Susan Sze, Ph.D.
Niagara University
Department of Education
Dunleavy 319
Niagara University
NY 14109
ssze@niagara.edu
716-286-8326

# AN ANALYSIS OF CONSTRUCTIVISM AND THE ANCIENT ART OF ORIGAMI

**Abstract** This paper provides a framework for thinking about origami construction and constructivism. In an attempt to understand the conceptual and theoretical framework supporting the field of inclusive teaching strategies in relationship to origami, I have prepared a model for origami which represents six types of constructive learning: (1) Hands-on learning, (2) explicit instruction, (3) higher order thinking, (4) multimodal instruction, (5) social learning, and (6) self-management strategies.

## INTRODUCTION

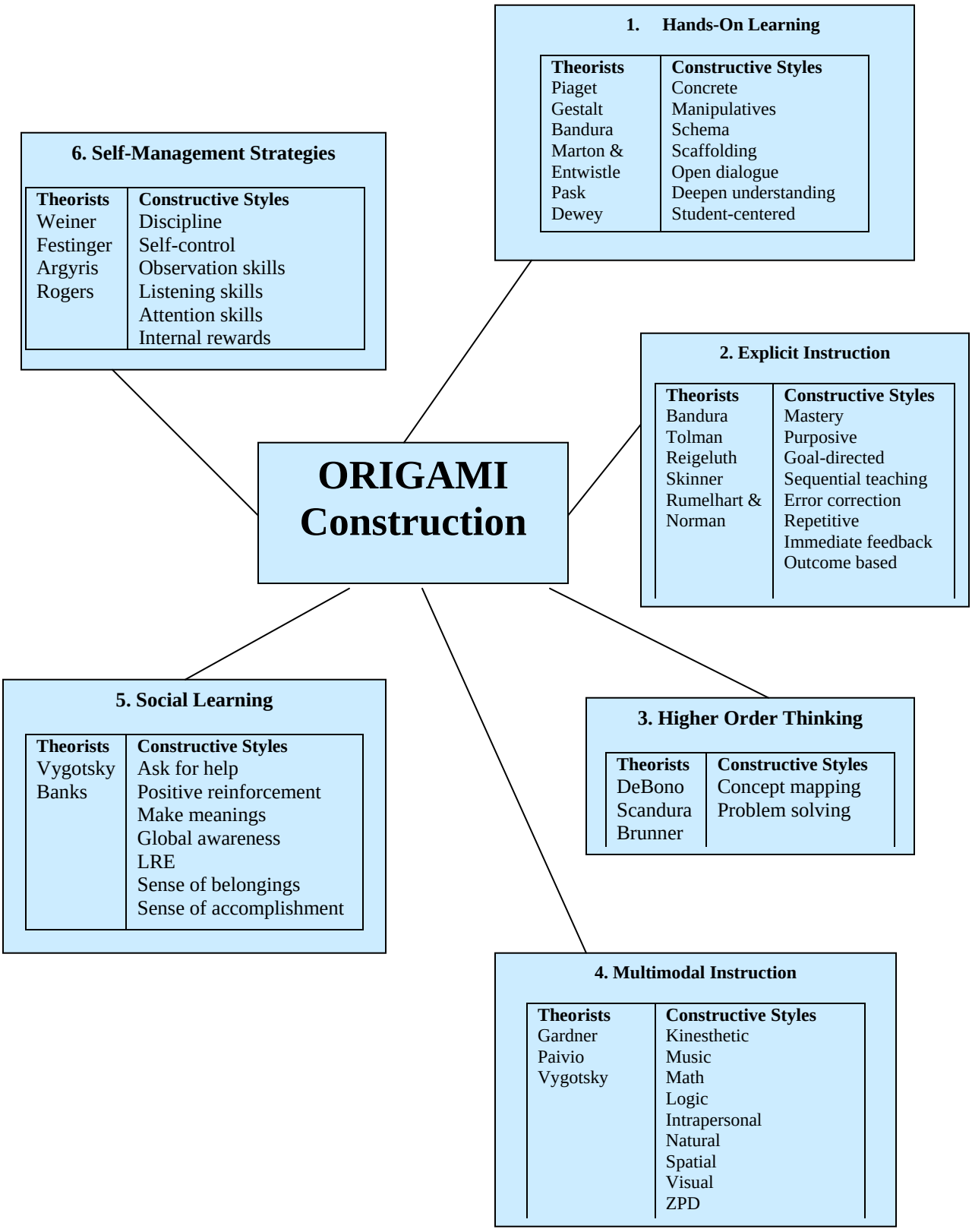
By folding and unfolding a piece of paper, students are involved in constructing and deconstructing concepts which eventually leads to a three dimensional product. A teacher must allow students to experience learning in a constructivist method. Origami, an ancient art which compasses hands-on learning, step-by-step instructions, schema building, prior knowledge activating, and spatial reasoning, logical concepts mapping (Ellis, 1938; Marton, Hounsell, & Entwistle, 1984; & Gay, 2000). Through origami construction, students have the opportunity to discover both individual difference and universal commonalities between the western and eastern cultures (Leo, 2001; Harriot & Martin, 2004). They are able to explore the differing perspectives, examine stereotypes, develop global awareness and hopefully, celebrate the diversity in their own classrooms. Origami combines different intelligences. It exemplifies the spirit of rural schools: creative, authentic, and coping skills (Sze, 2004). Origami stimulates more parts of the brain than just the antiquated teacher-lecture format. It is an educational approach involving joint intellectual effort by students, or students and teachers together. As students practice origami, they begin to understand and experience some of the complexities and interconnections of life laws and perseverance. Hands-on learning such as origami proves to be effective among the different learning styles and students from diverse population (Bucher, 1999). Teachers can apply the knowledge to involve a student in a total learning experience which enhances the student's ability to think critically, to create a class dialogue, and to pose questions to encourage higher level of thinking.

## OPERATIONAL DEFINITIONS OF ORIGAMI & CONSTRUCTIVISM

Origami: A Japanese art and science of folding paper into shapes representing objects (Webster dictionary). An early use of the term referred to Japanese paper folded in half, thirds or smaller sizes (Heibonsha, 1932). Folded paper came to be used for certificates which accompanied valued objects such as swords or gifts presented to others.

Constructivism: Constructivism is a philosophy of learning founded on the premise that, by reflecting on our experiences, we construct our own understanding of the world we live in. Each of us generates our own "rules" and "mental models," which we use to make sense of our experiences. According to Brunner (1966), learning, therefore, is simply the process of adjusting our mental models to accommodate new experiences.

CHART 1. CONSTRUCTIVE STYLES / THEORISTS / THEORETICAL FRAMEWORKS – ORIGAMI CONSTRUCTION



# A MODEL FOR ORIGAMI AND CONSTRUCTIVISM

A study conducted by Sze (2004) found that origami construction can be aligned with varies learning theorists and conceptual frameworks (See Chart 1). The model discusses how these learning theorists are applicable to origami construction. Learners make sense of their experiences by constructing their own understanding through their own "mental models". Origami construction is a process of adjusting mental and physical models to accommodate new experience by providing a least restrictive environment, purposeful learning, explicit instruction, multiple intelligences, outcome based performance, student centered learning, scaffolding, schema learning, concept mapping, multimode instruction, self-management, reflective learning, positive reinforcement, problem solving, and cognitive appropriate level instruction. I have prepared a model for origami which represents six types of constructive learning: (1) Hands-on learning, (2) explicit instruction, (3) higher order thinking, (4) multimodal instruction, (5) social learning, and (6) self-management strategies.

## 1. Hands-On Learning

### Student-Centered Learning

Prestia (2003) stated that many students with special needs have neurological, biological and sensory difference that affect how they learn and respond to the environment. Strategies like origami which accommodate sensory differences are essential for success and achievement in the classroom. By using sensory strategies for all students in the classroom, students with specific sensory needs are not singled out. Origami exercises enable the student to visualize the creative process in terms of outcome and process in a short time frame, with a tactile demonstration that is easily accomplished. Origami exercises utilize the five senses, incorporate the multiple intelligences areas, institute cooperative learning, and enrich all disciplinary area of learning including social studies, language arts, mathematics, and science. As students use their fine motor skills to fold and crease paper into fun shapes and structures, they build skills involving spatial reasoning, following precise directions in sequence, fractions, geometry, and more. Completed activity provides a model for students. The educational theorist John Dewey (1902) believed that "learning is active". He felt that students learn best through hands-on activities. Dewey supported the idea that all students have the capability to learn if provided the proper means such as hands-on activities and cooperative learning. Origami is an example of a hands-on activity. The physical classroom, based on Vygotsky's theory, would provide clustered desks or tables and work space for peer instruction and collaboration. Thus the classroom becomes a community of learning.

### Scaffolding

Scaffolding requires the teacher to provide students the opportunity to extend the current skills and knowledge. The teacher must engage students' interest, simplify tasks so they are manageable, and motivate students to pursue the instructional goal. In paper folding, although the teacher gives the lead, it is the entire community of learners that model the desired outcome, as each student refers to the next student. By breaking down the project into a sequence of steps, the teacher uses scaffolding. Reciprocal teaching allows for the creation of a dialogue between students and teachers. Sze (2002) states that this strategy involves the teacher and students exploring problems (e.g. math problem) and then sharing their different problem solving strategies in an open dialogue. To proceed to the next step, one must complete the previous one. In life, it is important to understand foundations before moving on to theory.

### Schema Learning

During the instruction, the teacher introduces the model, background information and benefits to students on the origami project. Through various paper folding exercises, students get the opportunity to create new ideas by building on previous knowledge. Learning is an active process in which students construct new ideas or concepts based upon their current or past knowledge (Brunner,1966). Contrary to the constructivism approach, origami instruction provides principles to students rather than encourages students to discover principles by themselves. Origami builds on schema both the right and left hemispheres of the brain, by using imagination, 3D-comprehension, attention, non-verbal thinking, and memory. As each of the geometric shapes is created schematic foundations are laid and can be used. To be successful, the student must watch closely and listen carefully to specific instructions and then carry them out with neatness and accuracy. This type of repetition ensures that the information enters the long term

storage unit of the learner's brain. In order to strengthen schemata, teachers constantly review and rehearse the information being taught. Consequently, creation of artifacts using origami engages the whole brain, as it requires the participation of both hands without the domination of one hand over the other. Clearly, the use of origami opens up the framework and dynamic of a typical, formal lesson, and provides students with a deeper understanding, and a more enriched and meaningful lesson.

## 2. Explicit Instruction

### Purposeful Learning

According to Tolman (1932), learning is always purposive and goal-oriented. Origami learning is an active, constructive process. Students must work actively and purposely to learn new ideas, skills, or information. They are not simply taking in new ideas. They are creating something new with the information and ideas. The class dialogue direct toward issues of the curriculum not addressed in expository text. Teacher poses questions to encourage higher level think and how these ideas are often intertwined with emotions. Through purposeful learning, students are able to apply, compare, and adapt what they have learned and experienced to new situations.

### Explicit Instruction

Swanson (1999) asserts that direct instruction produces very positive outcomes for students with disabilities. Origami is presented with direct instruction. When the students study paper folding in order to create an object out of paper, they are asked by the teacher to follow a specific set of instructions. The steps will be verbally expressed by the teacher in a very specific sequence. The teacher will ensure that all students have completed one step before they proceed to the next. It is extremely important that the teaching is also demonstrating each step of the procedure in front of the class and each student is independently creating their own item from a piece of paper. Directed instruction allows the teacher to plan instruction to crate a learning environment and modify instruction to accommodate learning styles (Gagne, 1987).

### Outcome Based Performance

Students become magically attentive and well behaved when an activity occurs where students can create something with the confines of art. According to Rogers (1969), significant learning takes place when the subject matter is relevant to the personal interests of the student. Origami exercises will benefit students with and/or without disabilities especially for those who have trouble follow directions. Origami steps enable students to strive for an end result, specifically a form of paper art, representing structures, symbols, feelings, or concepts. Phibbs (1991) describes how origami can be used to improve listening skills and student performance. Schematic learning through repeatable actions fosters one of the most basic learning skills: the ability to actively listen to classroom instruction.

## 3. Higher Order Thinking

### Concept Mapping

According to elaboration theory, instruction should be organized in increasing order of complexity for optimal learning. Reigeluth (1987) states that instruction will be more effective if it follows an elaboration strategy, i.e. the use of epitomes containing motivators, analogies, summaries, and syntheses. Origami always begins at the beginning unless students all know what it is mean if asked for a specific base. Whenever possible, teach the simplest solution path first and then teach more complex paths or rule sets (Scandura, 1973).

### Problem Solving

According to lateral thinking theory, the point of thinking is that many problems require a different perspective to solve successfully. In order to get a different perspective on a problem, one may try to break the elements up and recombine them in a different way (DeBono, 1991). Gestalt theory applies to all aspects of human learning based upon the laws of organization, proximity, closure, similarity and simplicity (Ellis, 1938). Origami instruction engages teachers to participate in reflecting on mathematics concepts and skills involved in the creation, pedagogy modeled, equity diversity, and history-cultural consideration. Teachers will become acquainted with the pedagogy and geometry concepts involved for

using this media in the classroom. Through paper folding, students learn to examine, transform, apply, represent, prove and communicate while helping develop a sense of spatial relationships (Phibb, 1991). Students require abilities to be used in describing, comparing, representing, and relating objects in the environment. The development of such abilities relies heavily on the kinds of experiences children have with real objects and on the ways which they respond to these experiences. Understanding of the concepts involved and the way the students learn allows the teacher to facilitate activities which are rich in exploration, application, representations, communications and mathematical reasoning. Origami provides a highly engaging and motivating environment within which children extend their geometric experiences and powers of spatial visualization. It gives a venue for their creative nature and invites play, problem solving, and problem posing.

## 4. Multimodal Instruction

### Multiple Intelligences

The theory of multiple intelligences (Gardner, 1993) proposes a major transformation in the way our schools are run. It suggests that teachers be trained to present their lessons in a wide variety of ways using music, cooperative learning, art activities, role play, multimedia, field trips, inner reflection, and much more. Origami combines different intelligences. It is a verbal activity (listening and reading directions), visual activity (model), as well as kinesthetic activity (hands-on). According to the dual coding theory (Paivio,1971), recall and recognition is enhanced by presenting information both visual and verbal form. This will be useful for students with attention deficit disorders and visual and hearing impairments. These types of activities stimulate more parts of the brain than just the teacher-lecture format. The exercise also requires hand-to-eye coordination. For difficult fold, a teacher may have to prepare several precise explanations. The steps provoke the students to think about the next step, being intuitive, trying to picture the final results. The students are usually working in groups of two or more, searching together for understanding, solutions, meanings, or creating a product.

### Precision Instruction

Throughout the verbal and visual instruction, the teacher uses origami vocabulary to describe each fold or base. In origami, pronouns like "it", "this", "there", or words like "over here" are not precise enough to be part of origami vocabulary. When describing a fold use its name, the place where the fold begins and ends, or other "landmarks" to locate it exactly.

### Cognitive Leveling

Teacher uses a large piece of paper to demonstrate the model. A teacher decides on the size and type of paper needed to be large enough to be seen from the back row. From a distance, the contrast between the white side and light colors or foil can not always be distinguished. Vygotsky (1978) asserts that cognitive change occurs within the zone of proximal development, instruction would be designed to reach a developmental level that is just above the student’s current developmental level. A teacher has to be knowledgeable about folding the model enough to know it backwards and which moves or folds are difficult. Besides being familiar with the vocabulary, a teach understands the skills of novice, intermediate, and advanced students and tries to match the model being taught to the students' level of competence, with enough difficulty to maintain interest but not enough to raise frustration. The teacher can adapt the level of design to the ability of the students. Give extra time: It may take three times as long to teach the model as it does to fold it so time has to be watched (Sze, 2004). This is so useful for meeting the requirements of effectively teaching a special needs student. At any level, there is a starting point and an ending point, with a number of steps between them. It makes the mountain of desired outcomes seem surmountable.

## 5. Social Learning

### Least Restrictive Environment

A good teacher creates a pleasant atmosphere by sharing jokes or stories while waiting for the students to finish a move. Doing so, a teacher enables a least restrictive environment for children with or without disabilities. Children with disabilities often lack the necessary social, behavioral, study, self-management, academic, and life skills. The importance of inclusive education in regards to students with special needs has been strongly emphasized through Public Law 94-142. Origami allows students to be

creative and build their confidence as they share their successes with others. By folding and unfolding a piece of paper, learners are involved in constructing and deconstructing concepts which eventually leads to a three dimensional product. There is a sense of accomplishment which is authentic when students "build" something their own hands.

Immediate Feedback

Behavior that is positively reinforced will reoccur (Skinner, 1954). The theory of Skinner is based upon the idea that learning is a function of change in overt behavior and requires immediate feedback. As the teacher walks around the classroom, demonstrating the folding steps and checking that the students are completing the task, the teacher is administering feedback repeatedly. Immediate feedback which contains accurate information is essential because delaying feedback for "intellectually challenged students results in more errors and a greater number of trials needed to reach solutions (Epstein, Brosvic, Costner, Dihoff, & Lazarus, 2003). In origami exercise, students are also encouraged to compare their model with their neighbor. More skilled folders can help by demonstrating on their own model.

6. Self-Management Strategies

Modeling

The teacher encourages the students to observe his or her demonstration of a move before they attempt it. Sometimes it may be helpful to teach each move twice. The social learning theory of Bandura (1977) emphasized the importance of observing and modeling the behaviors, attitudes and emotional reactions of others. The highest level of observational learning is achieved by first organizing and rehearing the modeled behavior symbolically (folding) and then enacting it overtly. Coding modeled behavior into words, labels or images results in better retention than simply observing.

Internal Reward

Many special needs children rarely feel as if they are successful with academic projects (Sze, 2004). Origami is a fun activity with a clear reward at completion. By breaking down the participatory exercise into bite-sized chunks, origami enables each student to gain a feeling of accomplishment. The students are motivated by creating an end product, so they are more likely to turn to other students for assistance. Students learn not to afraid to ask for help from their peers or the teacher. It is only natural that the student's enthusiasm spills over to those around them. It becomes a natural instinct to want help a neighbor who may be struggling with something the "skilled" student already mastered.

## SUMMARY

The relationship between origami and constructivism has a direct impact on diversity and rural special education. Origami represents Japanese ancient art which promotes culturally awareness and sparks intellectual, cultural and social exchange. Like multiple intelligences, constructivism focuses on learner's different gifts and learning skills. Origami construction is a process of adjusting mental and physical models to accommodate new experience. It levels the playing field for at-risk students, students with disabilities and students from a culturally and linguistically diverse background especially in rural schools where resources and exposures are limited.

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