

## **From Science to Art: Integral Structure and Ecological Perspective in a Digital Age**

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An interdisciplinary art education program, "From Science to Art," was developed for Israeli junior high schools to bridge the gap between the differing cultural perspectives of Jewish children from Islamic lands and those from European backgrounds (Alexenberg, 1974). It is based upon a bridging paradigm that draws from the common roots of both groups and new directions emerging in art. It is derived from the confluence between the integral structure of Jewish consciousness and the ecological perspective emerging in art and science of a digital age. Art of integral structure and ecological perspective breaks open the frame to create a vital dialog between multiple realms of discourse through active participation and creative play. It makes disciplines diaphanous to reveal underlying structures that unite them. It makes boundaries between disciplines as permeable as cell membranes that act as living processes for active interchange of information. It makes learning an adventuresome romp through a dynamic ecosystem of interrelationships flowing between real space and cyberspace.

### **Meeting of East and West in an Interdisciplinary Paradigm**

The State of Israel was reborn in 1948, after 1,878 years of the exile of its people throughout Europe, North Africa, and the Middle East. The European-style school system at the time of Israel's rebirth was designed and run by Jews who were primarily educated in Germany and Russia. In the 1950's, Jews from the Islamic countries of the Middle East and North Africa were driven out of these lands in which they had lived for centuries. In a very short period of time, Israel's population doubled with these immigrants from Islamic lands, called Oriental Jews. Oriental Jewish children were placed at a disadvantage in schools designed and run by Western Jews.

When I began the "From Science to Art" curriculum development project, there were nearly as many Oriental as Western Jews in Israeli schools. Oriental children with their mythological perspective were failing in schools designed for educating the logical perspective of the Western children. Although a number of programs were developed that attempted to change the ways of thinking of the Oriental children to fit them into the European mold, most Oriental children had great difficulty catching up to the Western children who had the advantage of being born to parents with European backgrounds.

"From Science to Art" was based upon the hypothesis that the opportunity for successful learning of both Oriental and Western youth would be equalized if both groups worked toward developing a new alternative perspective, at once familiar and strange to both groups. They shared familiarity with their common Jewish roots and lack of familiarity with new directions in art. An

alternative integral perspective that is shared by both Judaism's past and art's future made for a level playing field in which both groups were equally advantaged as well as equally disadvantaged.

Both the Oriental Jew's mythological perspective and the Western Jew's logical perspective provide alternative paths toward a common integral structure of consciousness. Gebser (1985) and Mickunas (1973) present extensive cross-cultural evidence in their studies of civilizations as structures of consciousness that mythological and logical perspectives are ever-present in an integral structure. Mythological perspective exists in agricultural civilizations with a two-dimensional, circular, cyclical, auditory structure of consciousness in contrast to the logical perspective of industrial civilizations with a three-dimensional, rectangular, linear, visual structure of consciousness. The integral structure of consciousness of a global digital civilization is a four-dimensional world of ecological perspective in which space and time are integrated in open-ended spiral and branching growth forms which create networks for dialogic dynamics through kinesthetic integration of all senses.

Handlebars and bicycle seat coming together to form a new image of a bull's head in Picasso's assemblage can be seen as a metaphor for the presence of mythological and logical perspectives in an entirely new integral structure. The nature of the new structure could not be predicted by studying the properties of the old component structures. Although we come to recognize a bull's head as a new Gestalt, we still retain the ability to see the component parts as handlebars and bicycle seat. In "From Science to Art," Oriental mythological perspective and Western logical perspective come together to form a new integral structure of consciousness through interdisciplinary learning activities in which boundaries between science and art became diaphanous.

The meeting of Oriental and Western youth as equals in learning opportunities that fostered integral consciousness and ecological perspective was significant at two levels. Art and science in an emerging electronic age demand integral thought and ecological perspective in which dynamic interplay gives rise to shared structural patterns. Both Oriental and Western youth were equally disadvantaged in encountering this alternative integral/ecological worldview that was new to both groups. In addition, their shared deep structure of Jewish consciousness was encouraged to bubble up to the surface after been plastered over by centuries of influence from living in Islamic and European countries. Having returned to their ancestral homeland, they were equally advantaged in retrieving their common Jewish roots that retained its integral structure throughout two millennia of exile. In an integral structure of consciousness, old and new, tradition and innovation, past and future come together in vital dialog. Art in an integral structure is an "art that combines pride in roots with an explorers' view of the world as shared by others" and "in cultural dissimilarities and the light they shed on fundamental human similarities" (Lippard, 1990, p. 5).

The confluence between the interdisciplinary perspective that characterizes the Hebraic mind and new directions of art in a digital culture is expressed in the word “Hebrew” that literally means “boundary-crosser.” It symbolizes the free flow of information passing through boundaries between different realms of experience. Rabbi Gershon Winkler (1998) titled his book that offers an in-depth understanding of Jewish tradition: *The Way of the Boundary Crosser*. The deconstructive energies of postmodernism freed up elements for reconfiguration in fresh ways in art’s emerging reconstructive phase being shaped by computers, the World Wide Web, and a down-to-earth spiritual awakening. The interdisciplinary thought based upon an integral structure of consciousness that has characterized Jewish learning and its way of life for millennia is emerging in the new cultural paradigm of ecological perspective. Suzi Gablik (1991) explains:

*“The new emerging paradigm reflects a will to participate socially: A central aspect of new paradigm thinking involves a significant shift from objects to relationships.... Whereas the aesthetic perspective oriented us to making objects, the ecological perspective connects art to its integrative role in the larger whole and the web of relationships in which art exists.... The ecological perspective does not replace the aesthetic, but gives a deeper account of what art is doing, reformulating its meaning and purpose beyond the gallery system, in order to redress the lack of concern, within the aesthetic model, for issues of context and social responsibility.”* (p. 7-8)

### **Morphodynamics in Art and Science**

“Morphodynamics: The Design on Natural Systems,” was an interdisciplinary graduate course that I introduced and taught in the Department of Art and Education at Columbia University Teachers College. I coined the word “morphodynamics” to mean “dynamic processes that give rise to form and structure.” I use it to introduce movement and change to the static word “morphology.” The “From Science to Art” curriculum project that I developed at Tel Aviv University uses this concept of dynamic structure as the central motif of all its learning activities.

In *Art Versus Nonart: Art Out of Mind*, philosophy of art professor Tsion Avital (2003) writes: “The new paradigm of art must be of a structural and dynamic character, in contrast with the figurative paradigm, which was content-oriented and static.... Another result of such a paradigm is the establishment of a common structural basis for art and science, and this will prove that the two domains are not two separate, alien cultures but rather different manifestations of the same mind (pp. 403-404). In the introduction to the *Scientific American* folio of paintings, drawings and photographs, *Art in Science*, scientist J. Bronowski (1960) argues that contemporary science is preoccupied less with facts than with relations, less with numbers than with arrangement.

*“This new vision, the search for structure, is also marked in modern art. I underline this common vision because I believe that history will look back on it as characteristic of our age. A hundred years ago the way to advance physics and chemistry seemed to be by making more and more exact measurements. Science then was a quantitative affair...but the concern of science in our age is different: it is with relation, with structure and with shape.”* (n.p.)

Ilya Prigogine (1984), who won the Nobel Prize for his work on the thermodynamics of nonequilibrium systems, explains in his book, *Order Out of Chaos: Man’s New Dialogue with Nature*, that the traditional science of the age of the machine tended to emphasize stability, order, uniformity, equilibrium, and closed systems. The transition from an industrial society to a high-technology society in which information and innovation are critical resources, brought forth new scientific world models that characterize today’s accelerated social change: disorder, instability, diversity, disequilibrium, nonlinear relationships, open systems, and a heightened sensitivity to the flows of time. This paradigm shift in science is echoed in the arts by Peter Weibel (1999) in *net\_condition: Art and Global Media*: “Modern art created the aesthetic object as a closed system as a reaction to the machine-based industrial revolution. Post-modernism created a form of art of open fields of signs and action as a reaction to the post-industrial revolution of the information society” (p. 19).

### **Talmud and Internet: Media for Interdisciplinary Learning**

The creative associative thinking in “From Science to Art” activities imitates the traditional interdisciplinary mode of learning that Jews have been engaged in for millennia in all the lands of their dispersion. The Talmud records this interdisciplinary dialog in a media structure consistent with its educational values. The structural similarities between the Talmud and the Internet attest to the confluence between integral patterns of Hebraic thought and ecological perspective demanded by digital media.

When I was professor at Columbia University Teachers College, technoprophet Marshall McLuhan came down from Toronto to lecture there. He talked about how the linear pattern of information resulting from print technology limited the thought patterns of people who learned from printed books. Word follows word, line follows line, paragraph follows paragraph, page follows page, chapter follows chapter, in a single necessary order from the first page to last. Learning through a medium that is a one-way street prevented creative, flexible, associative, open-ended, multidirectional, multidimensional, and interdisciplinary thought. Instead of just being authoritative, books became authoritarian, demanding thinking in straight lines from a fixed point of view. The book medium became a stronger message than its content. Textbooks created disciplines. Designed to be read in privacy, in seclusion from others, the book ended dialogue. It conferred the values of isolation, detachment, passivity, and non-involvement (see McLuhan, 1969 and 1994).

I invited McLuhan to my office to show him how the Hebraic dialogic mindset, which could not tolerate unidirectional thought limited by separate disciplines, used print technology to design multilinear books for interdisciplinary learning. I took a volume of Talmud off my shelf and showed him non-linear pages. I opened it to page 2 (there is no page 1) and pointed to the patch of text in the center of the page that starts with the *Mishnah*, written in Hebrew, followed by the *Gemara*, in Aramaic. All around the page are numerous patches of texts that are discussions of the central text and discussions of the discussions. We can hear the lively interaction of dozens of people as if they were in the same room at the same time. However, they are talking with each other across centuries and across the planet in free-flowing associative discussions that cross all boundaries between different subject matter. Their interactions are a model of interdisciplinary learning.

In the words of Rabbi Adin Steinsaltz (1989): “The Talmud is thus the recorded dialogue of generations of scholars. It has all the characteristics of a living dialogue. Freshness, vivid spontaneity, and acute awareness of every subject permeate every argument and discussion. The spirit of life breathes on every single page” (p. 9). It is not a set of books to be read in quiet solitude. Today, learning partners give life and continuity to the dialogue that began millennia ago by engaging the hundreds of voices talking across the folio pages in interdisciplinary dialogue. The two learners, a *hevrotah*, enter a page and move around within it while arguing with each other and calling for support from all the scholars before them. They can begin their learning on any of its 5,894 pages. The multivolume Talmud has no begin and no end. The *hevrotah* can jump around within a page, between pages, between different Talmud tractates, look into the Bible, kabbalistic texts, or any other sources, and relate them to issues of contemporary life. A study hall in a yeshiva filled with many learning teams is a busy, dynamic, noisy environment, quite different from the eerie silence of a library for linear books.

When I first began surfing the World Wide Web, it seemed a familiar place to me. I felt I had been there before. Talmud study had prepared me for its vast multidirectional options, hyperlinking and its non-sequential organization. I felt at home seeing home pages that had an uncanny resemblance to Talmud pages. As a member of the panel, “Toward an Aesthetic for the 21<sup>st</sup> Century: Networking, Hypermedia, and Planetary Creativity,” at the 1990 conference of the College Art Association, I explored this confluence between traditional Jewish media experiences and encountering the emerging Internet (Gallon, 1990). A decade later, Jonathan Rosen (2000) wrote in *The Talmud and the Internet: A Journey between Worlds*:

*“I can’t help feeling that in certain respects the Internet has a lot in common with the Talmud. The Rabbis referred to the Talmud as a yam, a sea – and though one is hardly intended to ‘surf’ the Talmud, something more than oceanic metaphors links the two verbal universes. Vastness and*

*an uncategorizable nature are in part what define them both.... The Hebrew word for tractate is masechet, which means, literally, "webbing." As with the World Wide Web, only the metaphor of the loom, ancient and inclusive, captures the reach and the randomness, the infinite interconnectedness of words.... I take comfort in thinking that a modern technological medium echoes an ancient one."* (pp. 7, 8, 11)

Canadian professor Eliezer Segal (2003) goes one step further. He uses the new medium to explicate the old. He created an interactive Image-Map site of a Talmud page, [http://www.ucalgary.ca/~elsegal/Talmud Page.html](http://www.ucalgary.ca/~elsegal/Talmud%20Page.html) to serve as a port of departure on a voyage through centuries of vital dialogue. The visitor to his site can click on any portion of the Talmud page image and be linked to a description of that patch of text. He explains the contents and purposes of the text in English, also describing when and where that patch of text was composed. A full Talmud page with a study guide to exploring the web of interrelationships is also available at the website of the World Union of Jewish Students,

<http://www.wujs.org.il/activist/learning/guide/page.shtm>. These websites invite visitors to join communities of explorers who weave interdisciplinary learning through time and space.

In the on-line magazine, *Computer-Mediated Communication*, Rensselaer Polytechnic Institute professor David Porush (1995) writes that the Talmud is an early example of hypertext.

*"A page of Talmud is structured around a single text surrounded by concentric layers of commentary and commentary on commentary. By form and content, it announces the unfinished quality of constructing knowledge and the collective construction of shared values. Even in its layout on the page, the Talmud suggests a kind of time and space destroying hypertextual symposium rather than an authoritative, linear, and coherent pronouncement with a beginning and ending written by a solitary author who owns the words therein.... The notion of private self, or the notion of singular origin of knowledge, pales into insignificance in the face of this talmudic-hypertextual-Internet-like vision of communally-constructed knowledge."* (p. 46)

Rabbi Menachem M. Schneerson (1995) teaches that the sweeping technological changes we are experiencing today were predicted some two thousand years ago in the Zohar, a classical text of Jewish mysticism. It describes how the outburst in scientific knowledge and technological advancement would be paralleled by an increase in sublime wisdom or spirituality. Integrating the wisdom of the mind and the wisdom of the soul, which is the role of the artist, can begin to usher true unity into the world.

*"The divine purpose of the present information revolution, for instance, which gives an individual unprecedented power and opportunity, is to allow us to share knowledge – spiritual knowledge – with each other, empowering and unifying individuals everywhere. We need to use today's interactive technology not just for business or leisure but to interlink as people – to create a welcome environment for the interaction of our souls, our hearts, our visions."* (p. 191).

## **Discovering Patterns Through Science and Art**

In *Consciousness and Culture*, Elizabeth Lozano and Algis Mickunas (1992) describe the unit of study on “Periodicity and Rhythmic Patterns” in the “From Science to Art” program as an exemplary model of integral pedagogy applicable to encounters between mythological and logical perspectives in other cultural contexts. Students explored periodicity and rhythmic patterns in nature and culture.

Students rolled out ink on a glass plate, pressed their fingers on it, and printed their fingerprints on uninflated white balloons and on tracing paper. They enlarged their fingerprints by blowing up the balloons and by placing the tracing paper in 35 mm slide holders and projecting them. They compared their fingerprints to each other to appreciate the uniqueness of each person. They saw that no two people have the same fingerprint pattern. Students compared their own fingerprints to fingerprints of chimpanzees. They learned that although there was a wide range of variation in human fingerprints, fingerprints from another species were outside that range. After students created classification systems for their classmates’ fingerprints, a police officer was invited to the classroom to explain the international system of fingerprint taxonomy. Students taped paper to the wall and projected their fingerprints on it while they drew the lines. They made paintings from their drawings. They enlarged fingerprints on a copy machine and printed them out on acetate sheets that they placed on top of one another to create moiré patterns. They discussed optical illusions and the psychology of human perception.

Students looked at reproductions of the “op art” of Bridget Riley and Henry Pearson. They read a Hebrew translation of my interview with Henry Pearson who discussed how he came to making his paintings that are in the collections of New York’s three major art museums – MoMA, Metropolitan, and Whitney. He described his fascination for the topographical maps of Japan he had to draw when he was in the U.S. Army. Years later after his studies at the Art Students League, he had a job listing for flaws in phonograph records. He would draw while listening to the same records over and over again. He drew rectangular forms as studies for his geometric paintings. One day, he curved the corners of his rectangles until he surprisingly found himself drawing imaginary topographic maps. “I tried inventing landscapes of my own, where the mountains were, where the valleys were. You could see how the lines would wander in and out. Then, I felt that these were too realistic somehow. I wanted to make them more abstract” (Alexenberg, 1981, p. 132).

Students studied topographic maps of the Israeli landscape. Were the geological processes that shaped the Judean and Samarian mountains and the valleys between them like the embryological processes that gave rise to fingerprints? They observed the generation of rhythmic wave patterns in a ripple tank used in physics classes. What were the connections between ripples in water, geologically formed topographies, and their own fingerprints? They watched a National Geographic film on zebras that showed how a pregnant zebra removed herself from the

herd so that the newborn would only see her pattern of stripes. The baby zebra would memorize its mother's unique pattern of stripes so that it could recognize her in the herd. A zebra that could not find its mother for nursing would perish. Does the supermarket laser recognize the bar code stripes on cans and cartons like a baby zebra recognizing its mother? Bar codes are the secret language of the digital age. We are all illiterate before the stripes that supermarket lasers can read.

Students examined the variety of stripe patterns on the *talit* prayer shawls worn by Jewish men in synagogue. They looked at Marc Chagall's paintings of men wearing a *talit*. The unsymmetrical sequencing of the parallel stripes on each *talit* looks like a bar code. They studied the biblical verses about Joseph's striped coat. "Israel loved Joseph more than any of his other sons, since he was the child of his old age. He made him a striped coat. When his brothers realized that their father loved him more than all the rest, they began to hate him" (Genesis 37:3-4). The students read biblical commentaries on the symbolism of the striped coat and discussed it in relation to their own feelings of the dangers of a parent's expression a greater love for one sibling over another. Some watched the video of Andrew Lloyd Webber's musical *Joseph and his Amazing Technicolor Dreamcoat*.

The students explored semiotics as a methodology for understanding how signs create significance. They created collages exploring relationships between iconic and symbolic representation and identic presentation through patterns of stripes (Alexenberg, 1976 and 2004). Iconic images represent the likeness of what it signifies like a picture of a zebra that looks like a striped horse. Symbolic images gain significance through community consensus with no direct connection to what it signifies. You cannot visually tell that the stripe pattern of the bar code on a can of tuna fish has anything to do with fish. Identic art presents stripes as themselves, not representations of anything else, as in the early paintings of Frank Stella.

Students went out onto the school playground on a sunny day, unrolled paper on the ground, cut it into long pieces one for each student, and taped them down. Working in pairs, each student drew around her classmate's two feet and her shadow. They returned to their drawings and placed their feet in the same places every hour for the duration of the day having their shadow drawn each time. The set of shadow drawings one on top of the other where visually linked to topographic maps and fingerprints. They painted overlapping serial self-portraits on their shadow drawings that had documented Planet Earth's rotation. "Conceptualizing the changing relationship of sun and earth, relating that dynamics to the form of one's personal shadow, and communicating these relationships in a serial painting – his squat noontime body form to a late afternoon elongated body form – moves the students toward an integral structure of consciousness by unifying time-space, subject-object, man-environment, and science-art" (Alexenberg, 1974, p. 151).

Another unit of study explored of the “threshold phenomenon.” We experience this phenomenon at the subatomic level when we walk on carpeting on a dry winter day and receive a shock as we touch the doorknob. We rub electrons off the carpet onto our feet. As negatively charged subatomic particles they repel each other, spreading out and coating our entire body. As our hand nears the doorknob, the electrons fly off our body all at once through a high voltage spark leaping the gap between our hand and the doorknob. The threshold phenomenon is an all-or-none-action. The flash only leaps from our body to the doorknob at the moment the gap between them becomes small enough to be bridged. Then our body totally loses all its charge all at once. Students observed this same process as a flash of lightning leaping between two hollow metal globes of a Van de Graaffe generator. This electrostatic generator can boost charged particles to an energy level of ten million electronvolts using a moving carpet-like belt and a metal globe on which to collect the subatomic particles that are dramatically discharged onto a second globe. Scientists use large Van de Graaffe generators to study nuclear forces.

At the molecular level, a dripping faucet demonstrates the threshold phenomenon. The water builds up in the faucet until it is heavy enough to form a drop and fall. Then there is no water left in the faucet and the whole process repeats itself.

In animals, a nerve cell fires when the stimulus reaches a high enough level to trigger a shift in electrical potential along the neuron. If the stimulus is too weak nothing happens. Only when the stimulus threshold is reached does the nerve cell fire. The same phenomenon at the cellular level can be observed at the level of the whole organism. Students photographed all-or-none gathering of turkey chicks. All turkey chicks rushed at once to round red plastic dishes filled with feed as soon as they were placed on the coop floor in the morning. There were no chicks at all remaining in other parts of the coop.

Students equipped with a video camera documented the threshold phenomenon at the socio-cultural level. They focused on an empty bus shelter after the bus pulled away from the stop. Several minutes later a person came into the bus shelter and sat down on the bench. Gradually more and more people came until it the shelter was overflowing. When the next bus came and the doors were opened, all the people boarded the bus until there were no people at the bus stop. Then more people started to come and the process began again. At a gate in the airport terminal, students documented the same threshold phenomenon.

At the level of human cognition, the students recognized in themselves how the earliest stage of the creative process exemplifies the threshold phenomenon. They had all experienced a new idea popping into consciousness fully formed as if out of nowhere. They learned more about this all-at-once flash of insight from Hebrew translations of the transcriptions of interviews of prominent artists and scientists in my book *Aesthetic Experience in Creative Process* (Alexenberg, 1981). The threshold phenomenon in the thought process of artists and scientists is the sudden emergence of a new idea in a prepared mind emptied of conscious striving. It is the

Wisdom (*hokhmah*) stage of creativity in the biblical narrative of the artist Bezalel building the Tabernacle in the Sinai desert. "I have filled him [Bezalel] with a Divine spirit, with Wisdom, Understanding and Knowledge, and with talent for all types of craftsmanship" (Exodus 30:3). At the level of the artistic product, an artist who finishes a painting begins anew with a blank canvas. Integral interdisciplinary perspective sees a diaphanous world in which fresh relationships between disparate realms of phenomena emerge. In the opaque worlds experienced through linear logical thinking phenomena are trapped within the boundaries of disciplines and in cyclical mythological thinking phenomena float past each other in unable to connect. Ecological thinking perceives interrelationships between phenomena that are invisible to logical and mythological minds. "From Science to Art" invites questioning. How does one connect one's own fingerprints with op art, topographical maps, ripple tanks, zebra stripes, supermarket bar codes, prayer shawls, Joseph's technicolor dreamcoat, one's shadows and the rotation of Planet Earth? What does the generation of electrostatic energy have to do with nerve physiology, waiting for a bus, turkey chicks feeding, cognitive processes, the Bible, and making a painting? In "From Science to Art," interdisciplinary explorations in science and art extend from the units on periodicity/rhythmic structures and the threshold phenomenon to units on bilateral and rotational symmetries, stochastic processes and asymmetries, spiral systems, and branching systems. Interdisciplinary explorations in science and art unify the structures of consciousness of East and West, cognitive and affective experiences, time and space concepts, and human beings and their environments. The cognitive act of matching, of creating relationships/connections/congruencies, is coupled with a concomitant affective response of joy/amazement/elation. This aesthetic experience in art and science is one in which "the energy of all one's discordant impulses creates a single image connecting varieties of experience (Bruner, 1963, p. 70). This single image, however, is not "a static unity of the uniform, but the great dynamic unity of the multiform in which multiformity is formed into unity of character" (Buber, 1969, p. 146)

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