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by

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Introduction

Much of what we know well is often at an intuitive level–derived from lived experience. Because this knowing is so much a part of being in the world, we often do not examine and reflect on its meaning, instead taking it for granted. We tend to place greater value on those things outside our ways of being in the world, the contrived hypotheses of our empirical questioning.

But those same empirical questions frequently originate in the lived experience itself, and such was the case with the study described here. The study investigates a much discussed topic–the evident superior achievement of Japanese students–but treats the question not as a set of hypotheses and data, but rather as a hunch about a uniquely embedded lived experience of Japanese pre-schoolers.

The hunch grew out of the experience of one of us who spent many years living in Japan as a teacher/principal of the International School in Hiroshima. Here he observed that the math performance of the youngest students improved when Origami–or paperfolding–became part of the curriculum. He also noted that there is no formal manipulative curriculum in Japanese kindergarten, and yet, first grade Japanese children are more advanced than American children in the logic of mathematics and on measures of spatial reasoning (American youngsters are more advanced only in verbal memory) (Stevenson, 1986). Looking closer, he found that Japanese children learn Origami at their mothers' knees. The textbook, *Origami* (1976), written for elementary teachers by the Nippon, Japan, Origami Association, argues that the ancient art of paperfolding "stimulate(s) the development of children's intelligence" and promotes a dialogue between parents and children, grandparents and grandsons, etc. From these observations of an embedded cultural phenomenon came a hunch–that constructive manipulative experiences such as Origami during the pre-operational stage support later mathematical understandings.

Walter followed up on his hunch when he returned to the United States and had similar experiences with American classrooms. His contagious belief in it drew me into becoming a fellow investigator, and we began our study by compiling an exhaustive literature review that supported our emerging idea that handicrafts are much more than entertainment for young minds. In fact, they are a form of schematic learning through the repeatable actions implicit in the routine practice and inventiveness that constitutes songs, hand games, and dance.

Paperfolding as a Unique Constructive Act

A piece of paper is a three dimensional whole on which homeomorphically the whole–through folding–becomes transformed into another "whole" or imitative object which can be reversed to its original form. Manipulatives, such as unifix cubes, Cuisenaire rods, original Legos, etc., on the other hand, begin as elements (unconnected wholes). Consider unifix cubes. We can connect them, give them an order, reverse the order by rearranging or removing them, and thereby give intelligent orderliness to them. But perhaps, for children, there is a fundamental difference in the quality of logical-mathematical experience between acting on conventional manipulatives and transforming through paperfolding. Seriation and reversibility (as only two operations to be considered) are experienced as parts to whole with conventional manipulatives and, in Origami, are experienced as whole transformed through second order parts or steps to another homeomorphic whole.

At its simplest, paperfolding involves figurative knowing (Piaget & Inhelder, 1956)–physical knowledge such as texture, size, color, and shape. Through folding, figurative knowledge gives way to logical-mathematical operations (e.g., seriation, reversibility) or knowledge derived from coordinate actions on the object of paper but not from the paper itself. Piaget and Inhelder argued that "motor activity in the form of skilled movements is vital to the development of intuitive thought and the mental representation of space" (p. 19). Both the pre-operational and the concrete operational stages are sensitive periods for the learning of movements that become internalized as cognitive operations. The pre-operational stage, ages 4-7, is the stage during which actions on objects become intuitively incorporated into the child's schemas. The stage of concrete operations, ages 7-11, is the critical time for operating on concrete objects to develop abstract concepts.

The logical mathematical operations intrinsic to the act of paper folding involve seriation and reversibility. The movements must be performed in certain orders, not as parts to a whole as in manipulatives (Legos, unifix cubes, etc.), and the Origami object is a whole that can be reversed to its original form through the reversal of steps and not merely the taking apart of pieces as in conventional manipulatives. The correspondence of figures and classes occurs because each paper folding base leads to a different class of objects folded from that particular one. Paper folding also develops topological and Euclidean space relations through active construction. In short, paperfolding embodies many of the movements vital to the development of intuitive mathematical thought and the mental representation of space.

In *The Child's Conception of Space* (1956), Piaget and Inhelder note that the concepts of geometry derive from an intuitive foundation–sub-logical–similar to logico-arithmetical ones, but on objects. This intuitive foundation is characterized by symbolic (mental or pictorial) images. Spatial and geometric reasoning emerge at an intuitive level–from within the pre-operational and concrete-operational child. Innovations in math education, however, have focused on math from the outside. They have been characterized by ways to teach more, at an earlier age and more efficiently (Kamii, 1985). Paperfolding, however, as an "innovation" with a constructive nature, may promote the invention of logico-mathematical knowledge from within.

A constructivist orientation also respects the social setting as an important element in the construction of meaning. Paperfolding is not typically a skill learned in isolation but rather in a social setting. It has elements of play as children share their construction, and in order to be successful, it requires knowledge that children and adults convey through physical examples and verbal explanations. Through the activity itself, the child comes to know the importance of following directions, being precise, listening closely, giving directions so that others can understand (with checking for understanding implied), and working toward neatness. These social/cultural expectations of schooling are implicit to success in the activity and not teacher imposed.

Studying Paperfolding

To date, the theoretical foundations for our hunch keep accumulating, but early on we had enough to initiate a question generating study. We acknowledged that Origami could not usefully be studied as a treatment or intervention, but rather as part of an organismic world view where humans are engaged in making meaning of the environment that surrounds them, both by acting on it (assimilation) and by acting on their own mental models of reality (accommodation). In addition, we articulated a set of shared beliefs about applied educational research:

(a) It should consider a question of interest to both researchers and practitioners;
(b) It should inform practice;
(c) The merits of an idea should be decided by how well it works in the classroom (Duckworth, 1987);

(d) The idea should be studied as situated in the context where it must grow and, if it works, eventually live;
(e) Everyone (teachers, university personnel, and children) should participate as researchers, practitioners, and learners.

Our methodology sought to make paperfolding not an intervention but rather a part of the lived experience of the school.

Phenomenological research provided the philosophic framework for the methodology. "Its particular appeal is that it tries to understand the phenomenon of education by maintaining a view of pedagogy as an experience of the whole, and a view of the experimental situation as the topos of real pedagogic activity" (van Manen, 1989, p. 7). Phenomenology asks what the nature of the learning experience is for children as they live it in their everyday life world. The researcher is not oriented to the object being researched, but instead to the subjective experiences of him/herself and the participants. The tendency to be governed by a set of fixed procedures is replaced by a willingness to let the experience do the leading.

Both of us are former teachers and one also a headmaster. For one school year we visited the Minneapolis Downtown Open School at least twice a week and initiated paperfolding with individual children, teachers, and groups of children. Teachers and researchers met in meetings and informally to share perceptions, plan strategies, and discuss results. Classroom observations and notes from these meetings were recorded.

Teachers also were interviewed formally at the end of the school year about their perceptions regarding successes and shortcomings of the project, feelings, pedagogical concerns, and individual meanings–as well as ideas for future research.

What We Learned

Perhaps the stories of the individual children reveal the most about the results. As one teacher put it, "We would not have known some of this about kids (without Origami)." She cited seeing Mike as a logical thinker–"he's jumpy otherwise." Initially Mike stood and watched the Origami activities or crumpled others' work. He would act like he wanted to learn but just would not. This attitude permeated all his work. Gradually, he took small steps and learned. Now he's one of the class artisans–patient, shows pride and care, and is focused on his work. This change in Mike has transferred to his other work as well.

Patty was isolated and Origami became her "path to joining the class." She became a teacher to others, and her mother reported that Origami reinforced a handiwork ethic in their home. Another student, Rachel, became completely lost in the folding. She quickly did her classroom contract for the day so she could have time to fold.

Gary was so proud when he could make the folds on his own. He has the ability to look at something and replicate it. Gary was at a shelter for one and a half months and out of school. He later related that he just kept folding and folding so he would not forget. All of us felt chilled by this disclosure but also speculated that folding was a social connection remembered through the actions, and those actions reminded him of the caring adults at his school. We also recalled that he had been the first male to learn to fold and thus had a position of some special importance in the school as many children sought his counsel on folding new objects. He may have wanted to retain this position with his peers.

Overall, the teachers felt that there was more risk-taking in general. Also noted was greater attention to precision, neatness, and pride in other areas as well. One teacher observed that she saw more "sustained creativity" as opposed to "spontaneous self-expression." The teachers all were pleased to see that children who did not star other places often starred at this. In this multi-age setting, paperfolding also banished age differences–the younger often taught older children.

Paperfolding was stimulating and enriching for the children. One teacher said, "Folding and folding and folding... (they) can't sit near paper without folding." She added that some children need their hands busy while they are listening.

In terms of paperfolding's effects on math, the teachers agreed that the math value is "in the long run." One remembered that when she introduced symmetry the word was unknown, but the children grasped the concept immediately. She had never found it so easy to teach this concept in the past.

The school coined "Whatever you do to one side, you do to the other" as Nick's Rule–unknowingly articulating a fundamental algebraic rule well before these children will learn algebra. Another teacher felt that doing Origami connects math "to something" for the children. The teachers especially noted that value for teaching order or seriation. The school used a hands-on, manipulatives-based curriculum, but the teachers noted that paperfolding took it to another level (i.e., more depth) with its embodiment of construction and transformation.

Teachers also saw value in doing paperfolding for building higher level thinking skills. The process can invoke "seeing things it looks like as you work," and children feel a thrill at the end. One teacher noted that there is no wrong way with manipulatives, but the children discovered that was not the case with paperfolding. On the other hand, children can do something with conventional manipulatives from the start and without instruction. With Origami, they must initially be shown. When they knew enough Origami to discover new forms (or schemas), however, the discoveries were more sophisticated.

The introduction of paperfolding in this school effected changes for the teachers and their practice as well as for the students. The first thing all the teachers noted was that it was "humbling to learn from a five year old" and uplifting to learn new schemas from a "poor child." But they felt that these experiences translated into more risk-taking for them–more willingness to experiment with constructivity in other areas of the curriculum.

At the same time, teachers and the two researchers agreed that Origami had been "hard to teach." Its introduction to the classroom was largely an exploration. At first children had "Walter passes" which allowed them to see him and learn individually. Both Walter and Karen introduced the crane at first and found that it was much too difficult for most of the children and that interest was fading fast. Karen then gave a large group lesson on folding a kitty, but we all quickly discovered that we had to work in small groups. Fortunately, by the end of this lesson, there were kittys all over the school, and the children were soon making families, coloring their kittys, and naming them. All of us became learners with the children. As one adult put it, "the personal interactions with the kids teach me."

Another important outcome for teachers was that through observing paperfolding they discovered the children's learning styles in a compelling way–"we would not have known some of this about kids." Teachers also voiced interests in pursuing greater involvement with Origami, including teaming with an older classroom or teaming with a classroom in Japan. Related to this was the observation that learning Origami made the country of Japan seem so much closer and accessible.

In addition, teachers experienced changes in their teaching. They reported that they now saw children as creators, inventors, and explorers. They set higher standards for work. All are experimenting with using the constructivity metaphor to design authentic assessments for the district's identified outcomes.

Finally, changes in the school reflect the changes in its people. Teachers expressed that the Origami project has resulted in a "deepening of the school's direction." They now identify themselves as a "caring, creative, collaborative community." The concept of competence has changed for the school–they have moved beyond "paper and pencil valuing." Words such as "seriation, constructivity, reflection, operations, reciprocity" are part of the discourse among the

teachers–words not commonly heard from elementary teachers. Teachers noted that Origami was an entré into constructive ways of "doing school," a metaphor for practice.

Discussion

From our involvement in this Origami project, we observed changes in ourselves, the children, the teachers, and the school community. We have come to see these changes in the context of reflective practice, a coming to ideas for the school community itself as well as the larger research community. We started with a hunch that there might be something unique about paperfolding that is learned during a sensitive period of four to seven years, when body-in-the-mind activities lead to the interiorization of logical-mathematical operations. The bigger picture is that we came to recognize the loss of truly constructive activities–specifically handiwork–in both the schools and our culture. This may be in part because American education has never really had a dominant constructive paradigm. Although the progressive strand running through American education embraces an activity pedagogy (Dewey, 1916), the prevailing instructional approaches, the way we organize our schools, management techniques, beliefs about children and learning (including the newer cognitive theories) are essentially mechanistic and behaviorist–what Piaget (1969) argues is "passivity as against activity."

Other researchers provide a comparative frame focusing on the contrast between the education of American children and children in other cultures. Merry White (1987), who has studied Japanese schools extensively, suggests that we might reevaluate our definitions of creativity. Western educators do not hold that creativity can be institutionally fostered. We see fostering creativity as tied to individual, spontaneous self expression rather than also including the development of skill through the learning and execution of schemas and forms. "Americans, in short, confuse self-expression with creativity ... rather than on taking pains." In contrast, White argues, the Japanese believe, "that before a child can be truly creative, or even express himself (herself), he (she) must be taught possibilities and limits of the medium; in short, one learns how to use the existing forms first."

Gardner (1989), in *To Open Minds: Chinese Clues to the Dilemma of Contemporary Education*, corroborates her conclusions. He documents that the Chinese child, through the learning of the visual arts, develops a vocabulary of schemas (a repeatable action), or formulas that allows them to reproduce representational drawings. The problem is that the Chinese school environment is so constrained that children cannot venture beyond these schemas and create interesting and original drawings. What he calls for is a balance between unguided exploration and spontaneous self-expression (the individuality dimension) and the learning of forms and schemas through routinized practice.

Finally, the experiences at the Downtown Open School emphasize that we need desperately to study the constructive and creative practices of other cultures as well as the history of our own. This includes looking at both Western and Eastern countries and their arts and crafts from both cognitive and pro-social perspectives. We suggest considering a wide variety of movement and rhythmic activities such as string games, jump rope games, Chinese tangrams, and American Indian arts and crafts (e.g., beadwork, dream-catchers). Of course, we believe Origami specifically should be studied further in all its dimensions. Clearly, given the new vision of what constitutes learning (Marshall, 1992) and the diversity of children in American schools, the time is ripe for a renewed exploration of traditional arts and crafts that promote active construction and collaboration.

References

Dewey, J. (1916). *Democracy and education.* New York: The Macmillan Co.

Gardner, H. (1989). *To open minds: Chinese clues to the dilemma of contemporary education.* New York: Basic Books.

Duckworth, E. (1987). *The having of wonderful ideas.* New York: Teachers College Press.

Kamli, C. (1985). *Young children reinvent arithmetic: Implications of Piaget's theory.* New York: Teachers College Press.

Nippon Origami Association. (1976). *Origami.* Tokyo, Japan.

Piaget, J., & Inhelder, B. (1956). *The child's conception of space* (F. J. Landon, Trans.). London: Routledge & Kegan Paul.

Stevenson, H., Azuma, H., & Hakuta, K. (Eds.). (1986). *Child development and education in Japan.* New York: W. H. Freeman.

van Manen, M. (1990). *Researching lived experience.* Albany, NY: State University of New York Press.

White, M. (1987). *The Japanese educational challenge.* New York: Free Press.

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