

KEEPING KNOWLEDGE ALIVE

The problem of keeping knowledge alive, of preventing it from becoming inert...is the central problem of all education. (Whitehead, 1967 [1929], p. 5)

This statement by Alfred North Whitehead in his short 1917 essay, “The Aims of Education,” has been a challenge to educators and curricularists for almost a century. It is not usual for us in education to consider that the ideas we expound are “dead,” “inert,” “useless,” “lifeless,” “barren,” and full of “mental dryrot.” Yet, this is the charge and challenge Whitehead has given us educators. In the Preface to the book *Aims of Education* (1967 [1929]) he states that “the whole book is a protest against dead knowledge” (v); and in his essay of the same name mentions the need to avoid “inert” ideas no less than seven times in the first three paragraphs. Ideas are inert when they are “disconnected,” atomistic, isolated; related neither to the practicalities of life, nor to an individual’s own interests, nor to the field in which they exist. Then they become monads without souls, floating through time and space. Relationality is, of course, a key theme in Whitehead’s cosmology; it is what he calls the “really real” (*Modes of Thought*, 1938, 205–06) and forms the heart of his “Philosophy of Organism” (*Process and Reality*, 1978 [1929], especially Ch. 2.)¹ Whitehead had a formula for keeping knowledge alive: the integration of the three teaching/learning modes of romance, precision, generalization (1967 [1929], Ch. 2), along with his wonderful teaching aphorisms: “Do not teach too many subjects”; “What you teach, teach thoroughly”; “Let the main ideas...be few and important”; and “Let them [the ideas] be thrown into every combination possible” (2). Before elaborating on and exploring these three “stages of mental growth” and the concomitant aphorisms, I’d like to describe a bit

the educational system Alfred North Whitehead received at Cambridge—one he felt filled him with dead, lifeless, inert ideas.

Cambridge, the university not only of A. N. Whitehead but also of Gregory Bateson, Bertrand Russell, and Ludwig Wittgenstein—individuals who directly or vicariously were connected to the ideas of Whitehead—was a traditional, Victorian institution in 1880. Whitehead entered Trinity College, Cambridge that fall to pursue a B.A. degree in Mathematics. He had been a strong “maths” student at Sherborne, a minor but good English public school, preparing (mostly East Kent) students for the universities of Oxford or Cambridge. As was common for undergraduates in those days, Whitehead avoided as many of the university lectures he could and spent three full years with a mathematics “coach,” training for the all-decisive Tripos—named not after the examination’s three parts but after the three legged stool on which the candidate sat while disputing with *his* examiners.²

As Victor Lowe (1985, Ch. VI) tell us, Parts I and II of the Tripos were traditionally “sat for”—five and one-half hours per day for three days in a row—in late May of the candidate’s third year. A week or so separated the Part I sitting from the Part II sitting. Part I was heavily Newton—the first three sections of Book One of his *Principia*³—while Part II focused essentially on the calculus, trigonometry, and analytic geometry. The candidate needed to know these areas quite completely (today we’d say “cold”), for the exam was mostly doing “riders” (intricate problems) attached to each question. Speed was of the essence,⁴ for one advanced to Part III by doing more riders successfully than one’s fellow candidates. It was for speed in problem solving, “tricks” as it were, that one hired a coach and worked with him weekly for three years. As Lowe (1985) says:

The man who had to stop and think about the bookwork [Euclid, Newton, etc.] would not get far; his fingers ought to be dispatching it while he was thinking about the rider. (101)

Dr. E. J. Routh, F. R. S., lead Wrangler (successful mathematics candidate) in the year Clerk Maxwell was second, was Whitehead's coach, as he had been for generations of Trinity mathematicians. His task was not to inspire his pupils with the beauty or usefulness of mathematics—for that “he would have been laughed” out of his profession—rather he was paid to drill his students “in tackling problems with precision and [in] finding the shortest [and most efficient] proofs” (101). In sum, Routh was a trainer, a coach, and a good one, in teaching for the test. It is this university experience which Whitehead (1967 [1929]) said lead British university students to a “paralysis of thought” brought on by “the aimless accumulation of precise knowledge, inert and unutilized” (37). As a Cambridge Don—a position Whitehead assumed after defending his thesis for Part III of the Tripos (taken seven months after the first two parts) on Clerk Maxwell's *Treatise on Electricity and Magnetism* (1873)—Whitehead worked hard and successfully to reform the Mathematical Tripos. In 1907 the Tripos was eliminated in mathematics, twenty-four years after Whitehead was fourth Wrangler (Lowe, 1985, 213).⁵

Of the triumvirate of romance, precision, generalization—the interplay of which Whitehead believed would keep knowledge alive—I'd like to begin with precision. This is the stage we understand best today. This stage forms the heart of any scientific or empirical research we do in education, and in our test oriented society is well prized. It is the stage our schools honor the most and the stage we ask teachers to develop the most. Romancing (playing with) knowledge or generalizing (abstracting) knowledge are not concepts we easily understand. While

we do understand precision, “the aimless accumulation of precise knowledge” (Whitehead, 1967 [1929], 37), or “training” alone (35), or “precision imposed” too early (33) is self-defeating. Thus, the art of teaching is one of timing, of placement, and of judicious use. In his comments on precision—“The Rhythm of Education,” 1912; “Aims of Education,” 1917; “The Rhythmic Claims of Freedom and Discipline,” 1922—Whitehead never says he is opposed to precision, far from it. He is not opposed to precise knowledge, to training, or even to imposition. He is opposed to these done at the wrong time (too early before romance has “run its course,” 33) or in the wrong way (“discipline when it comes should satisfy a natural craving,” 32). When “the intermediate stage of discipline” (precision) does come for Whitehead, around age 14, it comes with a firmness, even with a ruthlessness. As Whitehead says:

[In contrast to the area of romantic knowledge], the area of precise knowledge ... can be, and should be, definitely determined.... A certain *ruthless definiteness* is essential in education. I am sure that one secret of *a successful teacher* is that he *has formulated* quite clearly in his mind *what the pupil has got to know in precise fashion*. (36; emphasis added)

Whitehead, thus, sees the role of the teacher as one of integrating the development of personal interest—this is what the romance stage is all about—with training in the field studied. These two, interrelated, are absolutely necessary Whitehead believes if one is to move beyond “mere precision” to the generalization stage where knowledge is “utilized” (3), not in the sense of simple or direct application but in a deeper sense where one can make the main ideas of a subject “one’s own” (2). Here one can *be creative* with the ideas. This sense of creativity, of course, sends one to Whitehead’s cosmology, that for which he is so famous.⁶

Victor Lowe in his biography of Whitehead (1985, vol. 1; 1990, vol. 2) tells us repeatedly that in Whitehead's own personal teaching he followed the maxims he put forward, especially the one of needing "exact knowledge," of always "push[ing] on to definite knowledge" (Lowe, 1980, 58; Whitehead, *Essays in Science and Philosophy*, 1948, 128 [reprint of a 1911 essay]). And, of course, this sense of exactness permeates Whitehead's own work in *Process and Reality* (1978[1929]) when in his endeavor "to frame a coherent, logical, necessary system of general ideas in terms of which every element of our experience can be interpreted" (3), he argues that "[t]he scheme should be stated with the utmost precision and definiteness" (9).⁷

I emphasize this notion of definiteness in Whitehead's precision stage, not merely to help us be aware that he is not a "soft or mushy" liberal, advocating that "anything goes" in the teaching/learning situation but rather to prepare us, as readers, for the formidable challenges Whitehead saw coming in the then vaguely visioned post-modernist world. This challenge, as I see it, is how can we be certain, precise, definite, logical in a universe which we now realize is by its nature, by its reality, always in creative process, thus being uncertain, imprecise, indefinite, and non-logical? The answer to this question lies for Whitehead, I believe, in his concept of generalization/abstraction, and goes to the heart not only of his cosmology (including his metaphysics and theology), but also of what he feels any teacher needs to wrestle with if s/he is to be a "serious" teacher. Whitehead was a serious teacher; his craft was most important to him.

A serious teacher, though, is a playful teacher—one full of play—and so before delving into Whitehead's concept of generalization/abstraction, I'd like to comment on his first stage, that of romance. As an aside, an important one, while I am most interested in Whitehead's triune concept of romance/play, precision/definiteness, and generalization/abstraction, I do not take to his linear ordering of these groupings, to his calling them stages, nor to his assigning ages to

them. Rather, I prefer to consider these three as ways or modes of teaching/learning and of the interrelating of all three continually. In this latter view, I have support from Whitehead himself who at the end of his “Rhythm in Education” essay (1967 [1929]) says:

Of course, I mean throughout a distinction of emphasis, of pervasive quality—romance, precision, generalization, are all present throughout. But there is an alternation of dominance (28).

And a bit later,

The romantic stage [in one subject] should persist for years after the precise stage [in another subject] has commenced. (38)

For me it is not so much an alternation as a dynamic integration: all three continually interplaying among themselves.

Romance is Whitehead’s word for his first stage of the teaching/learning process, or as he calls it the “first apprehension” (17); whereas play is my own word—influenced as I’ve been by both Dewey and Wittgenstein. I believe, though, that Whitehead’s concept of romance and what I have to say about play can be synthesized. Whitehead says that the romance stage concerns itself with “unexplored connexions,” with “possibilities half-disclosed...and half concealed” (17). In this stage there needs to be enough freedom, freedom from set methodologies or “systematic procedures” to allow “an awakening to the *apprehension* of objects and to the *appreciation* of connexions” (18–19). The essence of this stage is one of “browsing” (22)—what Judith Genova (1995) borrowing from Wittgenstein, calls “playing with” (123–24). The territory which this stage, really mode of thinking, explores “is large, ill defined, and not to be controlled by any

explicit boundary” (Whitehead, 1967 [1929],36).⁸ This stage is important, not only as a precursor of precision but as its fountainhead: “There is no comprehension apart from romance” (33). This is why precision that comes too early is so dulling. As Whitehead says, drawing on his own years of experience:

If you have much to do with the young as they emerge from school and from the university, you soon note the dulled minds of those whose education has consisted in the acquirement of inert knowledge. (32)

The art to working with and within the romance mode, though, is not—as so many romantic progressives have done and still continue to do—to leave the child or learner alone to explore as s/he wishes. As Whitehead says:

This initial stage of romance requires guidance...accordingly, a certain pointing out [by the teacher] of important facts, and of simplifying ideas, and of usual names really strengthens the natural impetus of the pupil. (33)

This view of the human mind as curious and inquisitive and of the teacher’s role as aiding and helping the learner transform this inquisitiveness and blossom this curiosity is very Deweyan (1964 [1916], Ch. 10, 12, 13 especially). The human being, Whitehead (1967 [1929]) believes, craves to explore, to discover, to know—to investigate “curious thoughts, to shape questions, to seek for answers” (32). This “general process [that humans are curious and creative] is both natural and of absorbing interest” (32). But as Dewey has pointed out, this interest needs development; it needs to move from a stage dominated by “wonder” to one dominated by precision and definiteness. When this rhythm occurs, when the stage of romance (or play) has

“run its course” (33), then there is a natural movement—indeed “a craving”—to move to the next, different, more complex and challenging, stage. In this manner the desire for precision, for definiteness, for understanding beyond mere fascination, emerges naturally from (*stimulated exploration*). The teacher has a definite role in stimulating this exploration. The teacher aids, helps, guides, stimulates the student in exploration. The teacher does not impose precision too early (33) but guides the student in exploration as both teacher and student, cooperatively, throw ideas “into every combination possible” (2). In this way, nascent (romantic/playful) interest grows into mature interest (12). It is this personal interest which is the “*sine qua non*” for all further development; without which there can be no “mental development” (p. 31). The difficulty is, though, that personal interest needs careful development; but even in our best of intentions to develop that interest, we educators often kill the very process we wish to develop: “It is the unfortunate dilemma that initiative and training are both necessary, and that training is apt to kill initiative” (35).

A solution, if there is one, to this dilemma lies, I believe in Wittgenstein’s notion of play, particularly as this has been developed by Judith Genova (1995) and M. Jayne Fleener (2003). In his works, particularly in *Philosophical Investigations* (1958), Wittgenstein talks of “play.” While Wittgenstein uses examples of playing as a way to talk about order and “rules” without being confined by the narrow boundaries of logic—“Now everything is different (II, 180)—Genova sees important differences among these examples. “Playing at,” especially playing at language-games is somewhat metaphoric play—as in playing at tea or playing school. Here the rules are loosely defined by those playing. “Playing in,” takes on a more formal structure, akin to playing a well-known game (or engaging in a set subject, like mathematics) with a definite structure and history. “Playing with,” that which I see as the most powerful for integrating

training and initiative, is where one is aware of the rules (of a game or subject) and purposefully pushes against them, maybe to test them or to extend them or to transcend/transform them. In any event, in “playing with” rules and structures, one acquires an understanding of these at a deeper level than merely playing at or in. Creativity comes, but is certainly not guaranteed, by one exploring the boundaries of a structure. One makes a subject or bit of knowledge “one’s own,” (Whitehead, 1967 [1929], 2) as one is able to play with the subject or bit of knowledge: “inert ideas...are [those] merely received into the mind without being utilized, or tested, or thrown into fresh combination” (1). I am saying, in most simple terms, that “playing with” ideas, subjects, bits of knowledge is necessary for making said ideas, subjects, bits of knowledge, one’s own.

M Jayne Fleener, Andy Carter, & Stacy Reeder, (2003), in their research have found most teachers working inside the “playing in” frame and consciously or unconsciously staying away from the “playing with” frame, one of throwing ideas into “every combination possible.” In one instance, the authors continually saw a teacher wanting students to acquire the vocabulary (or language-game) of the subject (here fractions) as she saw it. The teacher did not “see,” in Wittgenstein’s sense, the potential for understanding, indeed a deeper understanding, the students were displaying as they struggled with the very concept of what a fraction was. The teacher wanted the students to acquire the “correct” vocabulary—to play “in” the field—rather than to help them develop their nascent potential for a deeper understanding as they (unconsciously, but definitely) “played with” the subject of fractions. In focusing on the students’ “mistakes,” she failed to “see” what was there before her very eyes. Precision too early imposed really does make us blind to the potential existent in most every teaching situation. Both Wittgenstein —

himself an Austrian schoolteacher for eight years—and Whitehead saw this clearly. Whitehead died in 1947, Wittgenstein in 1953.⁹

Generalization is the “final stage,” it is the “final success,” a return to the exploration of romanticism [Whitehead, 1967 [1929], 19), to the seeing of connexions, but with the power of knowledge not had in the first encounter.¹⁰ One is now able to focus on relationships, to see patterns among the facts studied. This new level gives the student not only knowledge but wisdom (29). The reason for throwing ideas (and facts) into various combinations has been to help the student “see” relationships, interconnections, patterns. It is at this level of thought that Whitehead believes one begins to “make knowledge one’s own.” One can now use the knowledge one has, for one has acquired not just facts but the power of knowing itself (26–27).

There are a number of interesting aspects about this stage. One is that this stage arises only after one has been able to go beyond what one has been taught. As Whitehead says:

Your learning is useless to you till you have lost your textbooks, burnt your lecture notes, and forgotten the minutiae that you learnt by heart for the examination.
(26);

And, in the same paragraph:

The function of a University is to enable you to shed details in favour of principles.

In his sixth “Dialogue” with Lucien Price (1954), Whitehead goes further and states that “static ideas,” those which are dead, inert, lifeless, actually accompany “too-good teaching” (63). That is, teaching, in both schools and universities, has a tendency only to impart information,

thereby “congealing creative intelligence.” It is, of course, not congealing creative intelligence that is Whitehead’s great passion, of keeping knowledge alive, vital and full of power. I know not if Whitehead was directly opposed to the Methodization movement, promoted so heavily by Peter Ramus and his disciples from the late sixteenth century on—a movement which was strong in Puritan times in both Cambridge, England and Cambridge, Massachusetts¹¹—but Whitehead certainly fits in with those so opposed. His comment on textbooks, the signature of the Ramists, was that “knowledge...[of this sort] marks an educational failure” (1967 [1929], 29). Such knowledge then, as now, is very constricting and does dull the creative intelligence, which Whitehead believed we all possess.¹²

Another aspect of Whitehead’s generalization is that this mode is not purely abstract. The abstract is where imagination, relationships, creativity, patterns all intermingle. But one is never to be merely abstract or theoretical. A disciplined mind, says Whitehead, “should be both more abstract and more concrete” (12). His strong insistence on “utilization” (1, 3, 32, to name but a few) is characteristic of how he believed one could make knowledge one’s own. Knowledge not used is “barren knowledge”; and our schools have too much of it, he believed. Whitehead, as we know, left Cambridge England to go to London since he was finding himself in a rut at the University (Lowe, 1985, Ch. XV). In London he accepted a position at the University of London as Lecturer in Applied Mathematics and Mechanics (Lowe, 1990, Ch. I). The practical application of knowledge was most important to him, his was not merely an ivory tower pedagogy. In his more philosophic writings he tackles this practice/theory distinction head-on. In *Process and Reality* (1978 [1929]), he says:

It is a complete mistake to ask how concrete particular fact can be built up out of universals. The answer is, "In no way." The true philosophic question is, How can concrete fact exhibit entities abstract from itself and yet participated in by its own nature? (20)

The educational issue I see here is how can the facts we teach be seen to exhibit patterns of relationships, patterns removed from, or on a cognitive level above the facts, and yet found in the very nature of the concept fact? The answer, I believe, lies in the notion that a fact by itself is really nothing; it acquires its "factness" only as it enters into relationships with other facts, only as it is contextualized.¹³

What Does Whitehead Have to Offer Teachers Today?

The pedagogical issues that Whitehead raised in the early twentieth-century are just as important, I believe, in the early twenty-first-century. And the analyses he made of these issues and the solutions he suggested continue not only to be valid but are reinforced, I believe, by the writings of others during this past century. So his message, as I see it, is even stronger and more poignant now as then.

Whitehead was passionate in his opposition to the type of learning and teaching he saw going on in schools, colleges, universities. He felt the knowledge dispensed, not by "bad" teaching but by what we would usually call "good" teaching, was dead, lifeless, barren. Thus, the challenge he presents to all who read him for educational purposes is to reconsider the very act of teaching. What should this act comprise? For him, it should not be dispensation of idle facts; such barren dispensation actually works against developing creative intelligence. As he says in a quote already given from one of his "Dialogues" with Lucien Price (1954):

I have a horror of creative intelligence congealing into too-good teaching—static ideas. . . . Teachers should be acutely conscious of the deficiencies in the matter taught. . . . They should be on their guard against their materials and teach their students to be on their guard against them. Once learning solidifies, all is over with it. (63)

This is not advice we in education usually hand out to our pupils. Yet, without paying attention to this advice, we easily become caught up in the routine of textbooks and tests—two particular issues Whitehead felt were a detriment to learning.

I can find nowhere that Whitehead was aware of the Ramist Methodization movement with its development of textbook learning which swept northern Europe, particularly among Puritan educators, in the late sixteenth and most all of the seventeenth centuries and which continues as a, really the, dominant educational influence today. A reading of literature on this movement,¹⁴ though, would help educators wishing to understand how we came to consider textbook teaching and testing as the paragon of good teaching. Whitehead's alternative, of course, designed to keep knowledge alive and to actually develop the creative intelligence he believed the human species to possess, was to approach teaching and learning from the tripartite perspective of romance, precision, generalization. With my own penchant for alliteration, I would call these the 3 P's of teaching/learning: Play, Precision, Patterns (or Principles). To play with ideas, to be precise with one's facts, and to see these facts related into a set of patterns showing us principles is the way, I believe, of keeping knowledge alive.

At this point, I'd like to give an example:

I was talking with a young math teacher about ways of teaching multiplication facts. I suggested that 12×12 could be played with, could be looked at as 6×24 , or even as $6 \times 6 \times 4$ (which of course could be factored into even more combinations). He was quite excited about this and we conversed. Then I asked him if he could see a pattern (or a metapattern) in what we were doing—one way to do this would be to go to the general factoring of numbers, another would be to see the principle that the heart of mathematics (as Whitehead states in his very early writings)¹⁵ is intricate and precise relationships.

Here, unfortunately, the conversation stopped! The quality for the abstraction of general principles was not part of his mental habitus.¹⁶

We who are in teacher education have a long way to go to truly educate our future teachers, as our teachers have a long way to go to truly educate our future leaders and citizens. There is, though, a developing literature to help us, a literature that is most complementary to the position which Whitehead lays out. Gregory Bateson, a neighbor of the Whitehead's in Grantchester, presents provocative ideas on difference, the role of perturbation in learning, and on patterning. John Dewey, of course, has a message about interest and its development that is strongly allied with Whitehead. Ludwig Wittgenstein's notions about language and play are seminal, if a bit obscure. Here Judith Genova and M Jayne Fleener have been helpful. David Jardine and colleagues have done fine work in helping us reassess what is basic in teaching and learning, and in bringing forward the aesthetic and spirit-ful, important points in Whitehead which I did not address in this essay. Finally some of my own work has thrown, I hope, a bit of light on modernity's methodization movement and its metaphysical base in a classical physics,

which Whitehead saw a century ago as being outmoded. This leads to the exciting, provocative and yet still speculative movements in chaos and complexity theories, which draw much of their emphasis from Whitehead's own work. Indeed Alfred North Whitehead is a wonderful guide to anyone willing to re-look at the very foundations of teaching and learning, to question fundamental assumptions, to create the yet-to-be.

Notes

- 1 As a mathematician, interested in geometry, it would be natural for Whitehead to be interested in relations. Lowe (1985) says that Whitehead came upon the importance of relations fairly early in his professional publishing career. [Whitehead did not begin serious academic publishing until he was in his late 30s. Two of his first academic articles were on what today we'd call chaos mathematics or nonlinear dynamical theory: the flow of fluids]. In a talk with Lowe, late in his life, Whitehead said the only original thought he really had was that the "stuff" of space—material objects (entities)—should be seen not individually or atomistically but "as a set of relations" (296-97).
- 2 While women from the nearby, self-contained colleges of Girton and Newnham were allowed, in 1881, to sit for the Tripos, and while a few could, with their chaperones, sit in the back row of some lecture halls, Cambridge prizes were not awarded to women until 1928 and degrees were not granted until after World War II (1948). See Lowe, 1985, 214–17 and 88–89.
- 3 The quantum revolution of the early twentieth century, which destroyed the Newtonian world-view, hit Whitehead especially hard. Whitehead had for his Tripos spent three years prepping on the first three sections of Newton's *Principia* (Newton I, II, III, it was called). As Lowe (1985) points out, this was for the Cambridge aspiring mathematicians their foundation (101). The "crumbling of this scientific rock" was, Whitehead said, "one of the crucial experiences of my life" (188). This experience affected Whitehead's relations to religion and ultimately led him to become agnostic. The crumbling of scientific certainty led him to question religious certainty: "How can they (Canterbury or Rome) be so sure," he asked. (In addition to Lowe, 1985, Ch. X, Section ii, see Price, 1954, "Dialogues," XXVII and LXII).
- 4 During the last week of May, Cantabridgians raced their oared shells against Oxfordians, but Tripos candidates "raced" against each other with the dining hall waiters taking bets as to how various candidates would place. Whitehead, as he predicted, placed fourth. (Lowe, 1985, 102-03).
- 5 Cambridge, I suspect even more than Oxford, prided itself on keeping tradition. W.T. Costello (1958) says of Cambridge in the early 17th century, "[T]he scholastic *status quo* at Cambridge was...to be jealously guarded....[T]he authorities at Cambridge were to concern themselves not at all in changing a subscript iota of tradition" (7–8).
- 6 Lucien Price (1954) in his last "Dialogue" with Alfred North Whitehead captures remarks by Whitehead on his belief in the creativity inherent in the universe in most poetic terms:
 God is in the world, or no where, creating continually in us and around us. This creative principle is everywhere, in animate and so-called inanimate matter, in the ether, water, earth, human hearts. But this creation is a continuing process, and the 'the process is itself the actuality,' since no sooner do you arrive than you start on a fresh journey. Insofar as man partakes of this creative process does he partake of the divine, of God, and that participation is his immortality, reducing the question of whether his individuality survives death of the body to the estate of an irrelevancy. His true destiny as co-creator in the universe is his dignity and his grandeur. (371)
- 7 The issue of *the degree* of precision and definiteness raises, as the French poststructuralists would say, a *problematic*. Too much precision limits creativity. Creativity seems to need a certain broad degree of looseness, of flexibility, of vagueness, of abundance (maybe even excess). Whitehead, himself, seems to realize this. In

one of his later Dialogues (1954) with Lucien Price, Whitehead remarks that Aristotle's ideas "are admirably definite" while Plato's "tend, in comparison to be vague." He then says "But I prefer the vagueness" (344). This issue will arise again in his remarks about romance/play, especially as this stage is a necessary precursor to the one of precision, or as I'd prefer to say, a necessary ingredient in the interplay between romance/play and precision/definiteness.

- 8 The concept of play being brought forth here is much akin to that Bruner, Jolly, and Sylva bring forward in their comprehensive work, *Play: Its Role in Development and Evolution* (1976). It is also akin to what the late Stephen J. Gould says in his provocative article, "An Earful of Jaw," *Natural History*, March 1990 (12-23). My own remarks on the role of play in cognitive development can be found in Doll (1979), "Play and Mastery"
- 9 While I have put Whitehead and Wittgenstein together here, regarding playing with ideas, Lowe (1985) points out that "Whitehead did not think well of Wittgenstein or of his ideas, and seems never to have been influenced by them. There was opportunity" (p. 277). Essentially Whitehead, a consummate Englishman, was annoyed by Wittgenstein's Austrian and Habsburg arrogance, his linguistic approach to philosophy, and of his driving a wedge between science and philosophy. Reading Allan Janik and Stephen Toulmin's *Wittgenstein's Vienna* (1973) helps one understand the difference between the English and Austrian "mind."
- 10 Robert Brumbaugh (1982) in his writing on Whitehead's three stages calls the generalization stage "satisfaction" (p. 177 ff.). In so doing, he emphasizes the sense of practical "success" or satisfaction an individual has in "making knowledge one's own." Throughout his writings on education Whitehead emphasizes the practical aspect of generalization—which he calls "the active utilization of well understood principles" (1967 [1929], 37). Acquiring these well-understood principles, though, is a different (but complementary) process—it is the "active adventure of thought itself" (37), of putting such thought "on a higher plane" (40). In short, of taking ourselves via (abstract) speculation beyond ourselves while at the same time being grounded in the reality of practical research
- This dualness of generalization—the practical integrated with the theoretical (to form a unified wholeness) is best found in Whitehead's writings on mathematics. In Chapter II of his *Science and the Modern World* (1967 [1925]), "Mathematics in the History of Thought," Whitehead says: "The paradox is now fully established that the utmost abstractions are the true weapons with which to control our thought of concrete fact". (32). To keep knowledge alive, the habits of mentality need to move beyond the (isolated) concrete to the (generalized) abstract but not to lose touch with the "brute facts" of the concrete. It is in the interplay of this relational duality that creativity lies, and in emphasizing the role of creativity in keeping knowledge alive, I have focused on the process of generalization/abstraction. For more on this uniting see not only Ch. II of *Science and the Modern World* but also Victor Lowe's comments on both mathematics and abstraction in his *Understanding Whitehead* (1962), and Robert Palter's essay, on which Lowe draws, "The Place of Mathematics in Whitehead's Philosophy" (1961).
- 11 For some history on this movement, still dominating much of our curriculum thought today, see Stephen Triche (2002) and myself (2001 and 2002).
- 12 Creativity is, for Whitehead, the ultimate process. Our universe is a creative universe. In the early pages of *Process and Reality* (1978 [1929]), he says: "In all philosophic theory there is an ultimate . . . In the philosophy of organism this ultimate is termed 'creativity'" (7), and "The creative action is the universe always becoming one . . . (57).
- 13 Two recent books which deal with this barrenness and meaninglessness of an isolated "fact" are M. Jayne Fleener, *Curriculum Dynamics* (2002) and David Jardine, Patricia Clifford, and Sharon Friesen, *Back to the Basics of Teaching and Learning: Thinking the World Together* (2002)
- 14 For reading on this Methodization movement I would suggest the following: David Hamilton (1990); (Walter Ong (1983); Stephen Triche (2002); and myself (2002)
- 15 Actually it was Bertrand Russell who first developed the notion that relationality would be a basic – "It is . . . the logic of relations which must serve as a foundation for mathematics" (quoted in Lowe, 1985, 236). Whitehead, though, not only "felt that his former pupil was on the right track" (237), he also made relations the heart of his cosmology (*Process and Reality*, Ch. 1, Section VII and *Science and the Modern World*, Ch. X).
- 16 Ideally this conversation should not have stopped here. To truly make knowledge one's own, to keep it alive, it is necessary, as Whitehead points out, to bring such knowledge, or cycle it, back to the practical, to the doing (gerund here). In his *Science and the Modern World* (1967 [1925]) Whitehead makes the fascinating

observation that we “cannot think without abstractions.” But for just this reason we must be “vigilant in critically revising our *modes* of abstraction”; for any “civilization which cannot burst through its current abstractions is doomed to sterility” (p. 59). He picks up this same theme at the end of the book when he says, “true rationalization must always transcend itself” (p. 201). Thus we cycle back to romance/play, but in so doing reassess the very abstractions/generalizations we have just developed; and this reassessment is now done with an eye toward beauty, intuition, the aesthetic and the artistic. The cycle is endless and in an evolutionary sense leads us on to ever greater depths and heights.

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