

A Study on Functionality of Collaborative Learning in Teaching Primary Mathematics

Seyed Ahmad Hashemi^{1*} and Hengameh Karimi²

1. Department of Education, Lamerd Branch, Islamic Azad University, Lamerd, Iran
2. MA student in Instructional Research, Lamerd Branch, Islamic Azad University, Lamerd, Iran

*Corresponding Author: S.A. Hashemi

Abstract

Collaborative learning is a pedagogical method widely discussed over the last three decades, since numerous studies have shown that students are more likely to succeed whenever there are more opportunities to socially and educationally interact with each other so as to achieve common goals. The set of skills highly emphasized in teaching mathematics include problem solving, reasoning and discovery, constructing hypotheses and theories, using technology and tools, estimations and numerical approximations, measuring, using diagrams and geometric evidence, numerical calculations and mental operations, pattern-finding, modeling and counting. There is a visible relationship between indicators, goals and skills involved in teaching primary mathematics. The relationship between basic math skills and collaborative learning demonstrates that mathematics scholars need to further consider the criteria of collaborative learning prior to setting goals and indicators for primary school mathematics. For that purpose, effort should be made to maintain the connection between collaborative (interactive) teaching methods and mathematics courses in line with achievement of an excellent education system for primary school mathematics.

Keywords: Learning, collaborative learning, math education, social skills, traditional methods of learning

INTRODUCTION

Every society has long been aspiring to instruct individuals toward progress and perfection, and ultimately bringing up sophisticated citizens. Needless to say, any progress made in various areas such as culture, economy, politics and society requires critically thinking and creative individuals capable of making proper decisions and devising sound plans. Developments in the education system depend on a wide variety of factors including modified teaching models and practices.

Vital need is felt today for modern methods of teaching regarding the ever-growing advancement of science and technology. Therefore, new teaching methods should be pursued so as to enable student shift from futile memorization of lessons toward actual acquisition. Employment of active teaching methods can be of great help to both students and teachers. An Active teaching method

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generally stimulates mental activity in pupils, thus providing a diversity of facilities for learning through encouragement and instigation, which in turn conveys the entire pedagogical implications appropriate for what children are interested in most. After all, there is no change taking place in the learner's behavior unless it originates from an inner tendency and natural enthusiasm (Safarian, 2010).

The industrial society nowadays needs to employ skills to solve problems, interpret and organize data, make measurements, predictions and apply mathematics in dealing with everyday issues. The essential changes in society, the explosion of quantitative information and accessibility to computers and calculating machines together redefine the priorities regarding basic math skills (Hosseini, 2012).

Experts believe that educating students going through active learning not only acquire more efficiently but also enjoy the procedure, because they are no longer mere listeners but active participators throughout the course of acquisition, totally responsible for their own learning (Gardener & Jules, 2000).

Collaborative learning is a pedagogical method widely discussed over the last three decades, since numerous studies have shown that students are more likely to succeed whenever there are more opportunities to socially and educationally interact with each other so as to achieve common goals (Keramati et al., 2011).

Active learning takes place through experience, trial and error and direct involvement in exploration, examination and problem solving, which in turn leads to knowledge discovery and generation. The teacher is expected to link mathematic interconnections (i.e. relationship between different mathematical concepts) and external connection (i.e. relationship between math with other sciences and their applications), thus enlightening the significance of learning reasoning and thinking methods for each learner (Ghasemzadeh Dibegi, 2007). By means of interaction, student learn how to discuss subjects together, share their ideas, better recognize differences and construct a new concept (Keramati et al., 2011).

This paper seeks to examine through an analytical-descriptive approach the functionality of collaborative learning in primary school math courses, paving the way for mathematics education by proposing certain techniques. Moreover, it attempts to further connect this field with collaborative learning through exploring several practical indicators of math literacy growth among primary school pupils.

Learning

Regarding the fact that education serves to facilitate the process of acquisition, it can be defined as a kind of information processing and gaining new knowledge and skills through realization or discovery, which eventually affect how learners will behave. The impact of learning on behavior is usually stable, making changes in individual experiences. Learning is sometimes used exchangeably synonymous with acquisition which is an outcome of cognition. Learning might be individual or social, thereby taking particular characteristics. In any case, learning brings about changes in the individual, whether simple or complex, tacit or implicit, full or partial, theoretical or practical. It consequently puts the individual talents into actual practice giving reality to a variety of capabilities. Accordingly, learning can be regarded as the ability to receive potential energy from information, which might be observed evidently in how an individual perceives, contemplates or behaves. Nevertheless, learning and behavior should be equated, i.e. learning is not merely tantamount to behavioral change (Afzalnia, 2005).

Collaborative learning

Collaborative learning takes place when students work in small groups to help each other learn. Collaborative learning groups vary in terms of size, even though four student groups are typical. In some cases, collaborative learning takes two-member groups. Since students are supposed to

work in collaborative groups, the arrangement usually remains the same for weeks or months, but collaborative groups meet only certain school days or academic years.

During cooperation, there is a collective energy known as synergy, which is applied by social models through formation of learning groups. Technically speaking, synergy highlights the social nature of how collective behavior and enhanced educational achievement are correlated. Nearly all the scholars who have proposed such models believe that education system plays a key role in preparing citizen for showing consistent behavior in order to improve social/individual life and ultimately secure an effective democratic social order. They also believe that assisting behavior can instigate mental and social attitude, bringing out happiness, pleasure and friendliness (Motamedi, Talavaki & Ahmadi, 2007).

Panitz (1997) recognizes cooperative learning as a responsibility taken to search information in order to provide answer to certain questions. As a facilitator, teacher supports national capital, but never guides the group toward predestinated results. For illustrating such procedure, there are certain forms of peer assessment. Collaborative learning is a broader concept covering different workgroups mostly teacher-centered. Generally, collaborative learning is seen as teacher-instructor where the teacher sorts out specific questions through which learners get prepared to solve problems based on designed topics and material. At the end of assignment, the teacher may design several types of tests. The difference between the two methods is that each tends to foster totally different learners. Cooperative learning is rather suitable for adult learners who better command the subject matter. This is to some extent founded on various effective education philosophies (Hashemi & Mehrabi, 2012).

Positive interaction among peer groups and positive attitude toward decision-making can be motivating factors in selection of students to participate in collaborative groups. In another study, high school students were experienced higher improvement and inner motivation for learning algebra concepts when they worked in collaborative groups as compared to solitary learning (Biabangard, 2011).

In any collaborative work as fundamental structure of education, there are several drawbacks. Firstly, collaborative learning requires longer time for covering a certain subject as compared to direct teaching methods. The advantage, however, is that learning registers at much deeper levels. Timid learners or those who need to perform at difference pace would feel there is not much benefit, while some learners simply prefer to work individually, which is weak point in that different learners supposedly carry out different assignment. There is one more question to be tackled: Is it true that small-group collaborative discussions can be an ideal method for intellectual growth at upper levels? One study has revealed that instructor-teacher discussions are effective for achievement of higher-level reasoning and qualitative explanation, whereas peer group discussions are explorative and generative (Hogan, 1999).

There are numerous ways to build cooperation and co-dependence for the entire class. The class goals can be written down. Classroom participation can be realized through offering didactic rewards such as extra marks or when students have collectively attained a goal or through non-didactic rewards such as extra time, gift clothes, and classroom celebrations. Classroom participation can also be boosted through appointment of groups to daily cleaning, managing class business or bank, or even involvement in other sort of activities useful for the class. Classroom co-dependence among pupils can be strengthened through resource allocation such as publishing a news bulletin for each group participating in preparation of an essay (Biabangard, 2011).

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Teaching mathematics

There are several emphasized skills in teaching mathematics:

1. Problem solving
2. Reasoning, exploration
3. Constructing hypotheses and theories
4. Utilizing technological tools
5. Measurement
6. Using diagrams and geometric evidence
7. Numerical calculations and mental operations
8. Finding models and patterns
9. Counting

Furthermore, learning, teaching, syllabus planning and assessment are among the key areas in mathematics teaching (Ghasemzadeh Dibeigi, 2007).

The goals pursued by primary math textbooks in Iran are as follows:

Table 1.Goals and indicators for first grade mathematics

No.	Indicators	Goals
1	Positioning	Understanding and recognizing directions and position of objects and shapes
2	Concept of numbers and their symbols	Understanding numbers 0 to 10 and their symbols
3	Counting	Understanding the sequence of numbers and counting in chunks
4	Two-digit numbers	Using decimal tables and counting numbers from 1 to 100
5	Comparison of numbers	Identification and representation of equal and unequal sets
6	Addition and subtraction	Understanding concepts of addition and subtraction as well as doing the operations
7	Problem-solving strategies	Problem-solving through guessing and testing strategies, sub-problem and systematic thinking
8	Magical square	Completing magical squares (Sudoku)
9	Problem solving	Single-objective problem solving
10	Using tools	Using non-grader ruler and stencil
11	Geometry	Recognition of geometric shapes, geometric components, and the relationship between shapes in geometric patterns
12	symmetry	Understanding the concept of symmetry
13	Measurement	Understanding the concept of measurement such as time, length and mass
14	Statistics and diagrams	Drawing bar quantitative graph and tallying objects

Table 2. Goals and indicators for second grade mathematics

No.	Indicators	Goals
1	Counting	Recounting two and three-digit numbers
2	Understanding two and three-digit numbers	Understanding the concept of number digits and place value
3	Comparison of numbers	Acquiring skills for comparing two and three-digit numbers
4	Approximate numbers	Acquiring skills for approximating two and three-digit numbers
5	Problem-solving strategy	Solving problems through drawing shapes, patterning, model-finding, elimination of undesirable modes, trial and error, sub-problem, simpler problem and symbolization
6	Procedural addition and subtraction	Understanding left to right addition and subtraction
7	Technical addition and subtraction	Understanding right to left addition and subtraction
8	Multiplication	Understanding basic multiplication concepts
9	Symmetry	Understanding bilateral and quadrilateral symmetry
10	Geometric shapes	Understanding geometric shapes and their comparison
11	Measurement	Understanding the concept of measurement such as time, length and mass
12	Statistics and diagrams	Drawing bar quantitative graph and tallying objects
13	Drawing graphs	Understanding types of graphs and how to draw each

14	Understanding fraction	Learning how to work with fraction
15	Understanding the concept of probability	Learning how to work with probability

Table 3. Goals and indicators for third grade mathematics

No.	Indicators	Goals
1	Counting	Learning skills for counting numbers up to 5-digits
2	Four-digit numbers	Understanding four-digit numbers and how to read and write them
3	Approximate numbers	Learning how to display approximate numbers on axis
4	Fraction	Understanding fraction and fractioned numbers
5	Comparison of fractions	Learning skills for comparing fractions
6	Addition	Learning how to add 4-digit numbers
7	subtraction	Learning how to subtract 4-digit numbers
8	Multiplication	Understanding the concept of multiplication, relationship between multiplication and addition as well as learning how to multiply one-digit numbers by each other
9	Division	Understanding the concept of division and its relationship with multiplication
10	Spatial geometry	Understanding special shapes, cubes, cylinder and cones
11	Plane geometry	Understanding concepts such as circle, angle, lines, polygons, symmetric patterns and their components
12	Measurement	Understanding concepts including length, area, mass, time and money value
13	Statistics	Learning skills for organizing and analyzing data, drawing pie graphs and conversion of graphs into one another
14	Probability	Learning how to predict possible states of an event
15	Problem-solving strategy	Solving problems through drawing shapes, patterning, model-finding, elimination of undesirable modes, trial and error, sub-problem, simpler problem and symbolization

Table 4. Goals and indicators for fourth grade mathematics

No.	Indicators	Goals
1	Numbers and place value	Understanding numbers from 7 to 12-digits
2	Comparison of numbers	Learning how to compare numbers up to 12-digits
3	Addition and subtraction	Learning the skills for adding and subtracting numbers up to 12-digits
4	Multiplication	Learning how to multiply multi-digit number by one another
5	Division and divisibility	Understanding the concepts of division and divisibility
6	Common fractions	Deepening the concept of deficit
7	Geometry	Understanding concepts such as lines, angles, polygons, perpendicular and parallel lines and symmetry
8	Measurement	Understanding the concept of capacity and unit of measurement for liquids (Liter)
9	Statistics and data collection	Learning skills for information gathering and interpreting

Table 5. Goals and indicators for fifth grade mathematics

No.	Indicators	Goals
1	Operation on numbers	Understanding and learning how to work with proper fractions, mixed integer, decimal fractions, decimal numbers, complex numbers, divisibility, comparison of common fractions, comparison of mixed numbers, comparison of decimal numbers, addition and subtraction of fractions and mixed numbers, addition and subtraction of decimal numbers, addition and subtraction of complex numbers, approximation, approximated multiplication, mental multiplication, multiplying fractions and multiplying mixed numbers, multiplication of decimals, divisions and fractions into mixed numbers, ratios and proportions, percentage
2	Geometry	Learning the skills for drawing symmetry lines, calculation of areas, constructing geometrical objects, angles, drawing triangles, calculation of volume, circles
3	Measurement	Learning how to make measurements in terms of length, mass, area, volume and capacity

Table 6. Goals and indicators for sixth grade mathematics

No.	Indicators	Goals
1	Numbers	Understanding the concept of larger unit fraction, mixed numbers, decimal numbers, approximated numbers and integers
2	Operation on numbers	Learning how to compare fractions, perform the four basic operations on fraction and mixed numbers, four basic operations on decimal numbers, approximate calculations and operations sequence and approximation methods
3	Measurement	Understanding necessity and concept of length, angle, surface and volume
4	Ratios, proportions and percentage	Understanding the concept of ratio, proportion and percentage
5	Statistics and probability	Learning how to collect and record information and understand the concept of probability
6	Coordinates	Recognition of coordinates place, understanding concepts such as circulation, symmetry and coordinates axis
7	Problem solving	Employing problem-solving strategies

(Hamzehbeigi et al., 2013)

Functions of collaborative learning in teaching primary mathematics

According to the above-mentioned categories, there is a relationship observed between primary math skills and collaborative learning as illustrated in the following table:

Table 7. Relationship observed between primary math skills and collaborative learning

No.	Relationship with collaborative learning	Goals of primary math teaching
1	Problem-solving	Problem-solving is basically a systematic thinking method for solving a problem directly correlated with individual intellect and rarely related to collaborative learning
2	Reasoning, exploration	Reasoning is more of an individual activity, while exploration is strongly correlated with collaborative learning
3	Constructing theories and hypotheses	Constructing theories and hypotheses form to a great extent through interaction with groups, thus correlating significantly with collaborative learning
4	Utilizing technology tools	Depending on the type of technology tool employed, it is somewhat correlated with collaborative learning
5	Estimation and numerical approximation	Estimation and numerical approximation is not significantly correlated with collaborative learning
6	Measurement	Measuring different concepts can be done in small groups. Hence, it is greatly correlated with collaborative learning
7	Using graphs and geometric evidence	Using graphs and geometric evidence has little relationship with collaborative learning
8	Numerical calculations and mental operations	Numerical calculations and mental operations have little relationship with collaborative learning
9	Modeling and pattern recognition	Modeling and pattern recognition is in significant correlation with collaborative learning
10	Counting	Counting has no relationship with collaborative learning

Discussion

According to the facts discussed earlier, there is a relationship between indicators, goals and teaching primary math skills. The correlation between basic math skills and collaborative learning suggest that mathematic scholars need to further maintain the connection between collaborative (interactive) teaching methods and mathematics courses in line with achievement of an excellent education system for primary school mathematics.

Since the goals and indicators of teaching primary mathematics derive from ten basic math skills and collaborative learning serves as a modern productive teaching method, the constructive interaction of the two fields can pave the way for education to attain its most ideal destination. Based on what has been discussed so far, there are a number of suggestions made to improve mathematics education below:

1. Experts in teaching primary mathematics need to set goals based on criteria of collaborative learning
2. Engage collaborative learning in an evident way so as to set primary math goals.
3. Taking into account collaborative learning as directly correlated with math goals in order to ultimately minimize multilateral interpretation by math syllabus authorities, which in turn leads to further progress in mathematics education.
4. Reporting scientifically and accurately the functionality of collaborative learning in the field of math teaching so as feedback the relevant experts.
5. Pinpointing the indicators of collaborative learning in a more scientific way so as to connect collaborative learning to a variety of other fields.

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