

THE DEVELOPMENT OF

Multiplicative Reasoning

IN THE LEARNING OF MATHEMATICS

edited by Guershon Harel & Jere Confrey

Development Of Multiplicative Reasoning In The Learning Of Mathematics

Judith T. Sowder, Bonnie P. Schappelle



Development Of Multiplicative Reasoning In The Learning Of Mathematics:

The Development of Multiplicative Reasoning in the Learning of Mathematics Guershon Harel, Jere Confrey, 1994-06-28

Two of the most important concepts children develop progressively throughout their mathematics education years are additivity and multiplicativity. Additivity is associated with situations that involve adding, joining, affixing, subtracting, separating, and removing. Multiplicativity is associated with situations that involve duplicating, shrinking, stressing, sharing, equally multiplying, dividing, and exponentiating. This book presents multiplicativity in terms of a multiplicative conceptual field (MCF) not as individual concepts. It is presented in terms of interrelations and dependencies within, between, and among multiplicative concepts. The authors share the view that research on the mathematical, cognitive, and instructional aspects of multiplicative concepts must be situated in an MCF framework.

The Development of Multiplicative Reasoning in the Learning of Mathematics Guershon Harel, Jere Confrey, 1994-06-28. Two of the most important concepts children develop progressively throughout their mathematics education years are additivity and multiplicativity. Additivity is associated with situations that involve adding, joining, affixing, subtracting, separating, and removing. Multiplicativity is associated with situations that involve duplicating, shrinking, stressing, sharing, equally multiplying, dividing, and exponentiating. This book presents multiplicativity in terms of a multiplicative conceptual field (MCF) not as individual concepts. It is presented in terms of interrelations and dependencies within, between, and among multiplicative concepts. The authors share the view that research on the mathematical, cognitive, and instructional aspects of multiplicative concepts must be situated in an MCF framework.

Indicators of Multiplicative Reasoning Among Fourth Grade Students James A. Carrier, 2010. Many students encounter difficulty in their transition to advanced mathematical thinking. Such difficulty may be explained by a lack of understanding of many concepts taught in early school years, especially multiplicative reasoning. Advanced mathematical thinking depends on the development of multiplicative reasoning. The purpose of this study was to identify indicators of multiplicative reasoning among fourth grade students. Inhelder and Piaget (1958) suggested that children, circa age eleven, are transitioning from the Concrete Operational Stage to the Formal Operations Stage and that it is not likely for children to demonstrate multiplicative reasoning without the structures of development supporting logical and abstract thinking. By employing a cross case analysis, this study explores the thinking of fourteen math students from a low socioeconomic school. Through cross case analysis, the researcher probed for patterns of multiplicative reasoning as students progressed through a test instrument which invoked varying levels of multiplicative reasoning. Section one did not distinguish between multiplicative algorithms and multiplicative reasoning. Section two discriminated with respect to multiplicative scheme extension. Section three discriminated with respect to unequal group identification and manipulation. Section 4 discriminated with respect to proportional reasoning but not with respect to multiplicative reasoning. The fourth grade subjects fell into three categories: pre-multiplicative, emergent, and multipliers. Those subjects who utilized multiplicative reasoning on less

than four questions were considered pre multiplicative whereas those subjects who utilized multiplicative reasoning on six or more questions were considered multipliers The remaining seven were those subjects who changed their approach from test item to test item sometimes demonstrating multiplicative reasoning strategies and at other times demonstrating additive reasoning strategies These subjects were considered emergent in the development of multiplicative reasoning This study developed twelve new sub levels that describe in more detail the multiplicative thinking of these fourth graders These new sub levels are Level 1 Non quantifier Level 1 Spontaneous Guesser Level 2 Keyword Finder Level 2 Counter Level 2 Adder Level 2 Quantifier Level 2 Measurer Level 3 Repeated Adder Level 3 Coordinator Level 4 Multiplier Level 4 Splitter and Level 5 Predictor This paper suggests that when teachers understand a child s method of deriving multiplying schemes and multiplicative reasoning strategies they are in a better position to provide the appropriate learning environment for the child Such interaction allows the listening teacher to build on the child s current level of mathematical understanding Students should be encouraged to discover for themselves the needed theorems definitions and mechanics of the number system and to personally develop any short cutting algorithms rather than simply being handed the algorithms by the instructor with little or no understanding

Abstract from author supplied metadata *Providing a Foundation for Teaching Mathematics in the Middle Grades* Judith T. Sowder, Bonnie P. Schappelle, 1995-01-01 This book provides middle school teachers with a firm pedagogical foundation based on the manner in which students learn the mathematics being taught

Handbook of Mathematical Cognition Jamie I. D. Campbell, 2005 First Published in 2005 Routledge is an imprint of Taylor Francis an informa company

Educational Psychology: Concepts, Research and Challenges Christine M. Rubie-Davies, 2010-11-29 Educational Psychology Concepts Research and Challenges brings together the latest research across many areas of educational psychology introducing and reporting on the most effective methodologies for studying teachers and learners and providing overviews of current debates within the field

Handbook of Child Psychology and Developmental Science, Cognitive Processes, 2015-03-31 The essential reference for human development theory updated and reconceptualized The Handbook of Child Psychology and Developmental Science a four volume reference is the field defining work to which all others are compared First published in 1946 and now in its Seventh Edition the Handbook has long been considered the definitive guide to the field of developmental science Volume 2 Cognitive Processes describes cognitive development as a relational phenomenon that can be studied only as part of a larger whole of the person and context relational system that sustains it In this volume specific domains of cognitive development are contextualized with respect to biological processes and sociocultural contexts Furthermore key themes and issues e g the importance of symbolic systems and social understanding are threaded across multiple chapters although every each chapter is focused on a different domain within cognitive development Thus both within and across chapters the complexity and interconnectivity of cognitive development are well illuminated Learn about the inextricable intertwining of perceptual development motor

development emotional development and brain development Understand the complexity of cognitive development without misleading simplification reducing cognitive development to its biological substrates or viewing it as a passive socialization process Discover how each portion of the developmental process contributes to subsequent cognitive development Examine the multiple processes such as categorizing reasoning thinking decision making and judgment that comprise cognition The scholarship within this volume and as well across the four volumes of this edition illustrate that developmental science is in the midst of a very exciting period There is a paradigm shift that involves increasingly greater understanding of how to describe explain and optimize the course of human life for diverse individuals living within diverse contexts This Handbook is the definitive reference for educators policy makers researchers students and practitioners in human development psychology sociology anthropology and neuroscience

Children's Fractional Knowledge Leslie P. Steffe, John Olive, 2009-12-02 Children's Fractional Knowledge elegantly tracks the construction of knowledge both by children learning new methods of reasoning and by the researchers studying their methods The book challenges the widely held belief that children's whole number knowledge is a distraction from their learning of fractions by positing that their fractional learning involves reorganizing not simply using or building upon their whole number knowledge This hypothesis is explained in detail using examples of actual grade schoolers approaching problems in fractions including the schemes they construct to relate parts to a whole to produce a fraction as a multiple of a unit part to transform a fraction into a commensurate fraction or to combine two fractions multiplicatively or additively These case studies provide a singular journey into children's mathematics experience which often varies greatly from that of adults Moreover the authors descriptive terms reflect children's quantitative operations as opposed to adult mathematical phrases rooted in concepts that do not reflect and which in the classroom may even suppress youngsters learning experiences Highlights of the coverage Toward a formulation of a mathematics of living instead of being Operations that produce numerical counting schemes Case studies children's part whole partitive iterative and other fraction schemes Using the generalized number sequence to produce fraction schemes Redefining school mathematics This fresh perspective is of immediate importance to researchers in mathematics education With the up close lens onto mathematical development found in Children's Fractional Knowledge readers can work toward creating more effective methods for improving young learners quantitative reasoning skills

Journal for Research in Mathematics Education, 2015 *Teaching Learners who Struggle with Mathematics* Helene J. Sherman, Lloyd I. Richardson, George J. Yard, 2009 This book was written to give teachers the tools they need to help students go from believing they can't do math to achieving real success and gaining confidence in their math skills This can be accomplished if parents and teachers instead of trying the same thing over and over again focus on how their students learn best To do this the authors present a systematic three step approach on how to assess student's strengths and weaknesses and then plan instruction accordingly The three step plan involves 1 Creating a Data Analysis Sheet DAS 2 Considering the learners

strengths and areas of concern 3 Completing a Mathematics Improvement Plan MIP Each chapter deals with a different mathematical topic place value problem solving fractions addition subtraction division decimals time and money etc A number of errors by a variety of students are described using a case study of a typical struggling student The text then explains how teachers can systematically assess the student s work and appropriately diagnose their problems By analyzing and understanding why and how their students make errors teachers can design appropriate ways to correct their mistakes and then promote long term learning through repetition and practice that is meaningful to them This book addresses mathematics education in a manner that encourages positive content growth and attitude for both teachers and students

Middle School Mathematics Students' Motivations for Participating in Whole-class Discussions Amanda Jansen Hoffmann,2004 JCT. ,1991* **Coherent, Dynamic Accounts of Prospective Secondary Mathematics Teachers' Knowledge of and Beliefs about Mathematics** Daniel Kevin Siebert,2000 This thesis presents accounts of the mathematical knowledge and beliefs of eight prospective secondary mathematics teachers PSTs as they progressed through a six week unit on division of fractions that was designed to bring about change in their knowledge of and beliefs about mathematics These accounts capture the sense that the PSTs made of their experiences during the unit and investigate how their knowledge and beliefs interacted to both facilitate and prevent change One of the pressing problems currently facing mathematics education reform efforts is that PSTs frequently leave college with critical gaps in their understanding of secondary school mathematics topics and with traditional beliefs about mathematics teaching and learning Efforts to better prepare PSTs have only been partially successful in part because teacher educators do not have a clear understanding of PSTs knowledge of and beliefs about mathematics and how PSTs perceive of their experiences in classes designed to influence their knowledge and beliefs This study used qualitative methods including grounded theory teaching experiment methodology and case studies to investigate PSTs knowledge of and beliefs about mathematics as they participated in the division of fractions unit The PSTs initial knowledge of division of fractions consisted mostly of procedural expertise with only limited conceptual understanding They tended to perceive of secondary school mathematics as an interrelated consistent set of rules procedures facts and definitions This interrelated rules perspective toward mathematics persisted for a short period after the PSTs began the unit However through a series of mathematical explorations the PSTs were able to develop new understandings for division of fractions This new conceptual knowledge led PSTs to rethink how they would teach division of fractions and to reconsider how they perceived mathematics They began to view mathematics as a collection of rules and procedures that were supported by underlying concepts Nevertheless they continued to see rules and procedures as the major landmarks in the mathematical landscape which in turn limited the mathematical understandings they were able to develop during the unit **A Study Examining the Impact of Computer-based Examples and Their Availability on Learning** Robert K. Atkinson,1999 **The Effect of Metacognitive Strategy Scaffolding on Student Achievement in**

Solving Complex Math World Problems Joan J. Marge, 2001 Students' Understanding of the Comparison of Linear, Quadratic and Exponential Functions Aaron Neal Simon, 1997 **Teaching Children Mathematics**, 2006

Commitment to Excellence Linda Anne Catelli, Ann C. Diver-Stamnes, 2002 This volume represents a working commitment by individuals and institutions to improve the education of inner city youngsters and to transform radically the preparation of people who will teach in the inner city The authors propose actions that are designed to direct teaching in the inner city

For the Learning of Mathematics, 2007 *Teaching Today's Mathematics in the Middle Grades* Art Johnson, Kit Norris, 2006 *Teaching Today's Mathematics in the Middle Grades* provides current and future middle school teachers with the mathematics content essential concepts methodology activities and resources to both learn and teach mathematics in grades 5 to 8 The authors focus exclusively on the middle school learner and the middle school mathematics curriculum Although each chapter discusses foundational mathematics concepts from earlier grades and previews topics that will follow the middle grades the emphasis is on the middle school This selective focus allows for proper development of critical topics in the middle school such as proportionality algebraic thinking and the integral role of manipulatives Assessment practices and problem solving are also emphasized from the viewpoint of effective practices for middle school students Unique Features React and Reflect features prompt classroom discussions by asking the reader to think independently regarding a statement issue or concern Try This features ask the reader to solve a problem first or extend the current discussion by working on an extension of a problem By completing the problem first teachers are putting themselves in the place of their students helping the teacher discover first hand common misconceptions Numerous exercises and activities appear at the end of each chapter to reinforce student understanding of various topics and ensure mastery of the mathematics content The NCTM Principles and Standards are emphasized throughout the book beginning with a discussion in Chapter 1 Each of the content chapters 6 11 opens with the relevant NCTM content standards for that chapter In addition marginal icons highlight areas within the text in which the NCTM process standards are discussed Reviewers rave From the content organization and approach it is evident that the authors have years of teaching experience This gives the text authority Marina Krause California State University Long Beach The authors do an excellent job of presenting in sequential order essential concepts methodology activities and technological resources essential to assist the beginning math teacher in preparing to teach in the middle school program Gerald Jarmon North Carolina Central University

Embracing the Tune of Expression: An Emotional Symphony within **Development Of Multiplicative Reasoning In The Learning Of Mathematics**

In a global eaten by monitors and the ceaseless chatter of immediate communication, the melodic elegance and psychological symphony developed by the published word frequently disappear into the background, eclipsed by the constant sound and interruptions that permeate our lives. Nevertheless, situated within the pages of **Development Of Multiplicative Reasoning In The Learning Of Mathematics** an enchanting fictional treasure brimming with fresh thoughts, lies an immersive symphony waiting to be embraced. Crafted by a wonderful composer of language, that fascinating masterpiece conducts viewers on a mental trip, well unraveling the hidden melodies and profound impact resonating within each carefully constructed phrase. Within the depths with this poignant review, we can examine the book is main harmonies, analyze their enthralling writing model, and submit ourselves to the profound resonance that echoes in the depths of readers souls.

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