ABSTRACT
                This document lists references on the teaching of
fractions, with many of the entries annotated. They are alphabetized
by the author by categories: Activity and Game; Addition and
Subtraction; Teaching Aids; Application; Assessment; Curriculum;
Decimal; Common Fraction; Division; Equivalence of Fractions; Errors;
Fraction Concept; Multiplication; Rate and Ratio; Research; and
Teaching. (MP)

A BIBLIOGRAPHY OF ARTICLES ON FRACTIONS

by

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A Bibliography of articles on fractions

Fractions occupy an important place in school mathematics programmes. According to the survey of the Priorities in School Mathematics Project (1981), four major goals of teaching fractions are related to; (a) their use in vocation, (b) consumer purchases, (c) illustrating basic mathematical ideas and (d) providing solution to algebraic equations. The teaching of fractions has always been a challenge to teachers in all grades. That it continues to be a challenge is attested to by the recent report of the National Assessment of Educational Progress (1980). According to this report, 13-, and 17- year-olds students find fractions to be a difficult topic. Although many of them can successfully apply an algorithm, they have little understanding of the underlying concepts and processess. Students appear to be learning many mathematical skills at the rote manipulative level. In this article a series of bibliography that involved activity and game, addition and subtraction, teaching aids, application, assessments, curriculum, decimals, division, errors, equivalent fractions, fraction concept, multiplication, rate and percent, research and teaching of fractions will be presented. It is the hope of the author that teachers of mathematics who want to emphasize meaning and understanding prior to intensive work with formal algorithms involving fractions will find some of these articles useful.

To conserve space, abbreviations are used for some of the titles of the peroidicals in the list itself. Full titles are listed below:

AMM   American Mathematical Monthly

AT   Arithmetic Teacher

DA   Dissertation Abstracts

DAI   Dissertation Abstracts International.

ESJ   Elementary School Journal

GT   Grade Teacher

JER   Journal of Educational Research

JRME   Journal for Research in Mathematics Education.

MT   Mathematics Teacher

SSM   School Science and Mathematics.

Activity and game

Albuquerque, H. D.. Fraction action-gameboard route helps kids compute.
Learning, 1978, 2, 84.

Armstrong, C.. Fradecent- a game using equivalent fractions, decimals,
and percents. AT, 1972, 3, 222-223.

Bradfield, D. L.. Sparking interest in the mathematics classroom. AT,
1970, 3, 239.

Carlisle, E.. Crazy fractions:An equivalence game. AT, 1973, 4, 303-304.

Cook, Nancy. Fraction bingo. AT, 1970, 3, 237-239.

Reese, J.W.. Yardstick game. Instructor, 1970,11,36.

Staritzky, M.. Pass a fraction. Instructor, 1973, 84.

Zytkowski, R.T., A game with fraction numbers. AT, 1970,1,82-83.

Addition and Subtraction

Adachi, Mitsuo. Addition of unlike fractions. AT,1968,3,221-223.

Beacker,A. L.. Remedial work in the addition of common fractions.
California Journal of Elementary Education, 1940,9,43-47.
He found that about one-third of the errors made by sixth grade
students in addition of fractional numbers were attributable
to equivalent fractions.

Burns, M.. The Math connections is yours to make. Learning, 1979,1,69-70.

Carmony, L.. Adding fractions incorrectly?. AT, 1978, 12, 737-738.
  The author discusses an excaption to an established rule for
  adding two fractions.

Ellerbruch, L.W. & Payne, J.N.. A teaching sequence from initial concepts
  through the addition of unlike fractions. In the Developing
  Computational Skills, 1978 Yearbook of the National Council of
  Teachers of Mathematics. Reston Virginia: The Council, 1978.

Lappan, G. & Winter, M.J. Some problems with fractions for the middle
  school. MT, 1981, 2, 102-104.

May, Lola. Adding and subtracting rational numbers. GT, 1968, 2, 74-81.

Pigge, F.L. An experimental comparison of three methods of teaching
  addition and subtraction of fractions in grade five. DA, 1964,
  25, 1789-1790.

Thiessen, D. David's algorithm for the L.C.D. AT, 1981, 3, 18.

  Teaching Aids.

Ashlock, R.B.. Introducing decimal fractions with the meterstick.
  AT, 1976, 3, 201-206,

Bennet, A.B.; & Davidson, P. S.. Fraction Bars. Palo Alto, California:
  Creative Publications, 1980.

Bohan, H. Paper folding and equivalent fractions-bridging a gap. AT,
  1971, 1, 245-249.

Bright, George. Ideas. AT, 1977, 1, 43-50.

Brown, C. N.. Fractions on grid paper. AT, 1979, 1, 8-10.

Bruni, J.V., & Silverman, H.J.. Using indoor games to motivate mathematics
  learning. AT, 1976, 3, 154-162.

Jeanine, M.. Renaming fractions greater than one. Catholic School
    Journal, 1966, 4, 72.

Leutzenger, L.P. & Nelson, G. Fractions with models. AT, 1980,
    5, 6 - 11.

Litwiller, B. H. & Ducan, D.. Fraction action. Teacher, 1977, 12, 47.

Sanders, W. J.. The use of models in mathematics instruction.
    AT, 1964, 3, 157 - 165.

Sanok, G.. Mathematics and saltine crackers. AT, 1980, 12, 36.

Schiller, D. P.. The effects of the fraction ruler manipulative
    for teacher computation of fractions. The Clearing House,
    1977, 3, 300 - 303.

Scott, W. Fractions taught by folding paper strips. AT, 1981, 1, 18-21.

Sherill, J.M.. Egg cartons agains ?! AT, 1973, 1, 13 -14.

Sherman, H. Fractions over easy. Teacher, 1978, 9, 139-142.

Sowder, L. Models for fractional numbers-a quiz for teachers. AT,
    1971, 1, 44 -46.

Sowder, L.. Criteria for concrete models. AT, 1976, 10, 468 - 470.

Sprau, D. From the file:Fractions. AT 1980, 12, 44.

an de Valle, J. & Thompson, C.S.. Fraction with counters. AT, 1980,
    9, 6 - 11.

Wochko, L.E. Manipulative Activities and Games in the Mathematics
    Classroom, Washington: National Education Association, 1972,
    43 - 45.

Jeanine, M.. Renaming fractions greater than one. Catholic School
Journal, 1966, 4, 72.

Leutzenger, L.P. & Nelson, G. Fractions with models. AT, 1980,
5, 6 - 11.

Litwiller, B. H. & Ducan, D.. Fraction action. Teacher, 1977,12, 47.

Sanders, W. J.. The use of models in mathematics instruction.
AT, 1964, 3, 157 - 165.

Sanok, G,.. Mathematics and saltine crackers. AT, 1980, 12, 36.

Schiller, D. P.. The effects of the fraction ruler manipulative
for teacher computation of fractions. The Clearing House,
1977, 3, 300 - 303.

Scott, W. Fractions taught by folding paper strips. AT, 1981, 1, 18-21.

Sherill, J.M.. Egg cartons agains ?! AT, 1973, 1, 13 -14.

Sherman, H. Fractions over easy. Teacher, 1978, 9, 139-142.

Sowder, L. Models for fractional numbers-a quiz for teachers. AT,
1971, 1, 44 -46.

Sowder, L.. Criteria for concrete models. AT,1976, 10, 468 - 470.

Sprau, D. From the file:Fractions. AT 1980,12, 44.

an de Walle, J. & Thompson, C.S.. Fraction with counters. AT,1980,
9, 6 - 11.

Wochko, L.E. Manipulative Activities and Games in the Mathematics
Classroom, Washington: National Education Association, 1978,
43- 45.

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Watkins, A.E. and Watkins, U. Fractions on the geoboard. MT, 1980,
    2, 133-139.

West, T. Some mathematical hard spots. AT, 1978, 9, 19-23.

Application

Beynen, J.V. and Mc Ginty, R.L. A geometric interpretation of
    series. MT, 1981, 3, 218- 220.

Ercalano, J. Fractional computation on a calculator. MT, 1979,
    11, 591-592.

Knill, G. Fingerprints and fractions. MT, 1980, 11, 608-609.

Maras, I.v. Fractions in metric countries. T, 1980, 4, 246.
    The author found that in countries where metric system are
    large amount of class times were spent on the teaching of fractions.

Mendoza, L.P. Using dice: from place value to probability. AT, 1981,
    4, 10-12.

Polley, G.W. Improper fractions. T, 1980, 4, 247.

Moore, C.G. An introduction to continued fraction. National Council
    of Teachers of Mathematics, 1964.

Olds, C.D. Continued Fractions New York: Random House, 1963.

Spieler, P.P. From the file:Fraction. AT,1981,1,49.

Thornton, C.A. A glance at the power of pattern. AT,1977,2,154-157.

Williams, G.A. The pythagoras theorem: a useful geometric tool for
    approximating $\sqrt{2}$. AT,1977, 4; 284-286.

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Assessment

Carpenter, T.P.; Coburn,T.G.; Reys,R.E. and Wilson,J.W. Result and implications of the NAEP mathematics assessment: Elementary School. AT, 1975, 10, 438-450.

Carpenter, T.P.; Coburn,T.G.; Reys, R.E. and Wilson, J.W. Notes from national assessment: addition and multiplication with fractions AT,1976, 2, 137-142.

Carpenter, T. P.; Coburn, T.G.; Reys, R.E. and Wilson,J.W. Results From the First Mathematics Assessment of NAEP. Reston, Virginia: National Council of Teachers of Mathematics, 1978.

Carpenter, T.P.;Corbitt,M.K.; Kepner, H.S.; Lindquist,M.M.; and Reys, R. Results of the second NAEP mathematics assessment: elementry school. AT, 1980, 4, 10-12, 44-47.

Carpenter, T.P.; Corbitt, M.K.; Kepner, H.S.; Lindquist, M.M. and Reys, R. Results of the second NAEP mathematics assessment: secondary school. MT, 1980, 5, 329- 338.

Post, T.R. Fractions: Results and implications from national assessment. AT, 1981, 5, 26-31.

Curriculum

Botts, T. Fractions in the new elementry curriculum. AT, 1968, 3, 216 - 220.

Cathcart, W.G. Metric measurement: Important curriculum consideration. AT, 1977, 4, 158-160.

In one part of the article the author discusses the role of common fractions with the implementation of the metric system of measurement.

Easterday, K.E.. A technique for low achievers. MT, 1965, 10, 519-521.

Engen, H.. Rate pairs, fractions and rational numbers. AT, 1960, 12, 389-399.

Firl, D.H.. Fractions, decimals and their future. AT, 1977, 3, 238-240.

The author believed that some basic computations with decimal should be taught earlier, while teachers did not have to be in a hurry to teach fractions until the junior high school.

Latino, J.J.. Take the folly out of fractions. AT, 1955, 2, 113-118.

Wilson, G.M. and Dalrymple, C.O.. Useful fractions. American Journal of Educational Research, 1937, 1, 341-347.

They found that common usage of fractions was limited to halves, thirds, quarters, eights and twelfths.

Wolfe, M and Braunfeld, P. Fractions for low achievers. AT, 1966, 12, 647-655.

Usiskin, ?.. The future of fractions. AT, 1979, 1, 18-20.

Decimal

Alexander, F.D.. One small jump--into repeating decimals and prime numbers. MT, 1974, 10, 520-525.

Anderson, J.T.. Periodic decimals. MT, 1974, 10, 504-509..

Burris, C.H. and Hobbs, B.F.. Minicalculators and repeating decimals. AT, 1978, 4, 18-20.

Carpenter, T.P.; Corbitt, M.K.; Kepner, H.S.; Lindquist, M.M. and Reys, E.E.. Decimals: Results and implications from National Assessment. AT, 1981, 4, 34-37.

Faires, D.M.. Computation with decimal fractions in the sequence of number development. DA, 1963, 5, 23, 4183.

Flournoy, F.A.. A consideration fo pupils' success with two methods for placing the decimal point in the quotient. SSM, 1959, 6, 445

Hilferty, M.M.. Some convenient fractions for work with repeating decimals. MT, 1972, 3, 240-241.

Hobbs, B.F. and Burris, C.H.. Minicalculators and repeating decimals. AT, 1978, 4, 18-20.

Hutchinson, M.R.. Investigation the nature of periodic decimals. MT. 1972, 325-327.

Jacobs, N.. More on repeating decimals. MT, 1975, 3, 249-252.

Kidder, F.R.. Pitton's Dilemma, on what to do about decimals. AT, 1980, 10, 44-46.

Leavitt, W.G.. A theorem on repeating decimals. The American Mathematical Monthly, 74: 669-673.

Margaret, H.. Some convenient fractions for work with repeating decimals. MT, 1972, 3, 240-241.

Prielipp, R.W.. Decimals. AT, 1976, 4, 285-288.

Rao, K.S.. Notes on the recurring period of the reciprocal of an odd number. The American Mathematical Monthly, 62: 484-487.

Rodidoux, D. and Montefusco, N. An easy way to change repeating decimals to fractions. - Nick's method. AT, 1977,1,81-82.

Sgroi, J.J. Patterns of repeating decimals: A subject worth repeating. MT,1977, 604-605.

Wagner, S.S. Fun with repeating decimals. MT, 1979, 209-212. She generates repeating decimals with a cyclic pattern.

Woodburn, D. Can you predict the repeated? MT, 1976, 675-678.

Common Fraction

Johnson, J.T. Decimal versus common fraction. AT, 1956,11,201-203.

Kolesnik, T.S. The division of common fractions. AT, 1960, 3, 133-134.

Kolesnik, T.S. Illustrating multiplication and division of common fractions. AT 1963, 5, 268-271.

Matthews, W N Teaching comparison of common fractions. AT, 1968, 3, 271-273.

Pickering, M.A. An investigation of children's learning of some concepts and principles which enable them to perform examples of addition of common fractions. DA, 1969, 4, 29A, 3533.

Division

Alkire, E.R. An experimental study of the value of a meaningful approach to the operation of division with common fractions. Unpublished Master's thesis, Claremont College, 1949.

Bergen, P. Action research on division of fractions. AT, 1966, 4, 293-295.

Bidwell, J.K. Some consequences of the learning theory applied to division of fractions. SSM, 1971, 5, 426-434.

Bray, C. J.. To invert or not to invert. AT, 1963, 5, 274-276.

Brickman, B. More rationalizing division of fractions. AT, 1955, 2, 25-26.

Brooke, G.M. The common denominator method in the division of fractions. DA, 1954, 14, 2290-2291.

Brueckner, L.J. and Melbye, H.O. Relative difficulty of types of examples in division with two-figure divisors. JER, 1940, 33, 401-414.

Capps, L.R. Division of fractions. AT, 1962, 1, 10-16.

Capps, L.R. A comparison of the common denominator and inversion method in teaching division of fractions. DA, 1960, 21, 819-820.

Christofferson, H.C. Division by a fraction made meaningful. MT, 1948, 9, 32-35.

Constantine, D.G. An approach to division with common fractions. AT, 1968, 2, 196.

Cornelia, N.J. Understanding division of fraction. Journal of Bussiness Education, 1966, 1, 157-158.

Dickey, J.W. Experimanting with apparatus in teaching division of fractions. National Elementry Principal, 1937, 7, 419-426.

Dilley, C.A. and Rucker, W.E.. Division with common and decimal fractional numbers. AT, 1970, 5, 438-441.

Donnell, W.J. Dividing fraction. MT, 1980, 12, 648.

He discusses a special way of dividing fractions.

Duker, Sam. Rationalizing division of fractions. AT, 1954, 11, 20-23.

Eagle, E.. Don't let that division become mysterious. AT, 1954, 10, 15-17.

Freeman, W.. Mrs. Murphy's pies - an introduction to division by fractions. AT, 1967, 4, 310-311.

Fromewick, A.. Nathan's conjecture. AT, 1973, 4, 289.

Greatsinger, C.. An experimental study of programmed instruction in division of fractions. DA, 1967, 27, 2442A.

Grossnickle, F.E.. How to use a fractional division. Journal of Education, 1954, 10, 17-19.

Hannon, H.. All about division with rational numbers -- variation on a theme. SSM, 1971, 6, 501-507.

Johnson, H.C.. Division with fractions: levels of meaning. AT, 1965, 5, 362-368.

Junge, Charlotte, W.. Now try this -- division of fractions. AT, 1968, 2, 177-178.

Koenker, R.H.. Dividing by a fraction. AT, 1965, 3, 225-226.

Koenker, R.H.. Certain characteristic differences between excellent and poor achievers in two-figure division. JER, 1942, 4, 578-586.

Krich, P.. Meaningful vs. mechanical method teaching division of fractions by fractions. SSM, 1964, 11, 697-708.

May, Lola. Division of fractional numbers can be meaningful.
GT,1968, 4, 64-72.

Mc Meen, G.H. Division of a fraction - a new method. AT, 1962,
3, 122-126.

Olberg, R. Visual aid for multiplication and division of fractions.
AT, 1967, 44-46.

Riedesel, A. and Shryock, A.J. The use of the common denominator
and the reciprocal in dividing fractions. SSM,1964, 1, 53-59.

Sluser, T.A. A comparative study of division of fractions in which
an explanation of the reciprocal principle is the experimental
factor. DA,1963, 23, 4624.

Stephens, L.E.. Retention of skill of division of fraction. AT,
1960, 1, 28-31.

Stephens, L.E. A comparative study of procedures used in teaching
division of fractions in sixth grade arithmetic. Unpublished
Master's thesis, University of California at Los Angeles, 1957.

Thompson, C. Teaching division of fractions with understanding.
AT, 1979,1,24-27.

Zeddies, M.L. Creativity in general mathematics. MT,1981, 3, 187,
In one part of the article the author illustrates a rather
strange way of quickly dividing fractions.

Equivelence of fractions.

Bohan, H. A study of the effectiveness of three learning sequences
for equivalent fractions. DA,1971, 31, 6270A.

Brown, C.K. A study of four approaches to teaching equivalent
   fractions to fourth-grade pupils. _DAI_, 1973, 33, 3465A.
   In this study four approaches to teaching of equivalent fractions
   to fourth graders yield the results that a textbook approach
   was inferior to 3 other approaches: the textbook with film,
   textbook with manipulatives, and textbooks with film and
   manipulatives. He also found that the textbook-film-manipulative
   approach yield significantly higher mean scores than the other
   three approaches.

May, Lola. Display fractions. _GT_, 1970, 12, 66-67.

Ruderman, H.D. Evenness and oddness extended. _AT_,1978, 3, 56.

Wood, W.S. A different way of finding fractional equivalents. _MT_,
   1980, 10, 514-516.

Errors

Aftreth, O.B. The effect of the systematic analysis of errors
   in the study of fractions at the sixth grade level. _JER_,
   1958, 9, 31-34.

Brueckner, L.J. Analysis of errors in fractions. _ESJ_,1928, 6, 760-770.

Brueckner, L.J. Analysis of difficulties in decimals. _ESJ_,1928,
   29, 32-41.

Brueckner, L.J. Persistency of error as a factor in diagnosis.
   Education, 1935, 11 140-144.

Clements, M.A. Analyzing childre's errors on written mathematical
   tasks. _Educational Studies in Mathematics_, 1980, 2, 1-21.

Gardner, P. Analysis of errors in fractions. In Studies in Arithmetic (vol 2) Edinburgh, Scothland: Scottish-Council for Research in Education, 1941.

Grossnickle F.E.. Types of errors in division of decimals. ESJ, 1941, 11, 184-194.

Grossnickle, F.E.. Kinds of errors in division of decimals and their constancy. JER,1943, 9, 110-117.

Guiler, W.S. Difficulties in fractions encountered by ninth-grade pupils. ESJ, 1945, 11, 146-156.

Guiler, W.S.. Difficulties in decimals encountered by ninth-grade pupils. ESJ, 1946, 3, 384-393.

Guiler, W.S. Difficulties in percentage encountered by ninth-grade pupils. ESJ, 1946, 6, 563-573.

Hopkins, M.H. The diagnosis of learning styles in arithmetic. AT, 1978, 4, 47-50.

Kallau, A.W.. Analysis and testing in common fractions. JER, 1920, 3, 177-192.

Laursen, K.W. Errors in first year algebra. MT,1978, 3, 194-195.

Morton, R.L. An analysis of pupil's errors in fractions. JER, 1924, 2, 117-125.

Pecks, D.M. and Jencks, S.M.. What the tests don't tell. AT, 1974, 1, 54-56.

Ranharter, H.K. and Johnson, H.C. Methods of attack used by good and poor achievers in attempting to correct errors in six types of subtraction involving fractions. JER, 1949, 4, 588- 597.

Sounder, H.C. The construction and evaluation of certain readiness tests in common fractions. <u>JER</u>, 1943,10,127-134.

Fraction concept

Brumfiel, C. Mathematical systems and their relationships to the real world. <u>AT</u>, 1970, 11, 563-573

Bruni, J.V. and Silverman, H. An introduction to fractions. <u>AT</u>, 1975, 11, 538-545.

Campbell, B.G. The child's understanding of three interpretations of certain unit fractions prior to formal instruction. <u>DAI</u>, 1975, 35, 4855A.

Coxford, A.F. and Ellerburch, L.W. Fractional numbers. In Mathematics Learning in Early Childhood, Thirty-seventh Yearbook of National Council of Teachers of Mathematics, Reston, Virginia: The Council, 1975, 192-203.

Duquette, R.J. Some thoughts on Piaget's finding and the teaching of fractions. <u>AT</u>,1972, 4, 273-275.

Gibb, E.G. Fractions. <u>GT</u>, 1962, 4, 54.

Gunderson, A. and Gunderson, E. Fraction concepts held by young children. <u>AT</u>,1967, 4, 52-54.

Gunderson, E.. Fractions - seven-year-olds them. <u>AT</u>, 1958, 5,233-238.

Hall, J.V. A self-starter approach to fractions. <u>MT</u>, 1950, 11, 331-333.

Hannon, H. Concept determines process- a look at the fraction symbol. <u>AT</u>, 1966, 4, 298-302.

Hartung, M.L. Fractions and related symbolism in elementry-school instruction. <u>ESJ</u>,1958, 4, 377-384.

Howard, C.F. Three methods of developing children's concepts
of fraction in grades V and VI' of the elementry school.
Unpublished doctoral dessertation, University of California
at Berkeley, 1947.
He found that none of the three methods; drill approach,
meaning approach, and combination approach was superior
but on long term memory, the drill approach was demonstrated
to be inferior.

Jenks, S.M. and Pecks. D.M. Mental imagery in mathematics.
AT,1972, 12, 642-644.

Jenks, S.M. and Pecks, D.M. Why blame kids ? We teach mistakes ?
AT, 1980, 11, 38-42.

Jenks., S.M. and Pecks, D.T. Share and cover. AT, 1981, 3, 38-41.

Kieren, T.E. On the mathematical , cognitive and instructional.
foundations of rational numbers. In R.A. Lesh (Ed,)
Number and Measurement, ERIC/SMEAC, Ohio State University, 1976.

Kieren, T.E. Knowing rational. numbers- levels of representations
and symbols,In M.M. Linquist (Ed) 1980 NSSE Yearbook, NSSE
Chicago, 1980.

Larson, H.L. The sturcture of a fraction. AT,1966, 4, 296-297.

May Lola. Fractions for primary. GT, 1967,4, 52-54.

May Lola. How to give meaning to rational numbers. GT,1968,1,62-64.

May Lola. Fraction for primaries. GT,1970, 4, 83-85.

Miller, Ann. Teaching the concept of 1/2 in the primary grades.
AT.1978,3,57-58.

Miller, G.H. How effective is the meaning method. AT, 1957, 3, 45-49.

Muller, F.J.. On the fraction as a numeral. AT, 1961, 5, 234-238.

Novillis, C.F. Four aspects of the fraction concept observed
in selected sixth grade students. Unpublished Master's
thesis. The University of Texas, Austin, 1969.

Pace, J. A rational approach to fractions. The Two Year College
Mathematics Journal, 1978, 9, 3, 154-158.

Phillips, J.. On fractions. Instructor, 1967, 3, 121,152.

Polkinghorne, A.R. Young children and fractions. Childhood Education,
1935, 11, 354-358.

Rapport, D. The meaning of fractions. SSM, 1962, 62, 241-244.

Rudnitsky, A.N.. and Drickamer, P. and Handy, R. Talking
mathematics with child. AT, 1981, 1, 14-17.

Scandura, J.M. Fractions-names and numerals. AT, 1964, 11, 468.

Scott, L. Children's concept of scale and the subtraction of
fractions. AT, 1962, 3, 115-118.

Streefland, L. Some observational results concerning the mental
constitution of the concept of fractions. Educational Studies
in Mathematics, 1978, 9, 51-73.

Multiplication

Arvin, C.L. An experimental study of programmed instruction in
multiplication of fractions. DA, 1966, 26, 7109.

He found no differences in achievement between children
using programmed materials compared to those in regular
classroom instruction, but programmed materials took only
half the time.

Austin, G.R. A study of programmed instruction response styles
and reinforcement schedules for teaching multiplication
of fractions. DAI, 1966, 26, 5218.
He found no differences between treatments comparing multiple-
choice answers versus written answers and 100% reinforcement
versus 50% reinforcement.

Chabe, A.M. Rationalizing inverting and multiplying. AT, 1963,
5, 272-273.

Collier, M. Learning to multiply fractions. SSM, 1922, 4, 324-329.

Fehr, H. Fractions as operators. AT, 1968, 3, 228-237.

Haddah, M.S. An error pattern leads to a discovery lesson. MT,
1980, 3, 197.

Hoffman, H.W.. Meaning for multiplication of fractions. AT, 1958,
3, 89-90.

Lankford, F.G. Some computational strategies of seventh grade
pupils. U.S. Office of Education, Project No. 2-C-018,
Washington, D.C. Government Printing Office, 1972.

May, Lola. Multiplying fractional numbers. GT, 1968, 3, 26-30.

Miller, J.W. An experimental comparison of two approaches
to teaching multiplication of fractions. JER, 1964, 469-471.
He designed materials with prompt feedback from pupils
and found them superior to the regular text on a posttest.

Rappaport, D. Multiplication is repeated addition. AT, 1965,
11, 550-551.

Romberg, T.A. A note on multiplying fractions. <u>AT</u>,1968, 3, 263-265.

He observed that many students seem to know the algorithm but made errors when they reduced their answers. He further noted that students failed to use a cancellation procedure in their multiplication.

Trimble, H.C. Fractions are ratios too. <u>ESJ</u>,1949,11,285-291.

Rate and ratio

Bidwell, J. From ratio to rational number. <u>SSM</u>,1966, 10, 661-669.

Crumley, R.D. Teaching rate and ratio in the middle grades. <u>SSM</u>, 1960, 2, 419-426.

Johnson, J.T. Are ratios fractions. <u>ESJ</u> 1948, 3, 374-378.

Schmalz, R. The teaching of percent. <u>MT</u>, 1977, 4, 340-342.

She emphasized the use of a preproportion statement, which is an intermediate step by which any percent statement takes on a manageable form in teaching percent.

Steffe, L.P. and Parr, R.B. The development of the concept of ratio and fraction in the fourth, fifth and sixth years of the elementary school. Technical report no. 49, Wisconsin Research and Development for Cognitive Learning, OE 5-10-154, Madison, Wisconsin: The University of Wisconsin, 1968.

Research

Anderson, R.C. Suggestions from research - fractions. <u>AT</u>, 1969, 2, 131-135.

Anderson, R.C. A comparison of the two procedures for finding the least common denominator in the addition of unlike, unrelated fractions. DA,1966, 26, 5901.

For finding the least common denominator, no significant differences were found between using rows of equivalent fractions and factoring denominators.

Babcock, G.R. The relationship between basal measurement ability and rational number learning at three grade levels. A thesis submitted to the Faculty of Graduate Studies and Research. University of Alberta, 1978.

Bat-hee, M.A. A comparison of two methods of finding the least common denominator of unlike fractions at fifth grade level in relation to sex, arithmetic achievement and intelligence. DA, 1969, 29A, 4365.

He found that the factoring method and a process using rows of equivalent fractions were equally effective in teaching student to find the LCD; and both procedures were superior to the inspection method.

Bauer, J.L. The effect of three instructional bases for decimals on computation skills of seventh-grade students. DAI, 1975, 5, 35, 251A.

He found that the common-fraction equivalents, the expended exponential notation and number-line approaches-- no significant differences.

Bergen, P.M. Action research on division of fractions. AT, 1966, 4, 293-295.

Bidwell, J.K. A comparative study of the learning structures
of three algorithms for the division of fractional numbers.
DA,1968, 9, 29, 830A.
He found that for division of fractions the inversion
algorithm was favored, followed by the complex fraction
and common denominator algorithm.

Bisio, R.M. Effect of manipulative materials on understanding
operations with fractions in grade . DAI, 1971, 8, 32A, 833
He found that the passive use of the manipulative materials
appeared to be as effective as their active use and better
than no use.

Bohan, H.J. A study of the effective of three learning sequences
for equivalent fractions. DAI,1971, 31, 6270A.
When paper folding was compared with a property-of- one
procedure; no significant differences were found expect
for retention, where paper folding was favored.

Bragg, S.C. Using student interest in developing curriculum
materials in decimal fractions and informal geometry with
emphasis on practical application for post-secondary
low achievers. DAI,1980, 10, 41A, 1451.

Burke, M.; Hilber, N.; and Romberg, T.A. The teaching of initial
fraction concepts (working paper 218). Madison: Wisconsin
Research and Development Center for Cognitive Learning, 1977.

Capps, L.R. A comparison of the common denominator and inversion
method in teaching division of fractions. DA,1960,10,21,
819-820. See also: Journal of Educational Research, July-August
1963, 56, 516-522. Also The Arithmetic Teacher, January
1962, 9, 10-16.

He found that there was no significent difference between common denominator and inversion algorithms on addition, subtraction, and division with fractions, but the inversion algorithm was better for multiplication with fractions.

Carney, H.F. The relative effectiveness of two methods of teaching the addition and subtraction of rational numbers. DAI, 1973, 8, 34A, 659-660.

Carter, M.K. A comparative study of two methods of estimating quotients when learning to divide by two-figure divisors. DA, 1960, 2, 20, 3317.

Choate, S.A. The effect of algorithmic and conceptual development for the comparison of fractions. DAI, 1975, 9, 36, 1410A.
He examined the cognitive structures of children who were taught a rule for comparing fractions versus children who were taught a conceptual approach to comparison. It seems that steps in a rule developed side by side with visual diagrams is the least effective way to teach algorithm.

Coburn, T.G. The effect of a ratio approach and a region approach on equivalent fractions and addition/subtraction for pupils in grade four. DAI, 1974, 2, 34, 4688A-4689A.
For addition and subtraction, the region method was favored over the ratio method.

Davies, R.L. A comparison of the relative efficacy of different methods of teaching fractions to slow-learning children at the secondary stage. Unpublished dissertation for the Diploma in Special Education of the University College of Swansea, 1969.

Ellerbruch, L.W. The effects of the placement of rules and concrete models in learning addition and subtraction of fractions in grade four. DAI, 1976, 4, 36, 6441A-6442A.

Galloway, P.W. Achievement and attitude of pupils toward initial fractional number concepts at various ages from six through ten years and of decimals at ages eight, nine and ten. Unpublished doctoral dissertation, University Michigan, 1975.

Among other things he found that students of all age levels had difficulty with number lines and he recommended more work with concrete materials.

Gray, R.E. and Allison, D.E.. An experimental study of the relationship of homework to pupil success in computation with fractions. SSM, 1971, 4, 339-346.

Green, G.A. A comparison of two approaches and two instructional materials on multiplication of fractional numbers. DAI, 1970, 8, 31, 676A-677A.

She compared the effects of two instructional approaches: area and finding a part of, and two instructional materials: diagrams and manipulative aids on the teaching of multiplication of fractions with fifth graders. She found the following: 1. diagrams and materials were equally effective in learning multiplication of fractions. 2. When comparing the four treatments, the area-diagram approach was the best, with the part-of-material group ranking second. 3..An attitude test showed that pupils liked the diagram approach better than the manipulative approach.

Hiebert, J. and Tonnessen, L.H. Development of the fraction concept in two physical contexts: an exploratory investigation. JRME, 1978, 11, 374-378.

Karatzinas, D. and Renshaw, T. Teachers' view of the Cuisenaire method. Scottish Educational Journal, 1958 41, 575; 39,595-596;40,613.

They found that the group using the rods were superior to a control group in a fraction test.

Kieren, T.E. Needed research on rational number learning. A paper presented at the number learning research conference, Centre for the Study of Mathematics Learning, University of Georgia, April, 1975.

Kieren, T.E. and Nelson, D. The operator construct of rational numbers in childhood and adolescence- an exploratory study. Alberta Journal of Educational Research, 1978,24.

Kyte, G.C. and Fornwalt, J.E. A comparison of superior children with normal children in the rate mastery of the multiplication of fractions. JER, 1967, 4, 346-350.

Larson, C.N. Locating fractions on number lines: effects of length and equivalence. SSM, 1980, 428-428.

He found that for students of grade 7, associating fractions with points of number lines of length one was significantly easier that with number lines of length two.

Miller, G.H. How effective is the meaning method? AT, 1957, 4, 45-49.

Although he did not obtain unequivocal results, Miller claimed that the Cuisenaire material was superior to the traditional methods for teaching fractions.

Muangnapoe, C. An investigation of the learning of the
initial concepts and oral/written symbols for fractional
numbers in grades three and four. DAI, 1975, 36,
1353A-1354A.
The results of his study shows that high achievement
seems to be necessary but not sufficient condition for
transfer.

Novillis, C.F. An analysis of the fraction concept into a
hierarchy of selected subconcepts and the testing of the
hierarohical dependencies. JRME, 1976, 7, 131-144.

O'Brien, T.C. An experimental investigation of a new approach
to the teaching of decimals. DAI, 1968, 5, 28,
4541A-4542A.

Owens, D.T. A study of the relationship of area concept and
learning of fraction concepts by children in grade three
and four. A paper presented at NCTM Conference,
Cincinatti, Ohio, April 1977.

Payne, J.N., Green, J., Choate, S., Muangnapoe, C., Williams,H.
and Ellerbruch,L. Initial fraction sequence. Unpublished
manusceipt, University of Michigan, 1974.

Payne, J.N. Review of Research on fractions. In R.A. Lesh
(Ed.), Number and Measurement. ERIC/SMEAC Ohio State
University, 1976.

Pigge, F.L. An experimental comparison of three methods of
teaching addition and subtraction of fractions in grade
five. DA, 1964, 9, 25, 1789-1790.
He concluded that the fifth graders profited from an
emphasis on developmental-meaningful activities that
included explanations and demonstrations, discussions,

audiovisuals and manipulatives.

Pigge, F.L.   Analysis of covariance in a randomly replicated arithmetic methods experiment. The Journal of Experimental Education, 1966, 4, 73-83.

This study was concerned with the relative effectiveness as measured by scores on a criterion test, of three methods of teaching addition and subtraction of fractions at the fifth-grade level.

Sluser, T.F.   A comparative study of division of fractions in which an explanation of the reciprocal principle is the experimental factor. DAI, 1963, 23, 4624-4625.

Stenger, D.J An experimental comparison of two methods of teaching the addition and subtraction of common fractions in grade five. DAI, 1972, 1, 32A, 3676.

For addition and subtraction, the subset-ratio method was favored over the usual method.

Steffe, L.P. and Parr, R.B.. The development of the concepts of ratio and fraction in the fourth, fifth, and sixth years of the elementry school. Technical Report No. 49 Wisconsin Research and Development for Cognitive Learning OE 5-10-154, Madison, Wisconsin: The University of Wisconsin, 1968.

They found that ratio diagrams were significantly easier to interpret than region interpretation and they conjectured that the ratio interpretation would be easier to teach than the region (measure) interpretation. Also they found that children lacked the understanding of equivalent fractions.

Triplett, L. An investigation to determine what influence
the use of the differentiated written materials has upon
sixth grade students achievement and understanding in
multiplication of fractions when compared with the single
textbook approach. DA,1963, 23, 4374.

Uprichard, A.E., and Phillips, E.R. An intraconcept analysis
of rational number addition: A validation study. JRME,
1977, 8, 7-16.

Williams, H.B.. A sequential introduction of initial fraction
concepts in grades two and four and remediation in grade
six. (Ed. S. Research Report) School of Education, University
of Michigan, 1975.
From this study it is clear that fractions related to
concrete material can be taught quite successful by grade two.

Wilson, G.H. A comparison of decimal-common fraction sequence
with conventional sequence for fifth grade arithmetic.
DAI,1966, 12,30, 1762A.

Teaching

Berge, M.H.. Fraction (grades 4-6) in 34th Yearbook of the National
Council of Teachers of Mathematics. Reston, Virginia:
The council, 1972, 517-520.

Burke, C. Teaching fractions. MT, 1979,2,93-95.

Hinkleman, E.A. A study of the principles governing fractions
known by fifth-and sixth-grade children. Educational
Administration and Supervision, 1956, 42,153-161.

He found that the principle of multiplying/dividing the numerator and denominator by the same number was among the principles least frequently understood by fifth and sixth graders.

Jenks, S.M. and PECKS, D.M. Is immediate reinforcement appropriate ? AT,1976, 1, 32-33.

Krulik, S. To read or not to read, that is the question ! MT, 1980, 4, 248-252.

In one part of the article the author discussed that simple expressions involving fractions were not read from left to right.

Riess, A.P. New approaches to the teaching of fractions in the intermediate grades. SSM,1964,2,111-119.

Ruais, R.W. A low-stress algorithm for fractions. MT, 1978, 4, 258-260.

Sauble, I.Teaching fractions, decimals and percent: Practical applications. Arithmetic 1947. Supplementry Educational Monographs, No.63 Chicago: University of Chicago Press, 1947, 33-48.

Shuster,A. and Pigge, F.L. Retention efficiency of meaningful teaching. AT,1965, 1, 24-31.

Smart, J.R. The why of arithmetic. AT,1979, 1, 21-23.

Thiele, C.L. Teaching common and decimal fractions and percent: General issues. Arithmetic 1947, Supplementry Educational Monographs. No.63 Chicago: University of Chicago Press, 1947, 23-32.

Spitler, G. Consider your alternatives. AT, 1979, 1, 42-45.

Wheatley, G.H. and Duinen, A.V. Mathematical road maps: A teaching
technique. AT, 1976, 1, 18-20.

They suggest the use of a flowchart to help students with
simplify answers to fractional problems.

Zweng, M.T. The fourth operation is not fundamental--fractional
numbers and problem solving. AT, 1975, 1, 28-32.

Reference

Carpenter, T.P.; Corbitt, M.K.; Kepner, H.S.; Lindquist, M.M.
and Reys, R.. Results of the second NAEP mathematics assessment:
Secondary school. MT, 1980, 5, 329-338.

National Council of Teachers of Mathematics. Priorities in School
Mathematics. Reston Virginia: The Council, 1981.