COGNITION, KNOWING, AND UNDERSTANDING: LEVELS, FORMS, AND RANGE

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ABSTRACT

Cognition, knowing, and understanding are analysed in terms of levels, forms, and range. It is found that cognition is knowing and that understanding is a range of knowing. Three levels of knowing (pre-conventional, conventional, post-conventional), three levels of understanding (prehension, apprehension, comprehension), and six forms of knowing (linguistic, emotional, imaginal, physical, physiological, conative) are distinguished. Levels and forms of knowing operate as a system and constitute a range of knowing. One's range of knowing determines one's extent of understanding. The three levels and six forms of knowing are compared and contrasted with the categories of cognition posited by: Bloom, Engelhart, Furst, Hill, Krathwohl, and Masia; Bruner; Piaget; Gagne; Kohlberg; Collis and Biggs; and Maccia and Steiner. The conclusion is drawn that the three levels and six forms of knowing are critical, elemental categories and that the categories of knowing posited by other researchers are either subsets, combinations, or conflations of these elemental categories.

The theme of this conference is "Educational Research for National Development: Policy, Planning and Politics." It seems patent that the process of national development entails the process of developing human potential, and that the development of human potential implies the development of cognition, individually, as a free and responsible human being, and collectively, as members of Australian society. A sound policy for the development of human potential is derivative from a sound conception of the levels, forms, and range of cognition that exist within the human potential. The question of which forms and levels of cognition ought policy-makers and planners undertake to encourage and support in the cause of national development is an axiological one. It is a question of worthwhile human attributes that characterise a just and fair society in which members of that society are accorded freedom, dignity, and purposeful lives. The question of how to gain acceptance of policies established by decision-makers and planners is a political one: Which personalities, arguments, and activities will sway the most people? Philosophers and those who think seriously about what makes a just society can help with forming possible solutions to the first question. Political scientists, politicians, and public relations experts can help with the second question. But, both questions are preceded by a prior question: Which forms and levels of cognition can be developed? Which of them are within the human potential?

Educological research (i.e., inquiry about the educational process) (Christensen, 1981a,b,c) has an important contribution to make in the solution of this prior question, and much is already known about the human potential for cognition, thanks to the achievements of researchers such as: Bloom, Engelhart, Furst, Hill, Krathwohl, and Masia; Piaget; Gagne; Kohlberg; Collis and Biggs; and Maccia and Steiner. But can the fruits of their labour be improved upon? This analysis is an effort to do so. The methods used in this analysis are essentially those of qualitative inquiry, and specifically, the standard techniques developed in conceptual analysis (sometimes also named ordinary language analysis). The techniques employed included necessity reasoning, concept isolation (or term isolation), definition, explication, model case, contrary case, borderline case, invented case, related concept, unrelated concept, word substitution, results in language technique, and new term technique. All of these inquiry or research techniques are discussed in Christensen, 1979:69-126.

To begin, in common usage, the term 'knowledge' names at least two categories. Knowledge in one sense is that category to which verified propositions, warranted assertions (in Dewey's terms), and true statements (both probably true and necessarily true) belong. It is the category of truths. A second sense is that category to which states of mind, competencies, expertise, and learned abilities belong. It is the category of cognition. Knowledge in the first sense is located in recorded language and recorded propositions. We keep this knowledge in places such as libraries (and more recently, in computer data banks). Knowledge in the second sense is located in people, and especially, in their ability to perform in well informed ways.

For the sake of clarity, let's name this second sense of knowlege with the term, 'knowing'. Also, for the sake of clarity, let cognition be conceived of as the process of knowing, and let knowing be conceived of as the realised ability to perform adequately in relation to personal purposes and states of affairs. This makes cognition the same process as knowing. For example, an instance of knowing is the realised ability of a commercial airline pilot to plot a course and to handle her or his aircraft safely so that passengers are comfortably and with minimal risk ferried from one location to another. It is not an ability which was realised by instincts. It took much practice and care in developing. It is an ability that is realised through the process of learning.

Cognition can be distinguished with respect to levels of knowing and forms of knowing. Levels of knowing are degrees of extent to which one has realised the ability to perform adequately in relation to some state of affairs. They are degrees of extent to which one knows. At least three levels of knowing can be distinguished: (1) **level 1**, pre-conventional knowing, or knowing α, (2) **level 2**, conventional knowing, or knowing β; (3) **level 3**, post-conventional knowing, or knowing γ. At **level 1**, that of pre-conventional knowing (or knowing α), the individual experiences a high degree of disorganisation, makes many mistakes, and has a low degree of control. It is a level in which there are many trials and errors, and much self-conscious effort is exerted. In coming to know how to ride a bicycle, for example, **level 1** is the stage of wobbling around and falling over frequently. In coming to know how to add, **level 1** is the stage of setting out four beans and five beans and counting all of the beans individually in the two groups in order to determine that four plus five make nine. **Level 1** is the level of knowing at which a novice might perform.

In the transition between **level 1** and **level 2**, the degree of control becomes extended and refined. Fewer mistakes are made, and conventions in performance are well on their way to becoming habituated, but there are still self-conscious uses of the conventions. Control is being achieved, but only with considerable concentration. With respect to bicycle riding, for example, the transition from **level 1** to **level 2** is characterised by steady riding and little wobbling, but control is not yet automatic. The rider puts in a great deal of concentration in order to co-ordinate the movements of foot, leg, arm, and trunk in order to assure balance. In the case of someone learning to add, the transition from **level 1** to **level 2** is characterised, for example, by the ability to add two and three digit numbers fairly efficiently, but not able to go beyond three digits. Once the transition is made, and knowing at **level 2** is achieved, one's performance becomes habituated and automatic. The conventions of any particular knowing have become mastered. Control within the limits of established conventions is achieved to a high degree, and there is little or no self-conscious effort exerted in the control. Adequate performance of conventions has become routine. In the example of riding a bicycle, the rider maintains balance, speed, and control without having to concentrate. It has become automatic to co-ordinate all of the necessary body movements for cycling. With regard to the case of addition, **level 2** knowing is characterised by understanding face and place value of numerals, the placement of decimal points, and efficient use of the basic addition facts so that one can add any number to any number. The conventions of addition are used quickly, efficiently, and accurately.

Knowing at **level 3** (knowing γ) is knowing that has extended beyond established conventions. Achievement of **level 3** knowing requires exploration, inquiry, and creativity so that one breaks new ground and forms new standards of performance that extend beyond the conventions of **level 2** knowing. In bicycle riding, it might be, for example, the development of a set of new techniques and expertise in cycling (lifting up the back wheel and doing a pirouette on the front wheel). In arithmetic, it might be the development of a new algorithm for doing addition. The new standards of performance that might be established at **level 3** of knowing could even contravene or reject the accepted conventions of **level 2** knowing.

In addition to levels of knowing, there are forms of knowing. Forms of knowing are the kinds of performances that can be realised. At least six forms are distinguishable: linguistic, emotional, imaginal, physical, physiological, and conative. Linguistic performances are those which signify meaning with symbols. They include speaking, reading, writing, reasoning in sentences and with mathematic symbols, and performing logical operations such as deduction, reduction, induction, and retroduction (cf. Steiner, 1978). They may be silent, told inwardly, or they may be spoken aloud, or written. Emotional performances are feelings of emotion in relation to some state of affairs, such as an emotional response to a rendition of Vivaldi's "Four Seasons," feelings of outrage about being falsely accused, or remaining calm and suppressing panic as one participates in the evacuation of a burning building. Imaginal performances are the acts of forming images, shapes, imagined sounds, and imagined relationships in one's awareness or consciousness. When someone forms a picture of a cow in the consciousness (but is not viewing a cow with the eye), this is performing imaginally. Likewise, imagining a tune by recalling it or creating it (but not audibly singing it or hearing it) is an imaginal performance. A third example is imagining where your opponent in a tennis game is going to drive the next shot. Physical performances are organised movements and gestures, such as swimming, ski-ing, driving a car, or high tower diving. Physiological performances are, for example, deliberately slowing one's heart rate, diminishing one's blood pressure, or blocking out pain. Conative performances are acts of volition or will. Conation is the state of mind of having purpose, and conative knowing is choosing or willing. It is an adequate performance of will in relation to some set of circumstances or state of affairs. Conative knowing is a state of knowing-to, as distinct from knowing-that or knowing-how. A person has achieved a state of knowing-to when she or he can say (and mean it), "I am willing to do that." That state of willingness, or knowing-to, is the same as conative knowing. In contrast, a person has achieved a state of knowing-how when she or he can say (and mean it), "I can now do that." Knowing-how includes instances of emotional, imaginal, physical, and physiological knowing. But it can include instances of linguistic knowing. For example, "I can do that," includes the ability to solve quadratic equations, speak Russian, and write essays on existentialism -- all instantiations of linguistic knowing. A person has achieved a state of knowing-that when she or he says (and means it), "I now know that is so." Knowing-that is an instantiation of linguistic knowing. So, the categories of knowing-how and knowing-that are not distinct; but knowing-to is quite distinct. It is conative knowing.

The three levels of knowing are related to the six forms of knowing in that every form can be distinguished with respect to some level (see Figure 1).

LEVELS OF KNOWING	FORMS OF KNOWING					
	LINGUISTIC KNOWING (A)	EMOTIONAL KNOWING (B)	IMAGINAL KNOWING (C)	PHYSICAL KNOWING (D)	PHYSIOLOGICAL KNOWING (E)	CONATIVE KNOWING (F)
LEVEL 3 (γ)	γA	γB	γC	γD	γE	γF
LEVEL 2 (β)	βA	βB	βC	βD	βE	βF
LEVEL 1 (α)	αA	αB	αC	αD	αE	αF

Figure 1: Levels and Forms of Knowing -- Possible Combinations

In Figure 1, linguistic knowing at **level 1** (αA) is restricted; at **level 2** (βA), it well developed and in accordance with conventions; at **level 3** (γA), it is creative and innovative. So it is with each of the other five forms. The first level is the pre-conventional. The second is the conventional. And the third level is the post-conventional. These forms and levels of knowing constitute range of knowing. Any individual has upper limits to the levels and forms of knowing which she or he has achieved at any given point in life. These upper and outer limits are the extent of an individual's range of knowing. In relation to football, for example, there are some people who can tell you all about the various teams, but they do not play the sport themselves. Their linguistic knowing of football is well developed, but not their physical knowing. There are others who play the sport well. They have an extensive command of defensive and offensive tactics and strategies. They anticipate well the moves of their fellow team members and the moves of their opposition. They also have a strong attachment and commitment to the game. Such people have well developed physical, imaginal, and emotional knowing of football. Such is their range of knowing.

Understanding is, of course, closely related to knowing, and especially linguistic knowing. Understanding arises from realising the ability to signify meaning to one's self with symbols (i.e., to in-tell). It is through symbolising that one can make sense out of states of affairs and thus come to understand one's environment and one's self in relation to that environment. The development of understanding requires experience and an ability to talk about that experience, either aloud, in-loud, or both. At least three levels of understanding can be distinguished. They are the levels of prehension, apprehension, and comprehension. In the development of understanding, enunciation precedes adjudication. That is, the act of saying or talking (either out loud or in loud) about a matter must take place before one is able to engage in the act of exercising competent and adequate judgment about a matter. Furthermore, the act of saying with little or even no meaning precedes the act of saying with meaning, in the normal course of developing understanding. Saying with meaning is conceiving, and saying without meaning is uttering sounds, or making senseless noise (i.e., senseless, at least, to the individual who is producing the utterance). The three levels of understanding (prehension, apprehension, comprehension) relate to the acts of uttering and conceiving, and they also relate to the acts of enunciating and adjudicating. Prehension is operating with language at the level of uttering without conceiving much meaning. Apprehension is conceiving symbols with meaning, but the meaning is restricted largely to denotative meaning. Comprehension is conceiving with both denotative and connotative meaning. It is the most expanded level of understanding.

At the level of prehension, an individual, for example, might be able to say (or write) the statement, "Osmosis is the process in which a solvent diffuses through a semipermeable membrane," but the individual does so without conceiving the meaning of the statement. Prehension is the act of uttering, but for the individual who produces the utterance, there is little sense in it (yet!). The level of prehension is the lowest level of understanding. It is the beginning, or dawning, of understanding, and it is a necessary or prerequisite level which an individual normally must develop prior to any higher levels of understanding.

At the next higher level, the level of apprehension, an individual is operating with language at the level of saying or talking (out loud or in loud) with meaning. However, even though apprehension is conceiving (using symbols with meaning), the meaning is restricted largely to denotative meaning. The individual can connect her or his language with specific objects and particular actions, but not extend the meaning beyond the level of denotations. Denotative meaning is the relationship between an object and a word. A tree is a denotation of the word, 'tree'. To denote with the word, 'tree', is to say, "tree," and mean the object, tree. One can point to (or denote) objects with words, and one way of explaining meanings is to point to the things or categories of things which words name. This is the act of explaining a word's meaning denotatively. So, denoting is pointing to objects with words. Denotations are the objects referred to by words.

And denotative meaning is the relationship between an object and a word in which the meaning of the word is the object to which the word refers. It is possible and fairly common for an individual to know how to use a word correctly, but not know how to explain the meaning of the word. And it is possible to know how to use a sentence correctly, but not know how to explain the meaning of the sentence. In such cases, the individual is using language (or systems of symbols) denotatively. The individual can point to objects and states of affairs with words. She or he can name, identify, describe, and to some extent explain actions, the workings of objects, and states of affairs. The individual can even predict, manipulate, and control states of affairs. But her or his language usage is functioning within the restricted use of denotative meaning. An individual who is operating at the level of apprehension can, for example, say the statement, "Osmosis is the process in which a solvent diffuses through a semipermeable membrane," and conceive the meaning of the statement to the extent of being able to point to actual instances of osmosis, solvents, semipermeable membranes, and diffusion. This ability to point to objects, actions, and states of affairs with words characterises understanding at the level of apprehension.

At the next higher level of understanding, that of comprehension, an individual is operating with language at the level of saying or talking (out loud or in loud) with denotative and connotative meaning. The individual can do more than point to specific objects, actions, and relations. She or he can extend beyond the level of denotations to that of connotations. Connotative meaning is the relationship between a word (or set of words) and another word (or set of words). The set of words, 'a woody perennial plant having a single usually elongaged stem generally with few or no branches on its lower part', is a connotation of the word, 'tree'. To connote with the word, 'tree', is to say, "tree," and mean the set of words, 'a woody perennial plant having a single usually elongated stem generally with few or no branches on its lower part'. One can point to, or connote, other words with words, and a second way of explaining (besides pointing to objects) is to point to other words which can be used in place of a word (or a term). This is the act of explaining a word's meaning connotatively. So, connoting is pointing to words with words. Connotation is a set of words which can be used in place of a word. And connotative meaning is a relationship between a set of words and another word in which the meaning of the word is the set of words that can be used in its place. At the level of comprehension, an individual is able to say, for example, the statement, "Osmosis is the process in which a solvent diffuses through a semipermeable membrane," and to conceive of the meaning of the statement both denotatively and connotatively. The individual is able to point to actual instances of osmosis, solvents, membranes, and diffusion. She or he is also able to say with other words what the statement means. To do the first is to conceive denotatively. To do the second is to conceive connotatively. Comprehension is doing both.

The levels of understanding relate to the activities of uttering and conceiving in that the first level (prehension) is is the same as uttering, and the second and third levels (apprehension and comprehension) are both different kinds of conception. The levels of understanding relate to the acts of enunciation and adjudication in that enunciation is saying or making a pronouncement about something. Enunciation is part of all three levels of understanding. Adjudication, or making judgments about something, is made possible by the three levels of understanding. At the level of prehension, well informed judgments are not possible, but prehension is a necessary foundation for the development of adjudication. As understanding develops through to the two higher levels, the capacity to make well informed judgments about something (e.g., objects, relations, states of affairs) also develops.

Levels of understanding are related to levels of knowing and forms of knowing in this way. Understanding enables an individual to describe, explain, and predict states of affairs. It also enables an individual to control, to some extent, states of affairs through anticipation, prescription, and intervention. The realised abilities to describe, explain, predict, and prescribe are all linguistic abilities. That is, they are instances of linguistic knowing. The realised ability to intervene may be of any form, e.g., physical, linguistic, emotional, physiological. Understanding, then, is linguistic knowing in all of its three levels, plus any or all of the other possible forms of knowing. That is, understanding is linguistic knowing that is articulated with any and all of the other forms of knowing. Understanding is a system of knowing in which linguistic knowing guides the other forms of knowing that are functioning within the system. This system of knowing that is understanding is located within the functioning of an individual. Human development, taken as the extension of cognitive function, is the process in which this system of knowing that is understanding develops from (1) a restricted and relatively uncomplicated, undifferentiated function into (2) an extensive, highly complicated and extremely differentiated function.

With regard to other categorisations of cognition (such as that of Bloom et al., Bruner, Piaget, Gagne, Kohlberg, Collis and Biggs, Maccia, and Steiner), they are either subsets, combinations, or conflations of the elemental categories of the three levels and six forms of knowing and the three levels of understanding. Bloom et al. (1956) and Krathwohl et al. (1956) have used the categories of cognitive, affective, and psychomotor domains to classify abilities that can be learned. Learned cognitive abilities, in Bloom's terms, are the same as linguistic knowing. They include the linguistic (conceptual) abilities to recall, comprehend, analyse, apply, synthesise, and evaluate states of affairs by means of signifying meaning with symbols (i.e., using language). Recalling in Bloom's terms is an instance of understanding at the

prehension level, or at the early stages of transition to the apprehension level. Recalling is taken by Bloom to be the ability to repeat something (e.g., a word or a phrase or a sentence) in a form identical or nearly identical to the way it might have been heard, seen, or originally encountered. Of course, recalling can take place in many forms, e.g., linguistic, emotional, imaginal, physical, physiological. But this point is not one that Bloom makes. Bloom et al. characterise comprehending as the ability to understand to the extent that an individual can restate a statement in other words (translation), reorder the statement (interpretation) or estimate or predict from a statement (extrapolation). And applying is the realised ability to use general ideas or procedures appropriately in new situations without help, direction, or prompting. In terms of our analysis, comprehending and applying are instances of understanding at the level of apprehension. Bloom's analysing (the ability to use language to identify the constituent elements, relationship of elements, and organisational principles of a field of phenomena), synthesising (the ability to use language to relate several aspects of a field of phenomena in such a way as to create new structure or organisation in ideas about the phenomena), and evaluating (making judgments about the worth of something) are instances of understanding at the level of comprehension.

Learned psychomotor abilities are knowing in relation to physical performances (e.g., swimming, playing tennis) and to physiological performances (e.g., slowing heart beat, lowering blood pressure, blocking out pain). But psychomotor abilities also include linguistic (conceptual), imaginal, emotional, and conative knowing. Playing tennis, for example, is a psychomotor ability, but it is not just physical knowing. One must know the rules of the game of tennis in order to play it (linguistic knowing). One must be willing to play by the rules (conative knowing). One must keep her or his emotions in control (e.g., not throw a violent tantrum every time a shot is missed) in order for the game to proceed. This requires emotional knowing. And one must imagine (anticipate) positions of the ball and of the opponent in order to volley and place shots (imaginal knowing). Psychomotor knowing, then, is actually a compex combination of physical knowing along with linguistic, imaginal, emotional, conative, and physiological knowing.

Krathwohl et al. have explicated the category of affective abilities, and they characterise learned affective abilities as those involved in the process of attaching a value to something, holding a strong belief about something, or having a deep-seated attitude about something. Affective knowing, in our terms, is a complex of linguistic, emotional, imaginal, and conative knowing. An example of an affective ability which Krathwohl gives is the observance of traffic rules. This requires linguistic knowing (knowing the rules). It requires conative knowing (willing to follow the rules). It requires emotional knowing (a positive feeling toward the rules). And it requires imaginal knowing (anticipating or imagining the consequences of a world without traffic rules in comparison to a world with such rules).

Gagne (1977) offers this set of categories as a scheme for classification of learned abilities: intellectual skills, cognitive strategies, verbal information, motor skills, and attitudes. Intellecual skills are instances of linguistic knowing because they entail conception about states of affairs by use of symbols. Through the use of intellectual skills, one is able by means of language to classify, tabulate, relate, distinguish, analyse, and quantify states of affairs. Gagne categorises intellectual skills in a hierarchy of less complex to more complex: signal learning, stimulus-response learning, chaining, verbal association, discrimination learning, concept learning, rule learning, problem solving. The way in which these eight levels of ability relate to the categories of prehension, apprehension, and comprehension is that signal learning and stimulus-response learning function at the level below prehension; chaining and verbal association function at the level of prehension; discrimination and concept learning (i.e., concrete concept learning) function at the level of apprehension; and abstract concept learning, rule learning, and problem solving learning function at the level of comprehension. The progression in understanding is from denotative to connotative linguistic performances. Verbal information is the ability to recall and state (by means of talking, writing, or otherwise signifying meaning by symbols) true statemetns, either verbatim or as a paraphrase. This ability to recall verbal information is another instance of linguistic knowing. Cognitive strategies are also instances of linguistic knowing. They are methods or procedures that are helpful in solving problems. They require the use of symbols to signify meaning, thus are clearly instances of linguistic knowing. For example, the problem of multiplying 98 by 15 can be achieved by regrouping the numbers: fifteen 100's are 1,500; fifteen 2's are 30; 1,500 less 30 is 1,470. Any shortcut that reduces the difficulty of some problem or facilitates tasks such as recalling, analysing, or working out the implications of something are cognitive strategies, and they are instances of linguistic knowing. Motor skills are the same as psychomotor skills, and the previous discussion of those abilities is applicable here. Attitudes are complex patterns of feeling, acting, and thinking in relation to a given state of affairs. Examples of attitudes include being cooperative, argumentative, obstreperous, passive, inquisitive, aggressive, candid, militant, or conciliatory. Attitudes are closely related to the category of affective abilities, and they are the result of a complex combination of linguistic, emotional, imaginal, physical, physiological, and conative knowing.

Piaget (in Green, Ford, and Flamer (eds.), 1971) has classified levels of understannding into four categories, and he has assembled evidence to link these levels with ages at which these levels typically develop. The four categories are sensori-motor, pre-operational, concrete operational, and formal operational stages. The sensori-motor level is characteristic of children from ages 0 to 2. At this level, children move and take limited action upon their environment, but they have no linguistic ability. They do not discern objects with language. As such, it is a level prior to prehension.

The next three levels (pre-operational, concrete operational, and formal operational) are so named by Piaget because they are levels of ability to perform conceptual operations in mathematical and scientific reasoning. The pre-operational level is that in which there is little or no ability to perform such operations. The concrete operational level is that in which there is limited ability to perform conceptual operations and usually with the assistance of physical referents. The formal operational level is that in which there is extensive ability to perform conceptual operations in mathematical and scientific reasoning without resort to physical referents. In our analysis, these three levels are instances or linguistic knowing. The pre-operational level functions at the level of prehension, in our terms, and bridges into the lower level of apprehension. The concrete operational level is an instance of linguistic knowing at the level of apprehension and bridging over into the lower level of comprehension. The formal operational level is an instance of linguistic knowing at the comprehension level of understanding.

The concepts and logical operations which constitute mathematical and scientific reasoning, of course, do not make up the whole picture of what can be understood about existence, the universe, or self. There is a range of understanding which can be developed in relation to many other human activities and enterprises, e.g., understanding in relation to art and aesthetics, morals and ethics, business and economics, past events and future developments, physical co-ordination and sports, musical performance and musicology, to name but a few. Kohlberg (1963 and in Hoffmann and Hoffmann [eds.], 1964) and Piaget (1948), for example, are among theose who have made studies of understanding in relation to moral and ethical states of affairs. Piaget identified three categories (levels) of understanding about morals, and he related those levels to the ages when children developed such understanding. The three levels are (1) heteronomous morality (moral realism, morality of constraint), (2) reciprocal punishment (punishment fitting the crime), and (3) autonomous morality (moral relativism, morality of co-operation). Kohlberg differentiated understanding about morality into seven categories: (0) egocentric judgment, (1) punishment and obedience orientation, (2) instrumental relativist orientation, (3) interpersonal concordance orientation, (4) authority-maintaining orientation, (5) social-contract, legalistic orientation, (6) universal ethical principle orientation. Understanding of and commitment to sound moral and ethical reasoning are not Piaget's and Kohlberg's concerns. Rather, they are interested in the timing and the manner of reasoning by children about ethical and moral states of affairs. Sound, conventional knowing (**level 2** or knowing β) of moral and ethical states of affairs includes (1) responsibility for self (the self-willing I), (2) responsibility for others (a regard for the wishes, interests, and welfare of others), and (3) universality of standards (the categorical imperative, applicability of the same standard for all persons in the same circumstances). This is to be contrasted with the categories which Kohlberg conceives (pre-conventional, conventional, post-conventional). His category of pre-conventional includes (0) egocentric judgment, (1) punishment and obedience orientation, and (2) instrumental relativist orientation; his conventional includes (3) interpersonal concordance orientation and authority-maintaining orientation; and his post-conventional includes (5) the social-contract, legalistic orientation and (6) the universal ethical principle orientation. In relation to our own analysis, reasoning about moral and ethical states of affairs is a combination of linguistic and conative knowing. Achievement of the conventional level of knowing (**level 2** or knowing β) about morality and ethics requires achievement of the comprehension level of understanding -- an ability to use language connotatively as well as denotatively. Again, in terms of our own analysis, Piaget's categories of (1) heteronomous morality, (2) reciprocal punishment, and (3) autonomous morality are part of **level 2** or knowing β (conventional knowing). Likewise, Kohlberg's seven categories are part of **level 2** or knowing β, and they are inclusive of the linguistic and conative forms of knowing.

An alternative classification of understanding has been proposed by Bruner (1960, 1961, 1964). The three categories he has conceived are (1) enactive, (2) iconic, and (3) symbolic stages of representation. That is, understanding can be developed and represented enactively, by physical action -- touch, feel, taste, bite, chew, hold, gesture. It can be developed and represented iconically, by seeing and drawing images rich in shape, line, colour, and tone. And, finally, it can be developed and represented symbolically, with conception of meaning with symbol systems (words, sentences, mathematical symbols). Bruner, like Piaget and Kohlberg, relate these categories of understanding to periods in childhood when children develop these categories. In terms of our analysis, enactive understanding is below the level of prehension, and it is an instance of, and perhaps a complex system of physical knowing. Iconic understanding is an instance of, and perhaps a complex system of imaginal knowing. Symbolic understanding is linguistic knowing at all of its levels.

Biggs and Collis (1982) clarified the distinction between developmental stages (such as Piaget, Bruner, and Kohlberg considered) and learning outcomes (such as Gagne, Bloom et al., and Krathwohl explicated). They addressed the problem of what learning outcomes were possible, and they conceived of five categories: (1) prestructural, (2) unistructural, (3) multistructural, (4) relational, and (5) extended abstract. In terms of our own analysis, Biggs and Collis categorised dimensions within linguistic knowing. Prestructural is pre-conventional linguistic knowing (**level 1** or knowing α). It is also understanding at the level of prehension. Unistructural, multistructural, relational, and extended abstract are instantiations of conventional linguistic knowing (**level 2** or knowing β). Also unistructural, multistructural, and relational are instances of understanding at the level of apprehension, while extended abstract is an instance of understanding at the level of comprehension.

Steiner (1981), like Biggs and Collis, treated the problem of what learning outcomes, or kinds of knowing were possible. She conceived of three categories: (1) quantitative, (2) qualitative, and (3) performative knowing. In Steiner's terms, quantitative knowing is the learned ability to describe and characterise states of affairs, including entities, activities, and relations. Conceptual and empirical analysis produce qualitative knowing. Performative knowing is the learned ability to take deliberate, organised, and effective action. The action can be physical, but it can be other kinds as well, e.g., linguistic (conceptual), imaginal, emotional, conative. Transactional analysis produces performative knowing. Qualitative knowing is the ability to recognise, characterise, and appreciate unique states of affairs, including unique entities, activities, and relations. Perceptual analysis produces qualitative knowing. In association with Steiner, Maccia (1973 a,b,c, 1977) also addressed the problem of what learning outcomes are possible. He, too, conceived the categories of performative, quantitative, and qualitative knowing. Qualitative knowing, he further explicated as dividing into three subcategories: recognitive, acquaintive, and appreciative. He characterised qualitative knowing as "a basic knowing," a "knowing that one," as distinct from a "knowing that" (Maccia, 1973 b). A learner has qualitative recognitive knowing when she or he can recognise a state of affairs and discern it from that which is not that state of affairs, and vice versa -- discern that which is not that state of affairs from that which is. Acquaintive knowing by a learner is extant when the learner at first hand experiences a state of affairs and becomes familiar with the essential and unique qualities of that given state of affairs (e.g., entities, activities, relations). The ability to identify the unique qualities of a known state of affairs by denotative use of language characterises qualitative acquaintive knowing. A learner has appreciative knowing of a state of affairs when she or he is acquainted with the something, can select elements that are appropriate to the something, and can select relations that are appropriate to the something. It is a "discerning judgment . . . that appraises the adequacy of part-whole entities and connections" (Maccia, 1973 b : 3). Maccia used the distinction between "knowing that one" and "knowing that" to conceive a second category of knowing ("knowing that" or quantitative knowing) and three subcategories: instantive, theoretical, and criterial knowing. He characterised "knowing that" as "non-basic knowing" (following Lehrer and Paxson, 1968). While a "basic knowing" is relevant to the unique, a "non-basic knowing" is relevant to the general. "Knowing that one" is "true belief that is completely justified and which justification does not depend upon any other statement or belief," but "knowing that" is "true belief that is completely justified and that justification is not defeated by any other justifying statement or belief" (Maccia, 1973b: 2,4). A learner has quantitative instantive knowing when she or he is able to make an assertion that is warranted by referencing the assertion with adequate authority. A learner can be said to have quantitative theoretical knowing when she or he is able to make an assertion and warrant the assertion by appropriate evidence or evidential argument. And a learner has quantitative criterial knowing when she or he can make an assertion and warrant the assertion by justificatory argument. Maccia contrasts "knowing that one" and "knowing that" with a third category: "knowing how to do that." It is an ability to execute some performance smoothly, appropriately, and repeatedly. "Knowing how to do that" is protocolic knowing. It is a single-pathed performance characterised by goal attainment through invariant sequences of movement. Maccia's fourth category is "knowing what to do," and he conceives three subcategories: conventional knowing, innovative knowing, and creative knowing. "Knowing what to do" is the ability to specify the manner by which some performance is to be altered in realising a goal, and it is manifested by mapping sequences for executing alternative novel performances. A learner has conventional knowing when she or he has the ability to execute a multi-pathed performance smoothly and to attain a goal through adaptive sequences of movement. A learner has innovative knowing when she or he has the ability to transfer elements of one performance to another and to attain goals by improving or inventing different ways of performance. Creative knowing by a learner is attained when the learner has the ability to transform elements of performances into unique forms and to unite disparate ways of realising goals. Innovative knowing and creative knowing can not be taught, only achieved. But what can be learned is how to recognise innovative and creative knowing (an important knowing for a teacher or evaluator!). The categories in the Maccia conception, then, are: (1) qualitative knowing (knowing that one), including recognitive, acquaintive, and appreciative knowing; (2) quantitative knowing (knowing that), including instantive, theoretical, and criterial knowing; (3) performative knowing (knowing how to do), which includes protocolic knowing; and (4) knowing what to do, which includes conventional knowing, innovative knowing, and creative knowing.

In terms of our analysis, qualitative knowing (recognitive, acquaintive, appreciative) is a complex system of all six forms (linguistic, physical, etc.) of knowing. Recognitive and acquaintive knowing function at the level of apprehension (denotative use of language). Appreciative knowing operates at the level of comprehension (denotative and connotative use of language). Quantitative knowing is a complex system of all forms of knowing in which linguistic knowing operates as a guide to the other forms of knowing. Quantitative knowing can function at the apprehension and comprehension levels. Protocolic knowing (knowing how to do) can be any of the six forms of knowing, and it is equivalent to the conventional level of knowing. Procedural knowing (knowing what to do), including conventional, innovative, and creative knowing, can be any of the six forms, and it is operating at the level of post-conventional knowing.

The work of Piaget, Bruner, and Kohlberg has focussed upon stages (periods of time in the lifespan of human beings) when groups and individuals are likely to be capable of developing specific categories of knowing. This work, if

sound and well substantiated, can have use in selecting knowing that is within the capabilities of learners. The work of Gagne, Bloom et al., Krathwohl et al., Biggs and Collis, and Steiner and Maccia have focussed upon the problem of identifying categories of knowing (learning outcomes) that a learner might undertake to study and learn under guidance. A system of categories of knowing is important for competently performing the task of selecting and specifying educational goals, aims, objectives, and purposes. In our analysis, we have explicated the categories of forms of knowing, levels, and range of knowing and levels of understanding. We have argued that in relation to other systems of categories, they are either subsets, combinations, or conflations of the elemental categories of levels, forms, and range of knowing and levels of understanding. Prehension, apprehension, and comprehension are teachable. So, too, are the six forms of knowing and two levels of knowing (pre-conventional and conventional), but not post-conventional knowing (because it is a creative, innovative level). With these categories, educological researchers are in a better position to advise policy-makers and planners about how to devise curriculum which incorporates a clear conception of the levels and forms of cognition that are judged desirable to encourage in the cause of individual human development and collective human development (including national development).

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