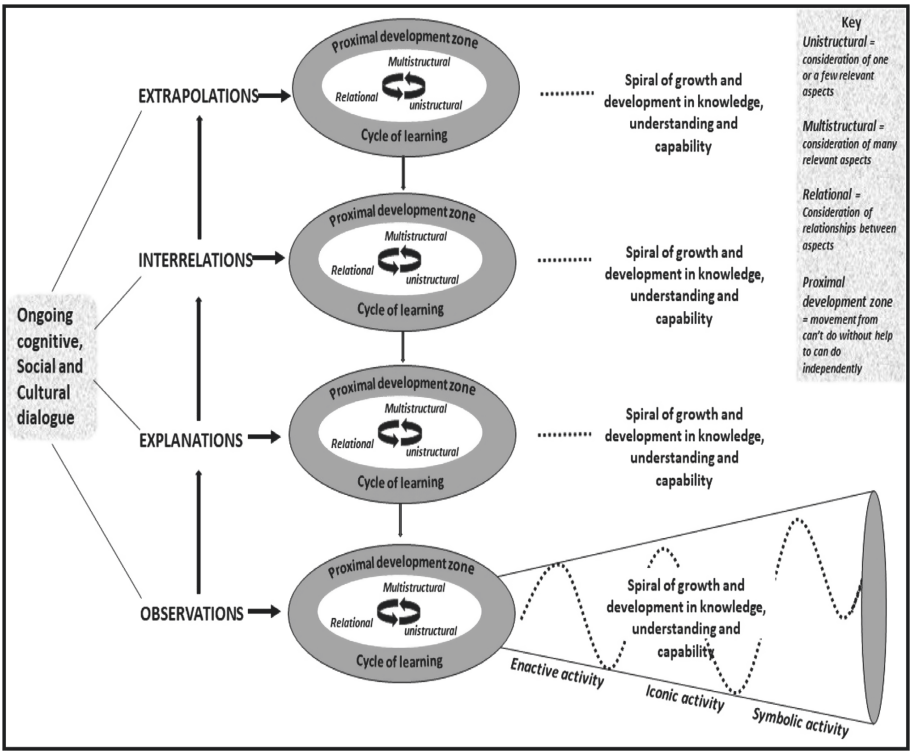

Fig. 4. Growth in learning.

Standards of thinking could be ascribed by observing progress from recall and reproduction, to development of skills and concepts, to growth in strategic thinking, to expansion of imaginative and innovative ideas and practices.

Appraisal of the questions people ask would be informed if the GGQs in Fig. 1 could be articulated in terms of different foci or maybe 'de facto' degrees of sophistication. Table 3 indicates increasing complexity in making observations, seeking explanations, perceiving interrelationships, and extrapolating understandings to unrelated contexts. The patterns are indicative with precise descriptions dependent upon their translation into the content and context of particular inquiries.

Profiling is analogous to telling stories about performance. It provides a means for appraising curiosity and questions posed in complex systems and 'wicked' problems, and the inquiries emanating from them (Ollove and Lteif 2017). Insight into some of the tacit, explorative, reflective and declarative knowledge being developed would likely be gained (O'Toole 2011). Analysis of the language used and imagery evoked in the verbal, written, visual or multimedia aspects of stories told would deepen these insights. (Lakoff and Turner 1989).

When people think about how their thinking has evolved, they come to recognise what they know and what they don't know (Costa 1984 and 2011). The metacognitive insights that emerge do much to inform the 'next' questions bubbling across the template of a persons' consciousness. And when 'next' is juxtaposed against the 'previous' more of

Table 3. Complexity within GGQs.

Generic generative questions	Focus Indicative examples			
	Observation	Explanation	Interrelationship	Extrapolation
FORM What is it like?	Features of things have similar and different properties	Things are made up of parts working together for a purpose	Elements interact, often harmoniously, to form systems	Designs can be adapted or transformed in different contexts
FUNCTION How does it work?	Different features in natural or human built systems work together	How entities interact in a physical or a living system powers its functions	Functions of a system are shaped by the roles and performances of its parts	Design principles on which a system is based informs future advances
CAUSATION Why is it like it is?	Intentions, ideas, and relationships affect the value and impact of actions	Consequences, impacts and benefits of ideas and actions can be predicted	Relations between entities reveals causes and effects, and ways to intervene	Ideas and actions reflect human and ecological values and their implications
CONNECTION How are things connected?	Things have internal links and external interrelationships	Interconnections between entities affect value and performance	Situated impacts and performances reveal needs and future possibilities	Insights into interconnectedness informs action and potential worth
CHANGE How is it changing?	Change in each context has specific causes, effects, and potential value	Context and purpose affect the emerging and latent effects of change	Factors affecting change vary in intent, nature, impact, magnitude…	Application of strategies for change affects intended benefits and impacts
PLACE What is the role of place here?	Places have specific features which vary in nature, role, and significance	The needs of each place incorporate specific purposes, needs, and conditions	Knowing how things work or could work helps refine human practices	Managing places requires balancing needs, intents, effects, and actions
RESPONSIBILITY Who might be responsible?	Actions by people and groups affect how self and others feel, and act	Personal choices have consequences that affect self and other people	Balanced choices combine purposes, principles, and obligations	Criteria and obligations for making choices vary in different contexts
CARE How can care be enacted?	Care for others respects their needs, desires, feelings, and circumstances	Caring people can empathise with diverse personalities and aspirations	Respect for the needs of people and communities creates realistic support	Collaboration creates nuanced ways to support, respect, and help others
ETHICAL Where are the ethical values?	Values behind ideas and actions underpin their worth and effect	Diversity in culture and tradition often underpins how people think and act	Views of worth, dilemma, and merit evolve with time and circumstance	Appreciation builds respect for diversity in values, beliefs, and traditions
AESTHETIC How is artistic value evident?	Different ideas and actions create specific features, images, and effects	Aesthetic concepts echo personal experience, perspectives, and intent	Artistic practices and artefacts reflect cultural, aesthetic, and attractive value	Aesthetic ideas and practices embody imagination and creativity
THINKING Why are ideas evolving?	Values, social practices, feelings, and emotions echo experience	Reasoning and sensemaking evolve as reflections on experience unfolds	Effective responses to challenges often grow from thinking laterally	Tension amid critical and creative thoughts incite inventiveness
INNOVATION How might new ideas help?	Inventiveness requires imaginative application of ideas in a context	Ingenuity searches for new ideas and fresh ways to apply old ideas	Development of innovative ideas and actions is a never-ending process	Original ideas or new ways to apply old ideas can change human practices

the unknown that needs to be explored comes into view. Indeed, metacognitive reflection is a mix of personal appraisal, and growth (Zohar and Barzilai 2013). The process is innovative in tenor as much as it is descriptive.

Much remains hidden within the personal knowledge people develop, which often makes a person's 'next' questions more enlightening than those already addressed. Selected GGQs become refined and different CQs often emerge in response to personal growth or collegial dynamics among people or shifting challenges within an inquiry (Elkins-Tanton 2018). When 'next' is intermeshed with the evolving substance of an inquiry a more profound picture of the sensemaking and the potential for further work comes into view. An agile view of 'where we are' and 'where to next' ensues. Indeed, curious patterns of - what is, what might be, what should be, and what will be – come into being.

1.5 Emerging Pictures

When thinking and dialogical capabilities are illuminated the state of an inquiry is revealed. A means to aid reflection on the maturation of performances from simple to complex understanding and movement of dialogues from certainty to exploration of uncertainty is presented in Fig. 5. The features for each 'condition' provide a lens for analysing the 'state of play'. Maps of the overall 'condition' that emerge may orientate towards technicality, judgement, or complexity. The question is '*where is the emphasis?*', especially as all three would likely be involved to some degree in most inquiries.

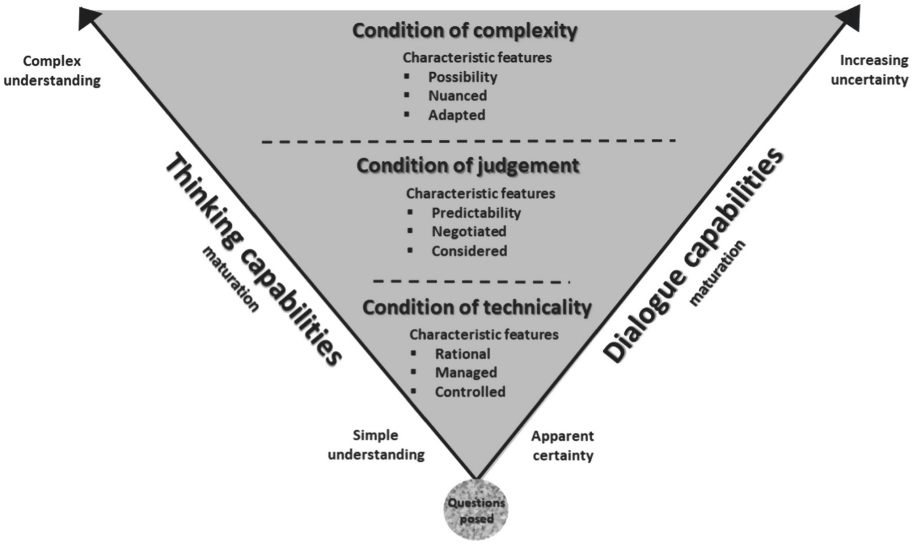

Fig. 5. Thinking and dialogical capabilities (Inspired by Zimmerman 2001)

The appraisal processes argued here are underpinned by a concern to celebrate curiosity, imagination and innovation. They are appreciative borne on 'can do', as distinct from

searching for what people cannot do or deficits in what they have done. Judgement is part of the process, but accrued benefits focus on appreciative understanding of the capabilities developed and expressed with an eye to further development.

2 Future Outlook

In this paper questions, curiosity and appraisal are viewed as an integrated whole that provokes innovative thought and action. Encouraging question-led learning would do much to light up curiosity and empower people and communities to deal creatively and imaginatively with life-world challenges as well as address global issues of present and future significance. 'Wicked problems' like the current pandemic, climate change, and population growth will challenge humanity for the foreseeable future.

From a teaching and learning perspective, pedagogical strategies and much curriculum practice would be enhanced if question-led inquiries were to become more prominent. Finding ways to support action among communities of learners across the spectrum of educational settings would be key.

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