Adult Mathematics Education and Commonsense

Noel Colleran

North Tipperary Vocational Education Committee, Templemore, Ireland.

John O'Donoghue

University of Limerick, Limerick Ireland

<Noel.Colleran@sheelan.ie>
<John.ODonoghue@ul.ie>

Abstract

The relationship between quantitative problem solving and commonsense has provided the basis for an expanding exploration for Colleran and O'Donoghue. For example the authors (Colleran et al., 2002, 2001) discovered the pivotal role commonsense plays in adult quantitative problem solving and suggest commonsense is an important 'resource' in the adult problem-solving context. In more recent papers *Adult Problem Solving and Commonsense:* (Colleran et al., 2003a) and *Adult Problem Solving and Commonsense: new insights* (Colleran et al., 2003b) the authors explored the valued position given to 'higher order' thinking as distinct from the 'other', 'lower' form of thinking, sometimes described as commonsense thinking. They also looked at the manner in which commonsense is created from 'natural learning' in a range of different environments. In Colleran and O'Donoghue (in press) the authors broadened the investigation to include the views of a number of researchers in the field of commonsense who suggest that commonsense is a powerful intellectual resource and provides the bedrock on which mathematical understanding is built. The authors have come to the view that the creation and use of commonsense require intelligent, creative thinking and this 'order' of thinking takes place naturally in the commonsense environment. Further this intelligent thinking is supported by attitudinal as well as structural elements that facilitate the individual to engage new commonsense situations so that they become natural learning environments.

Key words: adult, quantitative problem-solving, commonsense, natural learning.

Introduction

The authors' work on adult quantitative problem solving and commonsense has evolved over a number of years. For example the authors (Colleran, O'Donoghue & Murphy, 2001, 2002) have argued that commonsense plays a pivotal role in adult quantitative problem solving and suggested commonsense is an important 'resource' in the adult problem-solving context. In a more recent paper *Adult Problem Solving and Commonsense* (Colleran, O'Donoghue & Murphy, 2003a) and in *Adult Problem Solving and Commonsense: new insights* (Colleran, O'Donoghue & Murphy, 2003b) the authors explored the valued position given to 'higher order' thinking as distinct from the 'other', 'lower' form of thinking, sometimes described as commonsense thinking. They also looked at the manner in which commonsense is created from 'natural learning' in a range of different environments. They concluded that the creation of the commonsense resource requires a broad-based, adaptive use of intelligence and a form of

thinking which is intelligent, resourceful and creative. This intelligent thinking takes place naturally in the commonsense environment. Furthermore this intelligent thinking is supported by attitudinal as well as structural elements that facilitate the individual to engage new commonsense situations so that they become natural learning environments. In Colleran and O'Donoghue (in press) the authors broadened the investigation to include the views of a number of researchers in the field of commonsense who suggest that commonsense is a powerful intellectual resource and provides the bedrock on which mathematical understanding is built.

In this paper we start by describing the background and the manner in which commonsense became an important issue for the authors in the context of adult mathematics education. We then provide definitional aspects of commonsense, and follow with a discussion on the creation of commonsense in natural learning environments. We then evaluate the resource provided by commonsense in practical settings. We conclude by identifying some convergence regarding the role commonsense plays in mathematics education and suggest that further exploration is validated.

Background

In Colleran et al. (2001) the authors describe an educational programme for improving adults' quantitative problem-solving skills. There were three pillars on which this programme was built. Firstly, the quantitative problem situations addressed by the learners throughout the programme were drawn from appropriate contexts. This helped ensure that the problems were relevant, realistic and meaningful for the learners. Secondly, the process of *Action Learning* provided a social learning environment. This environment enabled discussion and dialogue which were fundamental to the development of thinking skills. Thirdly, an adaptation of Lonergan's (1957) philosophy enabled learners to discover the way they think when they are solving problems.

Lonergan's philosophy is derived from his 1957 publication entitled, "*Insight: A study of human understanding"*. He was a Canadian theologian and philosopher who died in 1984. In his book he describes how 'catching on' or 'getting the point' is a frequent event in the course of our daily lives. It would seem absurd to suggest that this act, the act of insight, could provide the foundation for a whole new philosophy on human understanding, however Lonergan's *Insight* develops this foundational view and also provides a number of cogent reasons why his philosophy is suitable in the context of adults solving problems:

- His problem-solving 'programme' is adult-orientated,
- He believed that a good starting point for the development of problem-solving skills is with the natural thinking process of the adult,
- He provides a *cognitional structure* which identified the thinking processes used by adults when they solve problems.

Lonergan's cognitional structure is at the heart of an educational programme to improve quantitative problem-solving skills among adult basic education learners developed by the authors (see Colleran et al., 2001).

Lonergan believed that the process by which adults come to know and decide is the same for all normal adults. Not only is the process the same, it is activated and employed without direction on the part of the individual. Therefore, the cognitional structure is *invariant* in that it remains the same for each knower and it is *naturally innate* because it happens without direction or effort on the part of the knower.

The preliminary stage of Lonergan's programme is the uncovering of one's cognitional structure, i.e. the innate, invariant thinking process. This discovery process, Lonergan postulates, will lead to an improvement in problem-solving and decision-making skills of adults.

Lonergan's programme unfolds on three levels of knowing:

- Commonsense knowing,
- Scientific knowing,
- Critical knowing.

Commonsense knowing, because it happens spontaneously in the concrete world, does not require the engagement of the problem-solving processes. *Scientific knowing* is employed when an individual engages a novel situation and the mental processes outlined in the cognitional structure (Figure 1) move from the concrete to the abstract.

Lonergan suggests that adults become effective problem solvers in two modes - the direct mode and the indirect mode. The *direct mode* of problem-solving requires the individual to concentrate on achieving a solution to the problem at hand - problems are solved by engaging the mental processes of the cognitional structure. However, the *indirect mode* requires the individual to attend not only to the solution but also to the *process* - the mental operations engaged during the solution episode. Understanding the process by which solutions are found is known as *critical knowing*.

In the context of our educational programme critical knowing enables learners not only to solve quantitative problems, it also provides the means by which they can engage with confidence the new quantitative situations that present themselves regularly and frequently in the ever-changing conditions of their daily lives.

Therefore, Lonergan's problem-solving and decision-making programme offers more than a structure for understanding, knowing and deciding. It offers a *developmental process* in which an adult learner can move from understanding, knowing and deciding at a commonsense level to a scientific level and finally at a critical level. It is also a *creative process* in which the individual struggles to spark new insights that may hold the key to a required solution. Lonergan's problem-solving and decision-making programme can therefore be visualised not as a two-dimensional cycle of mental activities but as a three-dimensional helix (Figure 1) which dynamically connects concrete understanding at the lower, commonsense level, to a deeper and more abstract understanding at the intermediate, scientific level, and finally to an even deeper metacognitive understanding at the top of the helix. Knowing at the concrete level provides the basis for scientific understanding and both commonsense and scientific understanding provide the basis for critical understanding. In this manner the learner builds understanding *from concrete understanding to abstract understanding to process understanding*. The loop structure enables the learner to back track if at any stage understanding becomes shaky. The loop also points to the relationship and the sequence of development of the three types of knowing.

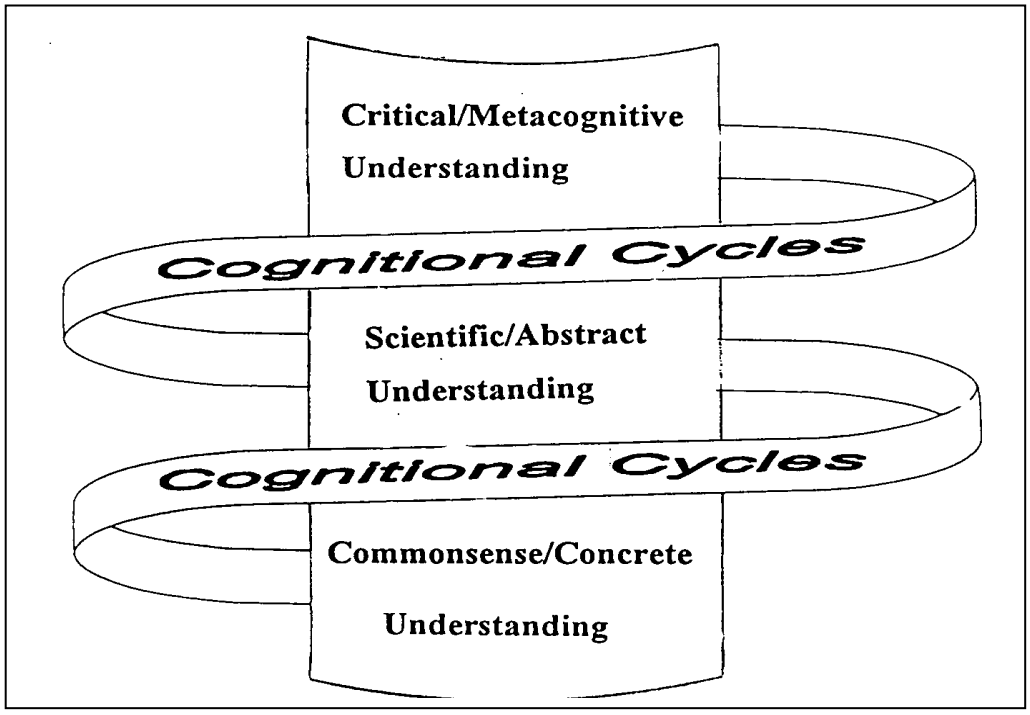

Figure 1. Helix illustrating Lonergan's dynamical and developmental process for understanding.

Evaluation of our educational programme provided a number of striking insights (see Colleran et al., 2001), however the most striking was the important role commonsense played for adults as they approached, engaged and resolved quantitative problems. It is therefore important to explore commonsense and commonsense environments.

Commonsense and commonsense environments

Lonergan (1957), who provides the source for much of the authors' understanding of commonsense, suggests that commonsense is a collection of insights accumulated by a community or individuals within that community, in a socio-historic setting. It is bounded by the concerns of human living and by workable solutions to daily tasks. Therefore, the knowledge that commonsense seeks is not motivated by the pleasure of exercising the mind but for the purpose of making and doing.

Coben (2002a) explores the origin of commonsense in Western thought pointing to a clear distinction between the British tradition regarding this concept and that of continental Europe. The British conception was "one of a practical faculty which the ordinary person exercises in his or her everyday life" while Continental European tradition regarded commonsense as that "which is expressed in the ideal being of a nation or people". She goes on to explore the commonsense of Gramsci which she proposes springs from the Continental tradition. It would be difficult to situate the commonsense of Lonergan (1957) in either tradition; however it is clear that his understanding resonates with elements of both traditions and particularly that of Gramsci.

In his recent paper *Making Sense of Common Sense Knowledge*, Kuipers (2004) suggests that commonsense is used without concentrated effort to meet the everyday demands of the physical, spatial, temporal and social world. He continues that commonsense knowledge consists of *Foundational Domains* of understanding that are learned at a young age. These domains, such as space, time, properties of materials and certain aspects of the social and physical world, are used to reason with commonsense issues.

Howson (1998, p. 258) defines commonsense as a vague, culturally dependent concept. It is based on local knowledge, past experiences and simple reasoning. "Common sense is distinguished by the way in which it depends upon evidence, accepted truths and conventions, and upon 'innate' operating systems of perception, meaning and understanding".

While there is no doubt that commonsense has been used by many people to mean different things there is general agreement that it operates spontaneously in the concrete, social world. The environment within which it operates is quite specific. It is specialised in the concrete objects of everyday living in terms of their relationship, not to one another, but to the individual. It is bounded by the concerns of human living and by workable solutions to daily tasks. "[Commonsense] ... clings to the immediate and the practical, the concrete and the particular. ... Rockets and space platforms are superfluous, if you intend to remain on this earth" (Lonergan 1957, p. 179). Common sense is pragmatic because it deals with practical problem-solving situations that present themselves in the course of everyday living.

However the content of commonsense understanding does not reside wholly in the mind of any single individual. It is divided out among the different individuals operating in different roles throughout the community. The result is a collection of specific totalities with their individual socio-cultural, and historical common sense. So to capture an understanding of a particular community one must inquire into the commonsense of many fields to discover the particular unity of commonsense understanding which "organically binds together the endlessly varied pieces of an enormous jig-saw puzzle" (Lonergan, 1957, p. 211).

Having established our understanding of what commonsense is it is now time to explore commonsense thinking and how commonsense is created.

Commonsense thinking

In Colleran et al. (2003a) we discussed the invisible nature of commonsense in action. Commonsense is used *without thinking* and therefore is not deliberately adverted to. It is employed in social environments that are routine and familiar. It is a dynamic intellectual process that moves from *Experience of Familiar Situations* to *Commonsense Understanding* and spontaneously to a *Decision*.

However, even though the term is called commonsense, *it is not common to all people*. The intelligent person of commonsense demonstrates a greater readiness "in catching on, in getting the point ... in grasping implications, in acquiring know-how" (Lonergan, 1957, p. 173). And while commonsense is not a natural endowment of all normal adults the capacity to create this resource is. This capacity is explained by Lonergan through a naturally available, innate and invariant cognitional structure by which all normal adults come to understand and learn (Colleran et al., 2001). However, there is a suggestion made throughout *Insight* (Lonergan, 1957) that the rigour of scientific thinking is not required to create new commonsense understandings - that new practical, concrete, commonsense understandings do not require a

similar form of sustained concentration as do new conceptual, theoretical and scientific understandings. However, Brio (1988) has the following observation regarding the creation of commonsense:

> The common sense 'circuit' of learning generates a noetic[1] 'nucleus', a habitual 'core' of understanding. This core emerges and develops in response to his multiple and advancing engagements with his situation. It expresses itself in the repertoire of gestures, concepts, linguistic capacities, skills, etc., which fit him for judging and dealing with it (pp. 48-49).

Whether practical or theoretical, concrete or conceptual, the creation of new insights requires individuals to think and use their cognitional capacities. In the context of commonsense activity, thinking takes the form of analysis and synthesis of available and accessible understandings. However, if available and accessible commonsense cannot provide for the situation at hand, the intellectual, creative processes must be engaged so that new commonsense insights and understandings can be created. This creative process is equivalent if not similar to the scientific knowing process delineated by Lonergan (1957, p. 285).

While the same explicit, elaborate procedure of the scientific researcher is not required for commonsense, something equivalent is to be sought by intellectual alertness, by taking one's time, by talking things over, by putting viewpoints to the test of action.

Commonsense thinking is not in search of the 'virtually unconditioned' (Lonergan, 1957) truth of the scientific inquirer, however it does require a truth which is conditioned by the sensible, meaningful and practical circumstances in which it finds itself. And because commonsense situations are dynamic the commonsense thinker must be creative and adaptive to these ever-changing contexts. In the next section we explore the manner in which commonsense is created and its adaptive nature.

Creating and 'adapting' commonsense understanding

In Colleran et al. (2003b) the authors proposed that the creation of commonsense understanding occurs naturally by employing a number of communicative methods as well as a particular predisposition. They suggested that talking as well as the use of gestures provide the means for communicating and creating commonsense. The use of these communicative methods is motivated and supported by an intrinsic and natural predisposition and an inbuilt desire to be intellectually creative and to behave intelligently among other people. The individual has no choice about behaving intelligently; the drive to understand is in-built (Lonergan, 1957). The result is that commonsense learning takes place naturally in commonsense environments.

The authors propose that there are a number of natural elements associated with commonsense learning that enable individuals to become commonsense capable as they engage a variety of real-life contexts. In Colleran et al. (2003b) they suggested that these elements include:

- An inbuilt desire behave intelligently;
- Utilisation of social commonsense; and
- Utilisation of relevant technical commonsense.

[1] The word *noetic* comes from the ancient Greek *nous*, for which there is no exact equivalent in English. It refers to *inner knowing*, a kind of intuitive consciousness - direct and immediate access to knowledge beyond what is available to our normal senses and the power of reason.

"An inbuilt desire to behave intelligently" is the natural endowment of all normal adults (Lonergan, 1957). This element remains constant in all natural learning environments when the individual is motivated to engage and participate. The experience of being 'in the dark' about things that matter to an individual is one that all normal adults wish to avoid.

Social commonsense is generated and utilised in an inter-subjective environment where speech and gestures are the mode of communication and where values, individual characteristics and personality are displayed in an effort to generate admiration and a good social relationship. This element of commonsense enables the individual to adapt to the social setting by employing the social commonsense already available and by building on this resource. *Technical commonsense* on the other hand is related to the specific skill domains, for example, carpentry, cooking, teaching, researching. This element of commonsense may also require adaptation in the new context and is developed quite naturally by building on the skills already acquired.

The authors contend that because of a number of attitudinal and structural elements such as those mentioned above the issue of 'transfer' takes on another dimension - one that challenges the impenetrable barriers constructed between contexts by those who view transfer of learning as problematic. These elements enable individuals to engage non-routine situations so that they become natural learning environments. This 'adaptive' characteristic associated with commonsense may open another perspective on the 'transfer of learning' problem and provide a framework for exploiting this resource in the formal learning context.

There are a number of elements associated with the creation of commonsense understanding; an inbuilt desire to behave intelligently, communicating through speaking and gestures, and the use of social and technical commonsense. These elements facilitate the creation of a 'natural learning environment' in which individuals can adapt commonsense understandings to each new commonsense situation.

Having developed an understanding of commonsense, commonsense thinking and how commonsense is created we now turn to the 'resource' commonsense provides particularly in the problem-solving context.

Commonsense as a resource

In Colleran et al. (2003a) we discussed the resource commonsense provides in the problem-solving context, i.e. it provides a resource with three distinct elements:

- An accumulation of practical understandings,
- A form of knowing,
- A basis for scientific understanding.

An accumulation of practical understandings

Commonsense is a collection of insights accumulated by a community, or individuals within that community, in a socio-historic setting. The context within which it operates is quite specific. It is specialised in the concrete objects of everyday living in terms of their relationship, not to one another, but to the individual. It is bounded by the concerns of human living and by workable solutions to daily tasks. "[Common sense] ... clings to the immediate and the practical, the concrete and the particular. ... Rockets and space platforms are superfluous, if you intend to remain on this earth" (Lonergan, 1957, p. 179).

A form of knowing

Intelligence is met in every walk of life. It is this everyday, practical, concrete, intelligence that Lonergan (1957) calls commonsense. However, even though it is called commonsense, *it is not common to all people*. And while it may be accessible to all normal individuals there are no acknowledged specialists or experts (Coben, 1997). The intelligent person of commonsense demonstrates a greater readiness "in catching on, in getting the point, ... in grasping implications, in acquiring know-how" (Lonergan, 1957, p. 173).
Commonsense knowing can be identified by the following:

- Pragmatism,
- Spontaneity,
- Socially generated,
- Temperamentality,
- Taking things for granted,
- No theoretical inclination.

Commonsense activity is not characterised by periods of sustained thinking and reflection - new understandings are required but they are already in the mind's inventory and are accessible. Intelligence activates a 'micro', instantaneous cycle of the cognitional structure with the purpose of establishing the familiarity of the situation and a satisfaction that no new insights are required to deal with the situation encountered. However, when the commonsense inventory comes up short and new insights are required to deal with a novel situation, the creative, intellectual processes must be activated.

One must also consider the difference between spontaneous commonsense decisions and actions and impulsive responses with resultant rash decisions. We do not want to confuse impulsive, rash decisions and actions with spontaneous commonsense actions. Dewey (1938) pointed out that education is about self discipline, and thinking creates the breathing space that transforms impulsive, ill disciplined, rash decisions and actions to reflective and disciplined decisions and actions. He suggested that education and learning are the agents that enable an individual to control these desires and impulses. While Dewey was not referring to commonsense his observations have been helpful in differentiating between sound commonsense decisions and impulsive, rash decisions.

In summary, common sense is confined to the particular, the experiential, and the concrete, where only non-technical, descriptive terms are used. It is the field of human interaction, where people operate during their everyday living. Commonsense is not impulsive and rash, however it operates within a cultural context where it settles for a mode and measure of understanding that enable human activity and human interaction to operate intelligently.

Commonsense as a basis for scientific understanding

However despite its limitations where would we be without commonsense? There would be no place for human temperament, spontaneity, practicality, intuition, aesthetic appreciation, love, hate and so on. In other words there would be no room for what makes us human, imperfect though that may be. However there is another type of understanding which tries to reduce the subjective 'drawbacks' to produce a more objective understanding, for example, scientific understanding. Lonergan tells us that the scientist is not the whole man or woman functioning "but the rest of the man subordinated to his intelligence. Like Thales so intent upon the stars that he tumbled into the well" (Lonergan Research Institute, 1996, p. 113). While an individual

requires commonsense understanding to survive effectively in this world, occasions may arise when scientific understanding is required. This is not to say that the subject is not intellectually engaged in the field of common sense. Commonsense requires an equally intelligent subject; it is the context that determines the function to which the intelligence is directed. Therefore commonsense can be regarded as a sea within which arises here and there islands of conceptual, scientific understanding and knowledge (Tekippe, 1996). Without this sea or concrete world of commonsense understanding, science has no starting point. It is into this particular, concrete world that science attempts to introduce universal, theoretical understanding.

Kuipers (2004) suggests that commonsense is a 'qualitative' rather than 'quantitative' resource. This qualitative knowledge is relatively easy to learn and enables individuals to solve a surprising number of problems. The interesting thing about qualitative solutions is that there are usually a number of possible courses of action unlike the single quantitative solution. He continues that part of the power of commonsense knowledge comes "from the ability to represent and use knowledge even when it is incomplete". However Kuipers suggests that qualitative solutions can be *strengthened* with quantitative information.

According to Howson (1998) commonsense acts as a resource:

- That provides a means to talk about mathematics,
- That educators must try to develop in students,
- Which we must draw on in our teaching,
- That provides a foundation for mathematical development,
- That provides and external motivation for learning mathematics.

Howson cautions, however, that there are limitations associated with commonsense because although mathematics is built on commonsense it can provide a constraining force on the development of mathematics because commonsense and the mathematical worldview are often apparently contradictory. We are reminded that mathematics too has its own commonsense so, as educators, we must attend to everyday commonsense as well as the commonsense of mathematics.

Therefore, in the context of solving quantitative problems, commonsense provides a wealth of practical experience, a spontaneous yet not impulsive feel for the solution to the problem through the commonsense knowing structure, a confident basis on which to build a scientific solution and an external motivation for learning mathematics.

Employing commonsense as a resource in the resolution of quantitative problems (Practical examples)

In the evaluation phase of our educational programme (Colleran et al., 2001) a number of instances provided clear evidence of situations where learners mobilised their commonsense as the starting point for the solution to 'real-life' quantitative problems. This was particularly apparent in the 'Stocks and Shares' and 'Designing a Car Park' problems. Learners began to feel confident enough to contribute what they thought was relevant in a particular discussion and were willing to take help from other learners or from the tutor if other learners could not help.

The 'realistic' context created in the 'Stocks and Shares' problem provided an opportunity for discussing reasons for strong and weak share prices. Learners talked about the relevance of bad press and how this could affect share prices. In the 'Designing a Car Park' problem learners

discussed issues such as the average size of a family car, the size of a minibus, how much room is needed to open the door of a car and how to represent the size of the car park site on a sheet of paper using an appropriate scale.

These quantitative problems provided fertile ground for the use of learners' commonsense including sense-making, judging, reasonableness and mature decision-making. Building on these 'commonsense' discussions learners began to discover and employ the following mathematical skills on a daily basis:

- Adding, subtracting, dividing and multiplying of whole numbers and decimals,
- Calculator work,
- Data tables,
- Percentages,
- Time,
- Estimation,
- Predictions,
- Linear measurements,
- Areas,
- Averages,
- Scales.

In an effort to clarify the qualitative difference between commonsense and scientific understanding the tutor used the image of a circle (see Figure 2). Firstly the tutor displayed the shape for a few moments and asked learners what did they see?

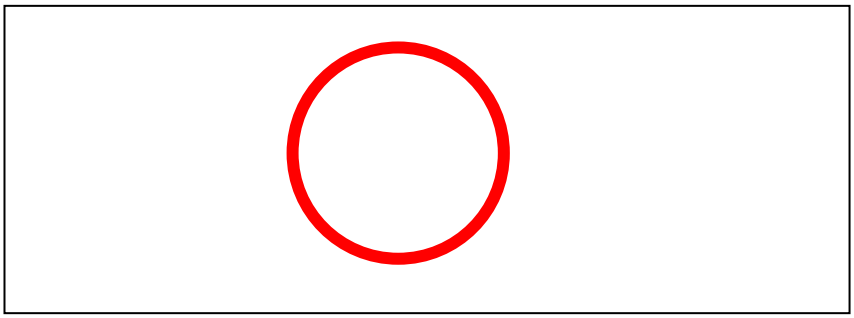

Figure 2. "What do you see?"

Immediately learners began to suggest 'a round shape', 'a red ring', 'a wheel', 'the Sun', 'a shape with no beginning or end', 'a universal symbol', 'it can be any size', and so on. The tutor then uncovered the image so that learners had time to concentrate. He then asked if this shape was displayed in a mathematics class what would it mean? There was immediate reaction from some learners with words such as 'circumference', 'degrees', 'area of circle', 'sphere' and 'perimeter'. The tutor continued with more probing questions such as why is it a circle? and what is the meaning of the word 'circle'? In struggling to come to an understanding learners suggested 'other shapes have corners', 'you can bisect this shape continuously'. Then one learner suggested that 'the midpoint to the edge will always be the same'. Again the tutor probed with a question, 'is a football a circle? 'All learners agreed that the circle must be flat. Finally learners agreed that a circle is a line on a flat surface that is equally distant from a point inside the circle. The tutor then confirmed the qualitative difference between the first,

commonsense, spontaneous description of the round shape and the scientific, thought-out 'definition' of the circle.

This was an excellent and enjoyable exploration for many learners for many learners who participated in the field trials of our educational programme. In his post-class interview Learner 8 was astounded and satisfied with this session:

> I thought it was interesting because at the start of it was just, oh, a circle right. But we kinda started talking about it and got more into it and we managed to get half an hour of talk out of it … from a circle? which I thought was amazing… I thought well, how am I here thinking and talking about a circle for so long. I found it very interesting. [L8:LI:Dec 14th 2000]

Learner 1, in his journal reflects the affective aspect to the class when he suggests *feeling* good about and *liking* thoughtful classes:

> A feel-good class with interaction and thinking… I like provoking, thoughtful classes. Today's 'circle' example was a good example of that. [L1:LJ: Dec. 7th 2000]

This was an important session for many learners because they were enabled, through the gentle probing of the tutor, to uncover what they knew about the circle and develop understanding. They also discovered that new understanding is achieved by taking time to think. There was a sense of achievement at having come to a 'definition' of a circle.

These examples provide evidence that commonsense provides not only a confident starting point but also the invaluable resource. It brings some clarity to the qualitative difference between commonsense and scientific understanding. And even though there are two intellectual fields of operation it does not imply that different people exclusively inhabit each field. A single human mind can and does operate effectively within both fields. When the individual is engaged with practical issues he or she is concerned with the development and growth of common sense of the particular place and time in which he or she operates. However, that same individual may need to develop scientific understanding in relation to their job or profession. This shift from commonsense to scientific understanding is similar to the developmental process described in Argyris and Schon, (1996). They describe a process that moves from routinised, tacit, commonsense understanding, which leads to no significant change of action, to a far deeper, scientific understanding, which brings about a change in the way the individual acts. The former is described as 'single-loop' learning while the latter is described as 'double-loop' learning. Until one attends to experiences in this reflective manner things will continue in the routine, however, with reflection the situation will become transformed from commonsense, single-loop learning to scientific thinking and double-loop learning. Again, the basis for scientific understanding is the routine world and it is reflection and scientific thinking that leads to new understanding and knowledge.

Lonergan (1957) assures us that science does not have a monopoly when it comes to intellectual demands and ability. Common sense and science are equally intelligent and they have a functional synthesis. Without commonsense there is no starting point for scientific understanding. Both science and commonsense operate as partners in the development of human understanding. However, there is concern that scientific knowledge has become a "fetish used to alienate students (and teachers) from their own native ability to know the world" (di Norcia, 1975, p. 27). Making sense of the experiential world is intellectually demanding and fundamental to everyday living and may provide an invaluable resource, particularly for adult learners when they are engaged in formal education.

Convergences and speculations

The authors have begun to recognize the convergence of a number of different strands in our work and the work of others e.g. Howson (1998); Coben (2002a, 2002b); Kuipers (2004). Kuipers (2004) in his definition of commonsense identifies foundational elements of commonsense including number and geometrical awareness, thus clearly identifying mathematics as part of the structure of commonsense. This may explain why adults describe the mathematics that they master as commonsense, i.e. this may go some of the way towards explaining the phenomenon of 'invisible' mathematics as reported by Coben (1997). Kuipers (2004) classification of commonsense is supported in part by recent findings of the cognitive scientists who have discovered that number concepts are 'hard-wired' into humans when they are born as discussed in Devlin's (2000) book *The mathematics gene.*

There is clear agreement that commonsense provides not only the bedrock on which mathematical understanding is built but also a resource that scaffolds mathematical development. Radical constructivism (von Glasersfeld, 1990) focuses on leaning as serving an adaptive purpose i.e. learning is a survival mechanism. Therefore we should learn to exploit natural learning in different environments, e.g. everyday life and workplaces. These ideas are implicated in commonsense knowing and therefore the challenge for us is to exploit commonsense in the service of adults mathematics education.

Conclusion

The perceived divide between commonsense and mathematical understanding provides both the insight and the challenge. The insight, which is similar to that of Tekippe (1996) when illustrating the relationship between primordial knowing and conceptual knowing, is that commonsense can be regarded as a sea within which arises here and there islands of mathematical understanding and knowledge. Without this sea or commonsense world, mathematics has no starting point. The challenge for educators is to cultivate learning environments which will enable learners to draw from their commonsense resource to strengthen and build mathematical commonsense (Kuipers, 2004; Howson, 1998). The authors suggest a convergence of a number of strands in adult's mathematical education research and seem to provide a basis for future research.

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