

Froebel's Views on the Role of Paper-Folding in Early Mathematics Education

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The intent of this paper is to reintroduce teachers, ranging from the area of early childhood mathematics education to upper elementary grades, to some important aspects of the works of German educator, Friedrich Wilhelm August Froebel (1782-1852). Perhaps Froebel's greatest contributions were the creation of the concept of the kindergarten, and the development of a series of "gifts" – play materials such as building and patterned blocks, string, and folded paper forms that are designed to foster the growth of a child's powers of observation, reasoning, and mathematical discovery. The subsequent worldwide spread of Froebelian ideas, practices, and methodologies have been suggested to have exerted a significant influence on the upbringing of many notable achievers such as Paul Klee, Frank Lloyd Wright, Charles-Edouard Jeanneret (Le Corbusier), Walter Gropius, Josef Albers, Buckminster Fuller, Wassily Kandinsky, Piet Mondrian, and George Braque [Brostermann 97].

Many of Froebel's followers have written books and articles based on his specific approach to using paper folding (usually referred to today by the Japanese term *origami*) in the classroom for promoting early awareness and appreciation of geometric concepts. For a partial online listing, see the entries compiled by the late British historian of origami, David Lister [<http://www.britishorigami.info/academic/lister/froebel.php/>]. A particularly valuable resource in this regard is a lengthy article by Eleonore Heewart [Heewart1895] who knew Froebel personally and received her training in Keilhaus, Germany from Froebel's colleague Wilhelm Mittendorff.

Froebel-inspired paper folding in the classroom spread from Germany to the rest of Europe, Great Britain, Japan, and North and South America, reaching a height of popularity in the period 1880-1914. Its unfortunate decline may have been due in part to increasing dependence of teachers on pre-set, rigid standardized folded forms and the lack of accompanying imaginative folding activities

In this paper, we focus on a 22-page passage from Froebel's collected works [Froebel 1902], translated from the German by Josephine Jarvis, that most effectively encapsulates his feelings about the pedagogical value of paper folding in kindergarten and the subsequent

grades of early education. The passage is remarkable in several ways. Firstly, it is devoid of any pictures or diagrams, which is rather unusual for presentations involving geometric content. Nevertheless his arguments are (with only a few exceptions) clearly understandable, especially if read very carefully with paper in hand. Secondly, the passage serves as a model - which we think worthy of emulation by teachers today - of how to promote the learning or discovery of a great deal of geometric knowledge in the early grades using just the simple geometry of a folded square and associated origami play activities.

In order to make Froebel's purely textual presentation more accessible to contemporary teachers, we highlight its essential contents with the aid of diagrams, and show that it is relevant today for the implementation of many of the *Common Core State Standards in Mathematics* (<http://www.corestandards.org/Math/>) for kindergarten-grade 4 in the USA.

[Brostermann 97]. Norman Brostermann , *Inventing Kindergarten*, New York: Harry N. Abrams, Inc., 1997.

[Froebel 1902]. Friedrich Wilhelm August Froebel, *Education by Development/The Second part of the Pedagogics of the Kindergarten*, translated by Josephine Jarvis. New York: D. Appleton and Company, pp. 96-117. This work may be accessed online at: <https://archive.org/details/friedrichfroebel100froel/>.

[Heewart 1895]. Eleanor Heewart (1895). *Course in Paper Folding – One of Froebel's Occupations for Children*, reprinted in John Smith, Ed. COET '91, *Conference of Origami in Education and Therapy*, UK: British Origami Society, 1992, pp. 101-153.