

School leaders need to be knowledge savvy but what do they need to know ?¹

John Munro

The core work of school leaders is to manage and lead their organizations so that the learning opportunities of all of their students is optimised. In the context of change on so many fronts, many leaders find this difficult.

Nor is the situation eased by an examination of learning. One of the characteristics of public education over the past 30 years has been an increased dialogue about learning. However, rather than leading to a clear understanding of what this means, the dialogue has led to a plethora of concepts, some of which are seen as opposites, some as complementary and some as including others. Schools have talked about authentic learning, whole brain learning, learning styles, co-operative learning, work place learning, scaffolded learning, reflective learning, problem solved learning, negotiated learning, integrated learning, self based learning, on-line learning, about the topic and metacognitive learning and most recently, personalised learning.

In this article I am proposing that the work of schools generally can be assisted by a focus on knowledge and how it is enhanced and used. By 'knowledge' I mean all that an individual or a group (a community, etc.) knows about themselves and their world. It includes their bank of experiences, their conceptual, linguistic and procedural knowledge, their accumulated cultural and family knowledge, their attitudes and dispositions, their knowledge of how to think and to learn it, their self identity and how they see themselves and others, their beliefs, for example the expectations they have of schools, they have. In other words, it is the 'lens' through which a person interprets and makes sense of their world at any time.

This approach defines learning in terms of changing or enhancing parts of this knowledge. When individuals or groups have learnt something, they may be able to do, understand or say particular things differently, have enhanced beliefs, have different attitudes or know more about themselves and their culture. In the present context of rapid change, educational provision needs to cater for greater diversity and breadth in factors such as culture and attitude, in addition to the drivers mentioned earlier.

This approach proposes that educational provision needs to be informed by a validated model of knowledge enhancement at the policy, leadership, curriculum and assessment, school leadership, teaching and student levels. In this paper I argue that knowledge and its enhancement and transfer provides a key unifying framework for public education in a time of change.

Much of the recent dialogue about effective teaching and learning ignores, or overlooks issues related to knowledge and its enhancement. I saw this recently when I was invited to attend a discussion about the value and means of teaching higher order thinking. Over 80 teachers from 25 schools were involved. At no time in the 2 hour discussion was any reference made to what the students might know having engaged in the thinking. The focus of the teaching was squarely on teaching higher order thinking as an end in itself.

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I am not arguing here against teaching higher order thinking. Instead, I believe that higher order thinking is a means to an end; that thinkers use these ways of thinking to enhance their interpretation or understanding of a topic or issue.

A school is less likely to get enhanced student knowledge if its teachers don't know to look for it ! School leaders need to be aware of this. They are better able to foster this if they know what it 'looks like'. Hence this paper.

While the education profession generally has emphasised learning over enhanced knowledge, this is not the case with other players in the education process:

- Students look for enhanced knowledge to decide if they have learnt in a particular situation: *Do I know more / can I do it now ? Do I understand it better ? Do I like it more ?*“.
- Parents use the criterion of what their students know.
- Education systems and governments, both explicitly or implicitly use this as, if not their main criterion, then one of the key ones they generally use when they are examining the success of learning.

This paper

- discusses knowledge, learning and understanding;
- describes a framework for examining knowledge enhancement; and
- shows how this knowledge can contribute to the work of school leaders.

What is a knowledge enhancement perspective ?

This perspective focuses on how aspects of knowledge change as an individual learns more about it. The aspects can be an understanding of a topic or a subject, ways of thinking or attitudes and dispositions. It answers the question : What does a learner's competence or understanding look like as they know more about it ?

Teaching to foster the knowledge journey. The 'knowledge journey' is driven by learning from others and self learning. School leaders and teachers who know what the journey looks like for various topics can more effectively match teaching and curriculum with what their students know at any time and help them learn more effectively. If they can recognise the steps or points on a knowledge journey, they can use the most appropriate teaching to move to the next step.

Some of the questions that the knowledge enhancement approach helps school leaders to answer:

- How does a student's new knowledge gradually change ? What does the change 'look like' ? School leaders who know this are more able guide or lead the teaching agenda ?
- How can teachers and schools recognise and deal with the knowledge differences that students bring to school ? Differences may be due to a range of sources. The focus on multiple types of entry level knowledge assists leaders to work with these, so that all students can make optimal progress on their knowledge journey.
- How can students learn to form a functional, useful knowledge of the topics they learn ?

Many schools have the experience of knowing they have taught particular topics but find their students have great difficulty using later the knowledge taught. They may not, for example, use it to solve problems effectively. The knowledge enhancement approach assists leaders and teachers to target this explicitly.

- How can we help students to think creatively or innovatively about topics they learn at school? The teaching needs to help them to get their knowledge to a particular form so that they can think creatively using that knowledge. Without this teaching, they will have less to think creatively about.

School leaders will be more able to lead and guide the implementation of effective teaching if they understand the 'knowledge journey' of topics. They will be more able to engage in on-going constructive dialogue with staff about learning and also to make more effective decisions about learning and teaching.

How can knowledge enhancement be described? The knowledge enhancement model describes how a person's understanding of a topic or theme gradually changes or transforms and the processes that guide this change. For simplicity it describes the enhancement in terms of three main phases of knowledge transformation.

The change is facilitated by a number of key evidence-based cognitive-affective processes that are referenced in cultural contexts. Teaching and school activities stimulate and guide both the 'processes' and the 'knowledge elements' that are transformed during learning.

In this article I describe the separate changes in various aspects of knowledge. This separation is again for simplicity. In the real world, the aspects of knowledge operate in an integrated way. When one aspect of knowledge is stimulated, the links aspects are stimulated as well.

There is insufficient space to describe the relevant teaching procedures. These are described in depth in Munro (2006).

What one knows : the starting point for knowledge enhancement

A person's existing knowledge provides the starting point for knowledge enhancement. It provides the 'platform' for interpreting the teaching information at any time and for evaluating and using feedback received. As noted earlier, I use the term 'knowledge' to refer to all that an individual or a group (a community, etc.) knows about one's self and one's world.

The various ways of knowing. It is useful for school leaders to be aware of the range of ways in which students can 'know a topic'. To give an example of each type, I have used a grade three – four class learning about how fish breathe. The types of knowledge and examples of each includes the following:

- (1) a bank of stored experiences and a distillation of these, that is, each student's experiential or episodic knowledge (Tulving, 2002; Gardner, 1995). Different students may recall images of gold fish swimming, seeing a dead fish, a big fish pursuing a small fish, colourful reef fish swimming among coral. Individual students' experience are personal and subjective and unique to the individual.

In each experience the ideas are linked in time and place and include the relevant feelings and the actions. These experiences have been shaped by economic, political, and cultural influences. From this experiential knowledge learners distil or draw out typical ideas, such

as the stereotypic or prototypic images they have of fish.

- (2) abstract conceptual knowledge (Anderson, 1982). Here the ideas are linked in more abstract, 'decontextualised' ways. The ideas apply to fish more generally, not to fish in specific situations. The students can talk about more general properties or features of fish. These are 'verbal propositions' and apply to many fish.

Examples are grade 3 students noting that *Fish die when they are taken out of water*, *Fish swim by wriggling their tails* and *Fish can swim under water with their mouths open*. They can also talk about various ways of breathing. Each sentence links two or more ideas. Each can also be linked with an action sequence that can be applied across a range of contexts.

- (3) the procedural knowledge or skills associated with the abstract knowledge. These are actions students learn to link generally with the key ideas. The students may do breathing actions and note when their breathing actions change, for example, when they do exercise and get tired. They may also wonder about how it is possible to breathe under water and whether fish have lungs or gills when they do lots of activity.
- (4) attitudes and dispositions towards the topic or the phenomena (Krathwohl, Bloom & Masia, 1956); learners link values and feelings with a topic, for example, whether it interested them or was useful, their motivational knowledge. They have beliefs relating to whether learning more about fish might interest them, or be useful knowledge they could use.
- (5) their identity or knowledge of self and how they are positioned in relation to others in the cultures of which they are a member. These include cultures determined by their school, their ethnicity, and the community in which they live, (that is, their social identities). Students learn from their cultures to decide whether topics taught at school are valued and useful to learn and how to learn them. They have beliefs about whether they are usually expected to learn scientific ideas (about fish) and whether the cultural groups of which they are members learn them. They may also form beliefs about how learning these ideas may change them in relation to others their demographic or cultural groups. Learning topics in science at school may, for example, mean they will be seen differently.

Students bring this knowledge into the classroom. They prioritise their identity in the classroom in terms of their identities in other cultures, for example, in the culture in which they work part time, the culture of the computer games that they play and in the culture of the peer group/s of which they are members. Their social identity in the peer group learning about how worms breathe may be more important than their identity as a student learning these ideas. They may know that their knowledge of how to play virtual reality games in cyber space is more important than their knowledge of how worms breathe in real space.

- (6) a knowledge of how to think and to learn, (Pressley & Harris, 1990), the learning actions they use, how they manage and direct their learning activity (their metacognitive knowledge), for example, how to reflect, to think creatively and critically, to think about possibilities), to transfer and contextualize one's knowledge, motivational knowledge, including motivation to achieve, whether they can be successful learners of the topic (that is, self efficacy; Nichols & Utesch, 1998).
- (7) a knowledge of how the teaching-learning context operates. They link the ideas with the contexts in which they learnt similar ideas previously, for example, how the roles of

‘teacher’ and ‘learner’ operated in those situations (knowledge of self in relation to others). They may recall how they went about learning about other animals such as insects and pets, and how it was acceptable to think about possibilities, take risks and to look for evidence. This knowledge can generalise to beliefs and metaphors about one’s world.

One’s understanding of a topic or a phenomenon is determined by what one knows about it at that time (Anderson, 1994; Reed, 1993; Roth, 1990). It is the synthesis of the aspects of knowledge above that are in the person’s consciousness or awareness at that time.

The ways of knowing are integrated These aspects of knowledge are not separate and isolated from each other in a ‘silo’ type model but are intricately linked into networks of meanings (McClelland & Rogers, 2003). Suppose a grade 3 class is told it will learn more about the topic *How fish breathe*. The students may recall images of fish swimming, other animals breathing, ways of talking about breathing, breathing actions, whether the topic might interest them and whether they expect to learn the ideas successfully.

These different ways of knowing about the topic are linked. The images can stimulate the words and the attitudes, and vice versa. The notion of a ‘schema’ is used to describe the linked set of aspects (Perkins, Jay et al, 1993).

Linking the various forms of the ideas allows the students to enquire and to ask questions. Following visualizing, for example, students may wonder how it is possible to breathe under water and whether fish have lungs or pant when they do exercise and get tired.

Knowledge and learning preferences. While individuals can potentially have all of the aspects of knowledge, they differ in what they know for each aspect. For the topic *How fish breathe*, for example, some students may have largely experiential knowledge and little abstract conceptual knowledge while others have more conceptual knowledge.

These imbalances in the forms of students’ existing knowledge influence how they engage in knowledge enhancement. Any teaching needs to make assumptions about how students learn. Any teaching procedure will favour some aspects of learning over others. Successful learning will be less likely when there is a mismatch between the learning demands made by the teaching and a student’s learning preferences.

Imbalances in the various knowledge forms of an individual have been conceptualised as learning styles (for example, Riding & Cheema, 1991) and differences in verbal versus performance ability (Wechsler, 2004). As well, an individual may know some topics largely through experiences and other topics more abstractly.

Cultural influences on knowledge Individuals learn these aspects of knowledge from the culture/s in which they interact (Cole 1998; Valsiner & van der Veer, 2000). Cultures value particular aspects of knowledge (Hodges, 1998) and foster particular ways of learning (Munro, 2007). For any individual, each aspect is likely to have both culturally defined and idiosyncratic aspects.

We have already noted that cultural membership influences how learners organise their knowledge. The culture can determine how ideas are linked and what is valued as salient experiential features to link with a concept. Cultures differ in

- how they define concepts and propositions,
- the typical experiences they foster and value,
- how they use knowledge to make decisions, to solve problems and to meet their range of

needs,

- the symbolism they use to represent and to link ideas,
- the ways in which they scaffold learning and
- the beliefs they foster about learners and learning.

Different cultures may approach the one knowledge journey through a topic quite differently. In a classroom in which several cultures are represented, it is possible that the teaching may favour particular cultural aspects of existing knowledge over others.

School leaders interested in knowledge enhancement can examine what is known about the existing knowledge of students in their school, and how their staff use this to maximum advantage for student growth. To what extent, for example, are the various aspects valued and used? Is cultural diversity and plurality seen as an asset and as advantage?

The learning or knowledge change process : The gradual changes in knowledge

During the knowledge enhancement process, learning can occur in each of the above aspects of knowledge. This section describes systematic changes in these aspects. The learning actions or processes that make these changes have social-cultural origins. There is insufficient space here to describe these actions. They, and the teaching conditions that foster these changes are described in much greater depth in Munro (2006).

The knowledge enhancement process involves individuals learning to link ideas in new ways. This section looks at the gradual enhancement of conceptual and procedural aspects of knowledge, attitudes and dispositions, ways of learning and thinking and one's understanding of the learning context. What students know about each aspect can increase in its quality and form as they learn more about the topic.

As learners make this transition in their conceptual knowledge, they as well transform the other aspects of their knowledge in parallel, integrated ways. They have the potential to learn more complex procedures, attitudes and ways of learning and thinking they link with the topic.

Trends in learning conceptual knowledge. As individuals learn more about a topic, their understanding of it changes in significant ways. This is more than simply adding to or extending what is already known. After the initial construction of the new knowledge, learners can transform it. This leads to enhanced understanding opportunities (Diakidoy and Kendeou 2001; Vosniadou, Ioannides et al. 2002) and the capacity to use the knowledge in a broader range of ways.

To transform their understanding, students re-forge links to represent more complex relationships that they had not perceived earlier. To do this, they question strategically, analyse and synthesize aspects of the new ideas, recognise common properties and features and link them in more complex ways. They 'deepen' their knowledge and may organise it into layers, so that some ideas are more general and inclusive and others more specific.

It is sometimes assumed that students will make these transformations automatically. Perhaps as a consequence, many school curricula neglect to support this type of learning (Bransford, Brown, and Cocking. 2004); the Third International Mathematics and Science Survey describes them as "a mile wide and an inch deep".

It is this concept of knowledge about a topic being transformed that is seen as an important awareness for school leaders. Leaders who can identify the various phases of the change, that it,

who know what each phase ‘looks like’, regardless of the topic, are more able to lead their schools to achieve the higher levels of understanding of any topic.

When school leaders are aware of the trends in how a topic can be understood, they can examine whether these trends are shown in the knowledge of students in their school and whether the teaching is sufficient to support and guide it.

When learning any topic, such as *How fish breathe* the conceptual knowledge develops in the following sequence:

1. ***Restricted understanding in specific situations.*** A new set of ideas is learnt initially in restricted or limited ways. Learners may understand its parts, but not integrate them. They understand the ideas in specific contexts but not generalize them. They understand them superficially and may not see their implications or inconsistencies.

The students may learn intuitively that fish breathe; it matches what they know about living animals. After watching fish in an aquarium, they believe that they must somehow obtain the air from the water.

They learn to ‘see’ the new idea in a range of contexts. In the experiences they see fish acting in ways that are consistent with breathing. Initially they need to work on seeing this evidence but with practise it becomes more automatic. They recognise the common idea by recalling what they had seen or experienced in earlier episodes. Their new knowledge at this time is largely experiential and is often imagery of particular contexts.

Their knowledge at this point is tentative. They may ‘believe’ a relationship exists, for example, that fish breathe through their mouths, but cannot, at that time, justify it logically. They show inconsistencies in the new knowledge, for example, they show understanding in some contexts only and may not recognize the same concept in different contexts.

2. ***Deepening and broadening the understanding.*** Learning continues after the initial construction of the new knowledge. Learners learn to recognise key common properties and features across their experiences and synthesise these into general patterns or trends. They learn to ‘untangle’ or ‘decontextualize’ the ideas from specific contexts and link the ideas in more complex ways. In other words they learn to generalize and summarize the key ideas of the topic.

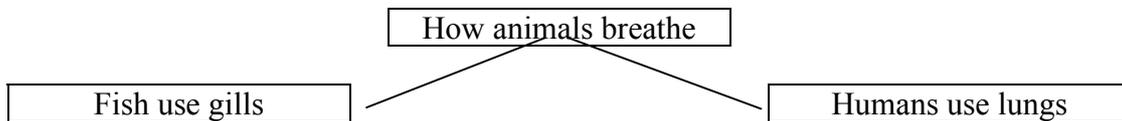
Talking about the patterns or trends allows them to link the imagery in each experience with more general features. They can now refer to the key ideas in a more abstract way. Saying the pattern helps them to see the logical aspects, predict when it will be relevant, analyse how it is used or applied in various contexts and use the common ideas to solve routine problems.

Students learn to link the abstract and the experiential aspects of the ideas and to move between them. They can imagine what the pattern might ‘look like’ in specific situations, for example: *Imagine fish in water that has less air in it. How might their swimming be different?*

The general relationships allow students to apply the new ideas better. The relationships tell them what to look for and help them to recognise the key elements of the new knowledge in new contexts. It helps learners to transfer the ideas and to identify their boundaries.

This type of understanding helps them to learn by making analogies with other topics. They can link how fish breathe using their gills with how humans use their lungs. Learning by analogy is a key means by which learners create new ideas. Its use is frequently neglected in formal education.

The general relationships help the learners to re-organize and re-prioritize aspects of their knowledge. They can, for example, think in terms of main and subordinate ideas at once :



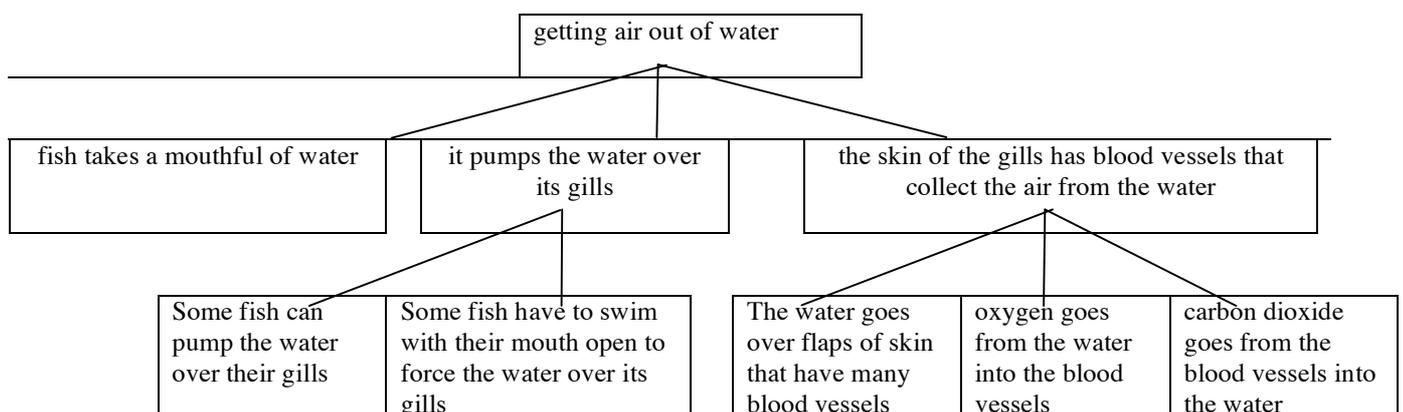
Learning the new ideas in more general ways involves the learners starting to use symbols to represent them. The symbols used include words, visual icons and actions. This helps students to learn how to use the conventional symbolic ways people use to communicate about the topic. This allows them to extend their knowledge further. They can use written information and other information bases and see how others have talked about the topic.

With their understanding in this form they can interact with more knowledgeable partners about the topic and participate in co-operative learning activities with peers. They can talk about and test their thinking, receive feedback and use this to confirm, modify or reject their expectations. The symbolic representations allow them to deal with more topic knowledge and to ‘compress’ it.

As they practice and use the new ideas, students need to invest less thinking space or ‘learning attention’ in them. They now have more attention to allocate to making links with related ideas. They can question ideas, identify more general links them and test these.

3. **"Big idea", automatized thinking about the topic.** Learners can be guided to further transform their knowledge, so that it is more like that of the ‘expert’ knower of the topic. Our third graders review and consolidate what they have learnt and then re-organize this around core concepts or "big ideas", such as *‘breathing by animals that live in water’*, *‘getting air out of water’* and *‘how air gets into water’*.

The big ideas are linked with each other. As well, each big idea has clusters of more detailed ideas linked with it. An example of this is shown for the third grade students re – organising their ideas about how fish breathe.



The constituent ideas are re-prioritised and meaning networks elaborated and differentiated further.

Learners often organize parts of the knowledge using "conditional tags" (Glaser, 1992). Examples of this are "If the fish can pump the water over its gills, it can breathe when it is still" and " If a fish needs to get more air from the water, it needs bigger flaps of skin with more blood vessels". This helps learners to retrieve specific aspects when they are needed for particular problems and issues. These types of links allow students to match their knowledge with a problem, search what they know and retrieve selectively what is relevant to the problem (Ericsson and Staszewski, 1989).

The students can use these clusters to chunk information relatively easily and to interpret information rapidly and efficiently at a higher level. The clusters guide their thinking about the topic and allow them to recognize features and patterns that others would not see. The links also help learners analyse a topic from different perspectives, for example, *What would happen if rivers get warmer ? Will fish find it easier to breathe ? or Why do gold fish like swimming near the surface of an aquarium ?*

Knowledge in this form makes less demand on the thinking space during learning than the earlier, cognitively simpler forms. Those whose knowledge of a topic is organized in this form can learn and think more effectively about the topic because they can use their thinking spaces (their short term working memories or their attentional resources) more efficiently.

When students have their knowledge in this form they can manage and use it with a high level competence. During problem solving they can use it to interpret, describe and solve problems and to resolve issues. They are more able to monitor how they are using it and readily change direction or re-question what they know. In terms of the fish breathing, the students can examine : *Would the gills in all fish have the same shape ? Is there a preferred shape of the gill flaps ? or Do bigger fish have more gills ?*

Knowledge in this form also facilitates creativity, knowledge creation and transfer in open-ended ways. Teachers can guide students to see how their understanding is, in some ways, incomplete. They can move easily between multiple forms of it (for example, between symbolism, logic and imagery), direct how they use it, construct multiple interpretations and make subjective judgments about these. Models of creativity (for example, Urban, 2004), agree that this form of knowledge is more likely to lead to creative outcomes.

This form of understanding can be used to construct 'creative' or 'innovative' ideas. When learners link an idea with 'what it means', 'how it is used' and 'why, when and where' and as well believe they can use it successfully, they can see its possible use in unusual situations. They can make 'far transfer' of the ideas and 'think divergently' about it. In terms of the fish breathing, the students can examine : *Would a fresh water fish be able to breathe as well if it swam into deeper water ? / warmer water ? sea water ? or What fish might be more likely to survive in 100 years ?*

Students are more likely to re-organise their knowledge in these ways when they are encouraged to :

- explore, analyse, reflect on aspects of the new ideas from multiple perspectives and synthesise new understanding, for example, by using thinking tools such as Bloom's levels of questioning.

- explore the transferability and generalisability of the ideas in both near and far transfer analogic thinking and to use analogy to generate creative knowledge.
- use ‘possibilistic enquiry’ and think about options in open-ended problem solving. Examples include : *Why is it harder for fish to breathe in muddy water ?* and *How would dangerous chemicals in the water affect how well fish breathe ?*
- create new episodes for the ideas using creative imagery thinking.

Cultures differ in how they foster these ‘open ended’ ways of thinking about the ideas (Chan, 1999).

The trend from restricted conceptual understanding in specific situations through deepening and abstracting conceptual understanding to "big idea" automatized conceptual understanding provides school leaders with a ‘road map’ for charting growth in student knowledge. It is used here as a reference framework for describing learning in the remaining aspects.

Trends in learning procedural knowledge. As learners make the above transition in their conceptual knowledge, they as well continue to develop their action or procedural knowledge of the ideas. The conceptual ideas can be linked with key actions. For the topic of *How fish breathe*, for example, key actions include

- the means by which the water in the fish’s mouth is forced over the gills,
- the actions by which the air in the water enters the blood vessels of the fish and
- the actions by which the air is carried around the body of the fish.

When students learn to represent the key ideas of a topic as actions, they can think more effectively about them. They can infer or ‘see’ the outcomes of actions and think about alternative actions. As well, when they ‘put their understanding into actions’ they can test their thinking.

Students learn to link the key actions initially in specific experiences and then to gradually abstract and generalize them. They learn to use the relevant actions strategically and selectively. The trend in learning procedural knowledge for a topic can be described in a similar way to the trend in learning the associated conceptual knowledge :

1. ***Restricted procedural understanding in specific situations.*** Students imagine and do the actions linked with the key ideas in the particular contexts or episodes. They observe and imitate the steps involved in the skill when they are directed.
2. ***Deepening and broadening the procedural understanding.*** Students learn the action sequence for each key idea across the experiences. They untangle the steps in the sequence from particular contexts and learn the more general action sequence. They learn to do the actions in a step-by-step manner, for each of the steps of the operation.

For third graders studying how fish breathe, the action sequences they learn to carry out are the operations of a fish pumping the water from its mouth over the gill flaps and the steps involved in the air moving from the water to the blood vessels of the fish.

3. ***"Big idea", automatized action thinking about the topic.*** Students can adapt, change or modify an action sequence to create or design novel actions that fit new situations. Our

third graders might examine: *How might the pumping action used by fish change if the water in which they live has chemicals that block the holes in the gill flaps through which the air passes ?* They learn to automatize the actions linked with how fish breathe.

Learning a disposition or attitude to a topic. When individuals improve their understanding of a topic, they may also confirm or change their disposition or attitude to it. They link values and feelings with the new ideas. This includes whether it is of interest, use or value to them and how easily they learnt it (Perkins, Jay et al., 1993).

This aspect influences subsequent learning. When their knowledge of the topic is stimulated on future occasions, so is the linked 'emotional knowledge'. This influences the motivation to learn more about the topic and how to do this. Interest is often overlooked in teaching (Boekaerts and Boscolo, 2002), even though it accounts for about 10% of the variance in student achievement scores (Schiefele, 1996).

Attitudes and dispositions are learnt, as are phenomena such as the motivation to learn (either mastery versus performance motivation), interest in a topic and self efficacy as a learner of it. These begin as topic or subject specific, although they can generalize.

Several co-occurring processes explain how learners link emotional knowledge with the other aspects. These include

- the emotion they invest in the learning (Schiefele, 1996).
- the extent to which deep processing is encouraged (Schraw, 1998).
- their perceived level of learning success.
- the extent to which they perceive they manage the learning activity, value themselves as learners and see that their activity led to learning, (McPhail, Pierson, Freeman, Goodman and Ayappa, 2000).

These processes are embedded in individual learning experiences. Over time, they become integrated into the learner's experiential knowledge of the topic. When the topic is stimulated on subsequent occasions, learners remember the feelings experienced on the earlier occasions.

Attitudes and dispositions to a topic are learnt or modified in a similar way. Initially they learn a disposition, either positive or negative, in particular experiences as an implicit feeling. Gradually, the attitude crosses specific experiences and becomes linked with the decontextualised concept. This generalisation is possible when the learner has the appropriate 'language for thinking'. With further learning the attitude and conceptual network become fused such that they operate as an integrated meaning-processing unit.

This transition in linking attitudes with topics they are learning is consistent with the taxonomy for affective domain learning proposed by Krathwohl et al., (1956). This taxonomy proposes the following sequence: individuals show:

1. a preparedness to receive or to tolerate an idea, for example, they agree to learn more about how fish breathe.
2. a willingness to respond actively to it, for example, they respond to questions about how fish breathe and actively engage in discussion about this.

3. a valuing of it, for example, they prefer to learn about how fish breathe more than other topics when given a choice.
4. an increased valuing such that the set of ideas has a preferred or prioritized influence on their thinking, for example, they generate their own questions or queries about how fish breathe and actively pursue this.
5. that they organize the values, beliefs, attitudes associated with the set of ideas into an internally consistent framework through which they evaluate the world.

The increasingly more complex disposition to a topic proposed by Krathwohl et al.'s taxonomy would seem to involve a re-organization or transformation in the learner's topic knowledge, with the links between the aspects becoming increasingly automatized. The change in disposition can be linked with the sequence in learning conceptual knowledge about a topic as follows:

1. the restricted conceptual understanding in specific situations can be linked with the prepared to receive and a willingness to respond to the topic.
2. the deeper, more abstract conceptual understanding can be linked with the topic being increasingly valued.
3. conceptual the "Big idea" automatized understanding of the topic can be linked with a world view disposition to the topic.

As well, one might expect the implication of self talk and the analysis of the ideas from multiple perspectives.

Knowledge of how to learn. As students learn a new topic, they can also improve their knowledge of how to learn. Key aspects of doing this include encouraging students to reflect on their learning, monitor their success as learners and talk about the learning actions and motivation styles that worked for them.

Particular ways of thinking are appropriate for each phase of conceptual or procedural learning. As well, particular types of self talk are linked with forming more positive dispositions and attitudes. In this section we examine two aspects of learning how to learn:

- learning ways of thinking about ideas they are learning and
- ways in which they can manage and direct their learning activity.

1. ***Learning ways of thinking about ideas they are learning.*** Learners use a range of 'knowledge transforming' strategies to 'look' at a set of ideas from alternative perspectives. Consider five learners thinking through the proposition : *Fish find it easier to breathe in colder water.* They each use a different knowledge recoding strategy : One learner visualizes it in particular contexts, a second acts it out, a third makes an analogy with a more familiar topic, a fourth says aloud the proposition and paraphrases it while a fifth searches for questions it answers.

These knowledge recoding strategies help learners to

- draw together multiple representations of a topic,
- reduce the 'learning attentional load' of a set of ideas,
- use what they know to generate new links and

- retain new knowledge for both short and long periods, possibly because they permit multiple codings of the same set of ideas.

Many learners acquire these strategies incidentally, in a developmental sequence. Others benefit from explicit teaching. The research on the effectiveness of strategy training (Swanson & Hoskyn, 1999) suggests that learners' environments and cultures influence their acquisition. In Western cultures at least, learners initiate and direct their use through self talk. Repeated use of the strategies enhances their automaticity.

The particular learning strategies learners use to link ideas are acquired developmentally. Strategies used to transform knowledge in more complex ways are assembled from simpler strategies.

Each phase of knowledge enhancement is learnt best when particular learning or cognitive strategies are used. Examples are as follows:

- for the restricted conceptual understanding in specific situations, effective learning strategies include visualising and paraphrasing each experience, can be linked with the prepared to receive and a willingness to respond to the topic.
- for the deeper, more abstract conceptual understanding, effective learning strategies include reviewing two or more experiences and talking about the common features, summarizing over the experiences, identifying the main and specific ideas, saying the shared pattern or rule.
- for conceptual the "big idea" automatized understanding, effective learning strategies include examining an idea from multiple perspectives, making analogy, using 'what if ...; and possibilistic thinking.

2. ***Learners manage their learning activity.*** Not only do learners engage in making new meaning during learning; they also manage or direct this activity. This is in greater demand during self initiated learning than when the learning is directed externally. However, in the majority of learning situations, learners exert some control over aspects of the learning. A key element of a learning framework is to explain the self management phenomenon, its nature and the mechanisms by which it operates.

This type of knowledge is referred to as 'metacognition'. It includes what learners know about useful learning strategies and how to use them selectively (Pitritch, 2002). Self talk or 'inner language' is a vehicle for facilitating their use. Learners gradually build this knowledge from the time when they first become aware of the distinction between 'the knower' and 'what is known' (often towards the end of the preschool years (Kuhn & Dean, 2004)).

As with other aspects of knowledge, this aspect has a social-cultural origin. It reflects what individuals learn about how their culture uses linguistic knowledge to manage and direct behaviour and the culture's perspectives on reflection about knowledge and thinking.

Learners use this knowledge in various ways. When learning by solving a problem during the conceptual "Big idea" automatized understanding of a topic, for example, they plan how they will work through it, monitor the effectiveness of their activity, modify it if necessary and review what they have learnt. They may decide how they will manage the cognitive demand of new learning and how they will allocate their learning and thinking activity. They make these decisions strategically and consciously initially and then automatically

One aspect of how learners manage their learning is through their beliefs about learning. One set of beliefs relates to how ‘intelligence’ works (Dweck, 1989). Some believe that their intelligence is fixed. They avoid challenges that may show them as less competent. Others believe that intelligence can be improved by effort, seek challenges and show high persistence. Most students lie between the two extremes and show domain specificity in these beliefs. These beliefs affect the goals students set, their persistence and how they go about learning. They are mediated through students’ self talk.

Learners can enhance their metacognitive knowledge and use in a range of ways:

- (1) by reflecting on and evaluating how they learn in specific situations;
- (2) developing an awareness of what they know and how it is enhanced;
- (3) learning to use both cognitive tools and the language for monitoring and analyzing their learning;
- (4) using question sequences such as “How did I know this ?” or “Why did I do this ?” to interrogate what they know and how they learn (Kuhn & Dean, 2004; Pitritch, 2002).

They also develop an awareness of their knowledge and later that of others and then expectations about knowledge generally. They may learn, for example, that

- ideas are not ‘set in concrete’ (or absolute) but are ‘our best guess’ or interpretation at the time, are ‘approximate’ and can usually be changed.
- asking questions helps to think about what you know at any time and may cause you to change it
- it is acceptable not to ‘be certain’ about a particular idea.

Knowing how to learn and how to manage the learning activity are critical for effective knowledge enhancement. Many schools have as goals the intentions to enhance students’ capacity to think and to learn and to foster a positive attitude to life long learning. School leaders who understand this aspect are more able to monitor the extent to which their school actually does this and lead their school to improve their practice in this area.

Learning the context. As well as learning the aspects of knowledge already discussed, learners store knowledge about the context in which they learnt. This includes their perceptions of

- the social and instructional climates of the learning context and the quality of the interactions with significant others (Hofman, et al., 2001).
- how the roles of ‘teacher’ and ‘learner’ are constructed in the contexts in which they learnt.

These aspects of knowledge are integrated within the learner’s experiential knowledge of the learning context. They influence both the goals students frame up for learning in the future (Chaiklin & Lave, 1993) and how they engage in it.

Each phase of knowledge enhancement involves particular learner and teacher roles. Examples of that students can learn are as follows:

- for the restricted conceptual understanding in specific situations, effective learner roles include being a trial and error learner.
- for the deeper, more abstract conceptual understanding, effective learner roles include being a rule learner and user.
- for conceptual the "big idea" automatized understanding, effective learner roles include being an open ended creator of ideas, being a problem solver.

An integrated view of knowledge enhancement. An integrated view of the gradual transition in knowledge enhancement, using conceptual knowledge as a reference, is shown in the following diagram. The dotted lines dividing the aspects of learning is intended to show their increasing synthesis.

The learner's existing knowledge						
experiential knowledge	abstract conceptual knowledge	procedural knowledge	attitudes / disposition towards topics	knowledge of self in relation to others	knowledge of how to think and to learn	beliefs and metaphors about one's world
learning new knowledge						
learn in a partial, non-fluent way ↓	experiential conceptual knowledge ↓	procedural knowledge: use new actions tentatively	attitude to topic • prepared to receive • willing to respond ↓	knowledge of self in relation to others	knowledge of how to think and learn	beliefs and metaphors about the learning context
learn in integrated way	abstract conceptual knowledge	new actions used as general procedures selectively	• topic is valued		Analyse, generalise, synthesize	
Learn in 'an expert' way	Big picture knowledge automatic	New actions automatic integrated	• world view		transfer, think creatively	
Transferring and generalising the knowledge						

How do learners know which ideas to link ? Focused teaching that guides and scaffolds students' thinking facilitates progress through the knowledge enhancement sequence. Students build new knowledge under two extremes conditions:

- when instructed or 'programmed' to link ideas in particular ways.
- during self-initiated learning; learners speculate about a possible new link, try it out to see how it fits, modify it if necessary and perhaps rationalize it. Learners frequently make analogies using their experiential knowledge to form new links. Thinking strategies such as visualizing assist here.

The balance between self directed versus externally directed learning has a matching distinction in constructivist theories of learning; radical constructivism (Von Glasersfeld, 1995) versus empirical constructivism (Jonassen, 1991).

The processes that sustain learning during knowledge enhancement

Various processes sustain learning during knowledge enhancement;

- focusing attention and retaining the necessary knowledge in short term working memory,
- consolidating the new knowledge and storing it in long term memory
- corrective feedback is critical to learning
- ensuring that learning is socially referenced.

School leaders need to be aware of these. These are the key processes that make learning and therefore knowledge enhancement possible. If their use is not fostered and scaffolded by the teaching and classroom climate in the school, and in some cases taught, knowledge enhancement is less likely.

Using short term working memory during learning. Throughout a learning session it is necessary that students retain and manipulate key ideas. At any point in time during a learning session you will have experienced thinking about some ideas and keeping other ideas in a ‘holding bay’. You will probably bring the ideas in the holding bay into the learning action very soon in the future.

The short term working memory, also called the ‘thinking space’ or what is ‘in your attention’ is where the action happens during learning. As such, it is critical to the knowledge enhancement process. There are key learning strategies that learners use to help ‘keep ideas alive here’. These include repeating the ideas to one’s self, paraphrasing them, visualising them and imagining them in particular contexts and acting them out.

It is easy for the ideas in the thinking space to be ‘knocked out’ or lost by other information. You will probably have experienced concentrating on or thinking about particular ideas when someone or something else attracts your attention.

The short term working memory can hold only a certain number of ideas at any time. It can easily be overloaded. It is useful here to talk about ‘short term memory space’, that is the amount of space ideas take up. Ideas that are most familiar to a person take up the least space. The more strongly two or more ideas are linked, the less attentional space each idea needs to be part of the person’s thinking.

It provides a clear justification for guiding students to develop the more complex levels of understanding of a set of ideas. The ideas in this form take up less thinking space or short term memory resources. This means that the students have more space for thinking about the ideas and for applying and transferring them. It follows that instruction that guides and allows students to use their short term memory or thinking space for effectively will facilitate knowledge enhancement.

Storing what has been learnt in memory and recalling it For effective knowledge enhancement, successful learning is not sufficient. Learners need to store what has been learnt in long term memory and recall it later. This is necessary at each phase of the knowledge enhancement process because learning at later phases depends on what is recalled at any time. At each phase it is recommended that learners review and consolidate the new knowledge and store it in long term memory.

The knowledge learnt can be retained in various long term ‘memories’; as (1) abstract conceptual networks; (2) generalised experiences in episodic memory; (3) automatized procedures (Tulving, 2002). Although formal education usually favours the retention of conceptual or procedural knowledge, it is the linked episodic knowledge that will facilitate the application and transfer of the knowledge and its use in creativity.

When learners' retention is monitored over several learning sessions, their memory representations change from being primarily episodic to more abstract (Conway et al, 1997). They begin to store their new episodic knowledge in long term memory and gradually add to it as they acquire the more abstract forms. Teachers can include in their teaching a range of strategies that guide students to encode knowledge in long term storage (see Munro, 2006 for examples).

Cultural influences on memory have several sources. They differ, for example, in the dominant forms of memory they value. Some value storing in imagery forms while others value more abstract forms (Chan, 1999). They also differ in how the processes of memorisation and understanding of new ideas are integrated (Kember, 1996; Marton, Watkins and Tang, 1997).

Corrective feedback is critical to learning Effective knowledge enhancement requires learners to try out their impressions at any time and receive feedback for them. Learners use the feedback both to evaluate and possibly modify areas of their knowledge, such as their understanding of the topic and their self efficacy (Bandura,1994). Hattie (2003) in a meta-review of a range of influences on learning, identifies feedback as the most important.

The corrective feedback is a type of formative assessment. To obtain it, learners need to know or learn 'how to read assessment situations', to display and align what they know, how to make opportunities for this and how to use the feedback they receive to evaluate their impressions. The feedback is itself knowledge that may include a comment on knowledge.

The feedback interaction provides a critical link with relevant cultural knowledge. Means for doing this are discussed in the next section. Cultures differ in how they construct the opportunities learners have for the feedback process, for example, the conventions that govern acceptable display.

Learning is socially referenced Knowledge enhancement is usually most effective when it occurs collaboratively, in interaction with significant others, for example, peers or teachers and mentors. Throughout all of the phases, participation in interactive dialogue and other activities, assists learners to manipulate and trial their understanding, align it with that of others and use the feedback to reflect on and evaluate it. Collaboration also provides the opportunity for students to have their learning scaffolded by peers or adults. This permits learners to acquire

- a shared understanding of the conceptual knowledge (Smolka, De Goes et al., 1995),
- a 'cultural' or group knowledge (Valsiner & van der Veer 2000) and
- an awareness of how this knowledge gradually emerges
- an awareness of both the culturally referenced and personal aspects of what they know, how to use each in an integrated way and to value each aspect.

Peer imitation, modeling and using vicarious feedback are learning mechanisms. Students learn to negotiate an understanding that has both a shared component and that allows them to link their idiosyncratic knowledge of a topic with this. This is the 'sociocultural' / social constructivism (Scribner 1992; Valsiner 1994; Wertsch 1998).

The processes that sustain learning are acquired developmentally. As children develop from preschoolers through the primary and then the adolescent years, the ways in which they use the processes that sustain learning gradually change or develop, in parallel with how they learn and think. This in turn leads to changes in the knowledge they learn.

Infants as young as three months show evidence of moving to an automatized knowledge. They can learn, for example, to respond spasmodically to a suspended mobile. Gradually they learn to make the mobile move more successfully; they cease doing the actions that don't help. Then they learn to do the actions more automatically and also to transfer the actions to other objects that they want to set in motion.

In other words, even very young children can move through the phases of knowledge enhancement. What they lack is the entry level knowledge platform for building the ideas typical of eight or eighteen year olds. As they build more complex knowledge, they learn more effective ways of thinking and sustaining their learning. The learners build the 'learning capacity' (both cognitive and affective) for make the necessary links.

The actual knowledge and ways of thinking they learn depend on the cultures in which they do the learning. How their cultures use language to think and to transform what the children is important. One change is in how children 'internalize' their egocentric speech and use this dialogue to manage their interactions with the world. The dialogue assists them to form links not previously possible, for example, to recognise what is common between past and present events and to reason cause and effect or consequence.

Implications for leading educational provision.

Being savvy about how knowledge is enhanced is a crucial tool in the work of effective school leadership. Throughout this paper I have identified a number of ways in which this is relevant to the work of school leaders.

What I am recommending here is that school leaders take some time to familiarise themselves with the key aspects of learning as knowledge enhancement, decide what it might 'look like' in their contexts and then examine how it is being implemented in practice in classrooms. This will lead to a range of options.

The following is a summary of the implications of knowledge enhancement for the work of school leaders:

1. ***Knowledge enhancement is a key focus for the work of a school.*** It locates student knowledge enhancement as a key foundation in professional dialogue about learning and as a key criterion to consider in decision making. It focuses the role of teaching on knowledge enhancement and encourages students and teachers to think of teaching from a student 'knowledge enhancement' perspective. In other words, it recognises that knowledge is the core 'currency' in a school and uses knowledge to link learning with teaching. Discussions about school architecture, the relevance and use of new technologies, practices in formal education such as the length of teaching sessions and the school day, the best assessment practices, can all be referenced, in part, on knowledge enhancement.
2. ***It provides a conceptual tool for interpreting challenges and problems in curriculum provision in a school from a learning – teaching perspective.*** Because it has been developed to take account of multiple ways of representing knowledge and of learning, it permits a consideration of how the key processes involved in knowledge enhancement may be modified and assists in conceptualizing personalized learning and individual learning profiles.

3. ***The model maps directly into teaching procedures*** Instructional Design Theory is the study of how to best design instruction so that learning will take place (Reigeluth, 1999) and is based directly on learning theory. The knowledge enhancement model provides a pedagogic framework whose goal is to enhance student knowledge and a means for understanding the learning - teaching interaction.

School leaders can use it to lead the implementation of teaching that explicitly guides learning. It encourages the questions : “What is the next step in enhancing students’ knowledge /understanding ? What knowledge links need to be formed ? What conditions are most likely to achieve this?”

4. ***It facilitates ‘assessment for learning’ procedures.*** Schools that use effective ‘assessment for learning’ procedures are more likely to optimise student learning outcomes. The model assists the school to implement ‘assessment for learning’ procedures to guide to the next embodiment of a topic. It provides a tool for understanding and making sense of student knowledge at any time.

The teaching can identify, for example, useful dialogue, questioning, feedback, collaboration to take student knowledge to the next level of complexity. In formal school contexts, a class may be developing two or more topics at the same time, one at the early phase of learning and one at a later phase. It assists in handling this.

5. ***It facilitates a knowledge enhancement perspective on personalised learning .*** School leaders frequently need to make decisions about variations in students’ existing knowledge. The model provides a means for describing the ‘learning pathway’ through a topic in a systematic way. By identifying the characteristics of knowledge at each phase of the transformation, it accommodates multiple ways of learning and facilitates the implementation of personalised learning.

This has direct implications for students whose approaches to learning are not accommodated by regular teaching. School leaders who are concerned about the learning progress of both gifted students and those who have difficulty benefiting from regular provision can be assisted by using the knowledge enhancement model to design personalised learning opportunities. It assists, for example, a comparison of learning in new technology contexts with learning in more traditional contexts.

6. ***It facilitates learning in multi cultural contexts.*** Our schools are multi cultural. Children come to our classes with a range of experiences that have been shaped by economic, political, and cultural influences. These experiences have a profound influence on how the students learn the particular topics that we teach. They can lead to students being alienated from learning, feeling disenfranchised, hopeless and not valued. An awareness of the knowledge enhancement model allows school leaders to recognise and do something about these influences. It assists the school leader to examine the curricula, teaching, evaluation, and policy being implemented and how these may be modified or fine tuned..

The questions : What knowledge is of most worth? and its revised form “*Whose* knowledge is of most worth? (Apple, 2005) arise at least implicitly. Through its conceptual approach and teaching, a school may show it focus on “culturally valued knowledge” that will provide a particular interpretation and show what is valued.

The knowledge enhancement model allows school leaders to guide their schools to value multiple interpretations of a topic that may come from a range of cultural, historical and political contexts and also the contexts in which these interpretations were created. This allows all students to learn a richer knowledge of a topic than a single, monocultural interpretation.

It also encourages teachers to use teaching practices that show an active and explicit interest in the knowledge of all students and a preparedness to at least listen to these, rather than accept that one is dominant. There are potential gains in this for school leaders, their schools and staff. Over a period of time what a school values as acceptable knowledge of a topic will change, as the initial culturally valued versions are modified. This will in turn allow the school's focus to mesh with that of the matching topic knowledge in the community of the school. It will increase the school's relevance, particularly as its students can use the knowledge they gain to understand and solve problems and issues confronting the school.

The knowledge enhancement perspective encourages school leaders to lead their schools to examine the interpretations of topics and themes in the communities they serve. This equips them to work with these interpretations, use them to develop culturally relevant interpretations that are informed by these and to use the A school leader here is working to enhance the relevant knowledge of the communities and cultures that constitute the school. Rather than being bound by an imposed curriculum, the knowledge enhancement model and its related pedagogy, over time, provides the leader with the tools necessary to fit the imposed curriculum to the context of the school. In one sense it assists the leader to develop a more equitable and democratic curriculum for the school.

7. ***A tool for looking at learning across knowledge domains.*** The model provides a tool that can be used to look at learning across knowledge domains. This is important for school leaders, who do not have the time to become familiar in depth with the nature of learning in each knowledge domain in their schools

The model also provides teachers from several subjects can use a similar conceptual tool for analysing and talking about learning in their areas and to identify similarities and aspects unique to their domains.

8. ***The perspective provides an integrating framework.*** The perspective can be used to integrate many concepts that are often seen as independent and separate. It provides, for example, a means of integrating the following ideas within a 'streamlined' framework:
 - motivation from the perspective of motivation to learn and to achieve
 - engagement in terms of 'engagement to learn'; a preparedness to engage in changing what one knows and with concepts such as self efficacy, beliefs about effort versus ability and other attributional beliefs and attitudinal dispositions to the topic.
 - goals are linked with what the person is challenged to learn
 - working memory (the locus for learning or knowledge change) and long term memory and to link it with knowledge

- the nature and qualities of the feedback that is exchanged during learning situations; this feedback has its origins in the knowledge of some people and is interpreted using the knowledge (including beliefs and intuitions) of others.
- curriculum in terms of the totality of conditions needed for knowledge enhancement and the syllabus (or VELs) in terms of the culturally desired knowledge outcomes.
- classroom climate relates to the conditions that enhance the change
- classroom management involves managing the barriers to effective engagement and knowledge change.

Education authorities continues to churn out new ideas for schools. Often schools and teachers, however, don't ask "What will these things look like in student knowledge? What will they look like in my teaching?" The framework helps them link the ideas within an integrated framework.

Conclusion

The knowledge enhancement model provides a set of conceptual tools that educators and students can use to understand and monitor learning and to implement pedagogic practice that supports knowledge enhancement. As noted, it allows you to understand directly how to facilitate the effective learning of minorities in an inclusive, knowledge –focused ways.

It draws attention to the need for a focus on the affective aspects of on knowledge enhancement. When this is done, the work of school leaders is made easier. As they put in place the conditions for all students and their families to see that their knowledge and values are recognised and valued, they foster a disposition of respect for the knowledge of others, for multiple perspectives and for the identity for others. This respect can lead to the development of a level of trust between the professional staff and its community is more likely. The trust in turn can lead to a sense of hope and possibility within the school community.

School leaders can ask themselves :

- What does my school know about knowledge enhancement? How well do staff understand the gap between what and students know and what they need to know?
- How well do staff understand and manage the learning factors that otherwise would lead to some students not learning as effectively? Is there a group of staff in the school who have sufficient understanding of knowledge enhancement to lead the work of and development of colleagues?
- How do students position themselves? How do the teaching and classroom practice position them? Are some students given better opportunity to succeed in the learning activity than others?

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