Isfahan Mathematics House

Report on Research Activities of Isfahan Mathematics House (IMH)

For Promotion of Mathematics Teachers in Primary Schools

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Introduction:

Experiences, class observations in high school classes and studies of members of the committee on primary instruction of Isfahan Mathematics House (IMH) which were carried out by the help of Isfahan Society for Mathematics Teachers (ISMT) and Isfahan Society for Elementary School Teachers[1] (ISEST) show that many teachers are not familiar with the goals of mathematics instruction in primary school. Also, they do not know the weaknesses and defects of these goals and the ways of practicing them in classes. In addition, many teachers are not familiar with mathematical concepts which they teach. In many primary schools, mathematics is not taught properly and many students are just afraid of mathematics because of incorrect instruction methods. These students can not follow and understand new concepts due to the continuity of mathematical concepts and misunderstandings of some basic concepts, in previous schooling.

On the other hand, students learn mathematics mostly in an abstract way and they have lack of sufficient skills for using their mathematical knowledge in everyday life. These problems cause the escape of mathematical data from their mind and not understanding the mathematics concepts by them. For these reasons students:

- Consider mathematics unreal, impractical and inconceivable.
- Hate mathematics and are afraid of learning it.
- Do not enjoy doing mathematical calculations and learning mathematics.
- Do not understand logical relationships between different mathematical topics and other sciences (even relationship between mathematics and real life) and because of these reasons they consider mathematics out of reach more than it is expected.
- Confront many problems in higher courses because mathematical concepts of primary school are basic and the mathematics is of important in other sciences.

Also, some teachers have problems like:

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- They have problems in teaching mathematics because they are not familiar with goals of mathematics instruction and they are not able to guide their students to reach specific goals.
- They do not have ability of answering and guiding students for understanding mathematics properly, since they do not understand some the concepts they teach and not having complete knowledge of what they teach.
- Because of not knowing the strategies of achieving goals of mathematics instruction in primary schools, they can not achieve these goals, even by knowing those goals, and thus they are not satisfied by their job.
- They escape from mathematics because they have no success in teaching it and they make the students hate mathematics by producing fear (of mathematics) in them.

One of the evidences for proving these claims is the result of TIMSS[2] exams. Educational performance of Iranian students in the year 1994 -1995 of this exam shows that total score of mathematics exams in third and fourth grade has been 28% and Iran gained 24th place among 24 countries in this grade and 25th place among 26 countries in fourth grade.

Activities:

These pieces of information led IMH to carry out the following activities:

1) Holding an exhibition of mathematical instruments and paving the way of establishing a Mathematics Playing Room. It has been planned that students can visit the exhibition with their teachers and play with mathematical instruments in that room. This matter leads to better understanding of mathematics studies among students and their teachers and transform the absolute abstraction into understanding and feeling mathematical concepts.
2) Forming workshops on the goals of mathematics in primary school in which the goals of mathematics are studied by the aid of participating teachers. In each workshop at most 25 teachers take part and they separate in teams in a face-to-face format. This workshop is usually leads by an education expert and a mathematics specialist who work together as a team.

In these workshops, in which teams are selected randomly, at first the participants introduce themselves in any manner they like. Then the groups

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[2] Third International Mathematics and Science Study

labeled and the questions, which explained in appendix 1, are handed to them.

At first participants study the questions individually and provide some answers. Then, they discuss those answers in their group and by the guidance of workshop leaders. Each team agrees on a set of answers. At the end, one member of the team (selected by the workshop conductors) explains the answers, which are usually written on transparency papers, to others and other teams can discuss the answers and complete them. During this discussion, many weaknesses and abilities of teachers are revealed and, the teachers getting more familiar with the goals and they experience the method of establishing these goals practically.

Firstly the questions focus on ascertain of how much the teachers know goals of mathematics instruction (Appendix 1). The aim is that the teachers test themselves on the following subjects:
   a) How much are they familiar with the goals?
   b) What is the meaning and importance of goals in education?
   c) How can known goals be implemented in primary school classes?

Then, the list of goals of the mathematics instruction in primary school, which has been approved by Iran Education Ministry (Appendix 2), is given to participating teachers and they become familiar with these goals. They also talk about necessary goals which are not in the approved plan. The discussion continues in a similar way and at last it is summed up by the teachers themselves and with the guidance of workshop conductors.

Later, in some sessions international goals which have been identified by the National Council of Teacher of Mathematics (NCTM), are presented to teachers[3], and their important points are explained. Then some questions about those goals are propounded. The teachers are asked to express the observed weaknesses of goals of mathematics instruction in primary schools in Iran educational program on the basis of their information and experiences and also international studies. They express their ideas for all members of their workshop after discussing with other members of their team. Some results of these discussions have been mentioned in appendix 3.

In general, at the end of the workshop, participants gain a general view about the goals and the approaches to each of these goals. During discussions, they become familiar with TIMSS results and it helps them to become more familiar with the weaknesses of teaching mathematics in primary schools.

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[3] http://standards.nctm.org/document/chapter4/index.html

The follow up studies show that these workshops have positive effect on teaching methods in primary schools.

In addition, the experience of team working for participants lead to establishment of common sessions during academic year, in which teachers discuss their problems and difficulties of teaching mathematics with each other and they try to promote their methods of teaching in this way. A sample poll of them can be found in appendix 4.

3) During holding goals ' workshops and because of the observations of mathematics teachers in high schools that students have not understood a concept of primary school's mathematics well enough, IMH decided to plan two workshops on the concepts of numbers and geometry.

   These workshops were planned by experts of education specialists and mathematics teachers and other experts in IMH. They were administered in a team format.

   The questions propounded in these workshops are in appendix 6 of the Farsi version of this report. During discussions of these workshops, the roots of many disabilities of students in higher academic grades were detected and by the aid of volunteer teachers who participated in these workshops, concepts and appropriate methods of teaching those topics and notions were studied.

Result of these activities:
   1) *Possessing teaching certificate for teachers who pass workshop courses on goals and mathematics concepts is necessary.*
   2) *The goals are not clear for many teachers and indeed the methods for establishing those goals in teaching have not been defined for them and thus there should be opportunities for teachers to become familiar with goals and the method of implementing them.*
   3) *Many teachers are not familiar with mathematics concepts that they teach and also the methods for teaching them. Therefore, these concepts should be explained and analyzed for them in workshops before and during their career.*
   4) *Modern standards of mathematics instruction in Iran primary schools need to be compiled. These standards should be compiled by the aid of other teachers, mathematics teachers and educators. Thus, these standards should not be compiled in closed rooms of educational organizations.*
   5) *For formulating standards, being familiar with international standards of mathematics instructions is necessary. Also, these*

standards should be made native on the basis of possibilities and local potentials.

6) *After formulating these standards and validating them by teachers' organizations, they should be taught to teachers in similar workshops by the aid of scientific and educational associations of teachers. Then, these standards should be administered.*

7) *Using ICT facilities and making mathematical concepts tangible for students are necessary. These two should be considered in future plans of primary education.*

Appendix 1

"IMH's workshop for studying goals of mathematics instruction in primary school"

More acquaintance with goals of mathematics
instruction in primary schools
Goals of the workshop:

Cognitive:
- More acquaintance with goals and concepts of mathematics instruction in primary schools
- Acquaintance with world wide studies on mathematics instruction in primary schools
- Criticism and analysis of goals on mathematics instruction and increase the attention pf participants to them
- Study and analysis of existent mathematics books for finding the conformity of the goals with the content and understanding of the concepts

Behavioral:
- Creating sensibility in teaches for recognizing goals and concepts of mathematics instruction
- Attention to goals of mathematics instruction of other countries
- Making interests in further studies on this topic

Psychomotor:
- Making lesson plans and performing on the basis of instructional goals.
- Teaching mathematical concepts in a right way

Method:
- Through active participation of participants via team working

Activities

Activity No.	Kind of activity	individual work	Team work
1	At the beginning, answer following questions individually on the basis of your experiences and by using the text books: **what are the goals of mathematics instruction?** Then discuss your answer with others and make up the final answers	15 min	45 min
2	In your opinion, **what other goals should be considered in the curriculum**?	5 min	25 min
3	Study and criticize approved goals of mathematics instruction in national curriculum and analyze attention of teachers to each of these goals.	-------	30 min
4	Watch movie about TIMM studies and discuss them.	30 min	
5	Study NCTM instructional standards and make a list of the goals you like to be on top of your teaching on the basis of these standards and approved goals of the national curriculum.	-------	30 min

At the beginning of the workshop, also the teachers were asked to answer this question:

- *Express your feeling about mathematics in any way you like.*
- *If you like, please express the reasons, as well.*

Appendix 2

"General goals approved by the Ministry of Education"

General goals of mathematics instruction in General Education Period[4]

General goal of education in general education is to make an individual ready for all dimensions of life. Therefore, mathematics instruction in this period should achieve the following goals:

a) Educating intellectual discipline and proper thinking instructing the way of using known data for gaining results:

   Through this, the student learns how to use his/her knowledge for gaining new results on the basis of different stage reasoning and its dominant idea for expressing a subject or solving a problem.

b) Enabling to do numeral calculations in everyday life:

   After finishing public education, the student should be able to do calculations which he/she needs in usual life like: four main operations, percentages, notations, etc.

c) Enabling to do mental calculations, guessing and estimating questions which are necessary in everyday life:

   The student gradually gains the ability of mental calculations for satisfying social need. He/she can have an approximately correct estimation of longitude, area, and weight of the objects around him or herself.

d) Instructing required mathematics in relation to other general courses:

   Through this, required mathematics for other courses of general period is instructed.

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[4] Quoted from Teacher Book(instruction manual) of mathematics of first grade of primary school ministry of Education, 2000

e) Enabling to estimate solutions of problems and guessing the answers for the questions:

Student is enabled gradually to guess the solutions of problems before writing them down and thus he/she gets the ability of finding general lines of solutions of real life problems.

f) Enabling to understand mathematics contents of programs, formulate them into mathematics form and solve them:

Because many problems of everyday life, which expressed by phrases and sentences have implicit mathematics pattern, the student can distinguish these patterns generally by achieving this goal. It means that first; he/she recognizes the mathematics content of the problem and then solves it by applying the mathematical pattern.

Question:
Study and criticize the approved goals of national mathematics instruction and analyze each of these goals.

Appendix 3

The goal of mathematics education from some participating teams' perspectives

Team 1

1. Using and applying mathematics in every day life.
2. Writing numbers and place value of numerals.
3. Learning four basic operations.
4. Measuring.
5. Identifying, making, and learning the methods of using mathematics tools in measuring.
6. Identifying the geometrical figures (different types of lines, angles, surfaces), and capacities.
7. Identifying the order of numbers and comparing them.
8. Counting the numbers
9. Mental calculations (in addition and subtraction).
10. Learning estimation and numeral computations.
11. Understanding direction.
12. Showing the numbers in different ways like diagrams.
13. Realizing the basic meanings (concepts) in statistics like average (mean).
14. Realization the concept of set and belonging or not belonging to a set.
15. Learning of making and solving problems.
16. Realization of time, hour and its parts and the ways to calculate the complex numbers.
17. Understanding the currency.
18. Understanding the meaning of axial and central symmetry.
19. Acquaintance with mathematics symbols (addition, subtraction, inequalities and equality).
20. Understanding fraction (comparing and fractional operation), percent, and decimal numbers.
21. Knowing the divisibility by 2, 5, 3, 9, 10
22. Reading and writing in mathematics.

1. Help to enhance logical and mathematical intelligence and creativity in students.
2. Create logical thinking and inventive and logical intellect.
3. Apply mathematical operations in every day life and achieve the required goals.
4. Find the ways for solving problems and achieve organized mentally and intellectually minds in students.
5. Acquaintance with surface (area), perimeter, capacity (in all grades).
6. Acquaintance with measuring elements such as length, area, fluids, mass (3rd to 5th grade).
7. Acquaintance with the number concept, ordering numbers, and acquaintance with numerals and applying them in place value table.
8. Acquaintance with four basic operations in mathematics and their symbols and applying them (all five grades).
9. Acquaintance with common fraction, and comparing fractions, compound numbers and related four basic operations (from 3rd grade up to 5th grade)
10. Acquaintance with geometrical figures like cylinder, cube, square, and parallelogram (all five grades).
11. Acquaintance with the meaning of inequalities, and equalities (1st grade).
12. Acquaintance with percent, ratio and proportion (5th grade).
13. Acquaintance with angle and bisector (5th grade).
14. Acquaintance with different types of line (open, closed, straight,) (1st grade) (straight line; 2nd grade).
15. Acquaintance with time (The hour) (2nd to 5th grade).
16. Acquaintance with money and its calculation.
17. Recognition odd and even numbers.
18. Using games and using mathematics as a hobby to grow creativity (2nd to 5th grade).
19. Acquaintance with axis and applying it in arts by using colors.
20. Acquaintance with axis of numbers and applying them in four basic operations.
21. Acquaintance with calendar, day, month, year, and season (2nd grade).
22. Acquaintance with graphs and the way to plot them.
23. Acquaintance with measuring tools (scale, meter (tape), liter, protractor, and triangle) (2nd grade and on).
24. Using mathematical laws and formulas to achieve required goals in a short time.
25. Acquaintance with the ways of making geometrical figures (5th grade).
26. Acquaintance with the concept of mean and its application (5th grade).

27. Acquaintance with angle, diameter, length, width, height, and radius (2nd grade and on).
28. Acquaintance with decimals (5th grade).
29. Converting the units (from 2nd grade) and using it in buying fabric.
30. Acquaintance with parallel and crossing lines.
31. Acquaintance with mental arithmetic without using calculators.
32. Acquaintance with divisibility of numbers (5th grade).
33. Relating mathematics with other courses like art, physical education, and religion.

Team 3

General Goals
1. Acquaint students with mathematical concepts.
2. Create inclination to mathematics and its concepts.
3. Using mathematical concepts in every day life.

Minor Goals
1. Learning how to write and read numbers (from 1st grade).
2. Learning four basic operations (from 1st grade).
3. Acquaintance with geometry (geometrical figures, the names of their parts, similarities and differences) (from 1st grade).
4. Learning area and perimeter of geometrical figures (from 3rd grade).
5. Learning the meaning of teaching time and using clocks (from 2nd grade).
6. Recognition of many and its usage (from 1st grade).
7. Recognition of weights and different ways of their computation (from 1st grade).
8. Acquaintance with universal measuring units (from 2nd grade).
9. Learning fraction and fractional calculation (from 3rd grade).
10. Learning perfect, ratio, and proportion and solving related problems.
11. Applying number writing and four basic operations in every day life.
12. Applying geometrical theories and figures in real life problems.
13. Applying different parameters and areas in life and our surrounding.
14. Using watch for determining the time in day and night.
15. Using measuring units (weight and meter) in real life problems.
16. Interest in computation and mathematical practices.
17. Establishing confidence and joyful spirit in learners.
18. Applying intelligence in enhancing logical reasoning.
19. Reinforcing thinking, memory, understanding, and creativity in solving problems.
20. Establishing logical thinking and questioning when confronting a new problem.

21. Applying the right models in solving problems at any age.
22. Reinforcing the constructing and creative sense in students.

Team 4

1. Enhancing intellectual power, directed thinking and power of thinking.
2. Applying mathematics in every day life (calculation, scale, proportions, units, and using money and time scales.)
3. Solving difficulties in life.
4. Discovering the rules by the students themselves.
5. Rearing creativity power and invention and establishing curiosity sense for finding and discovering the unknowns.
6. Rearing the ability to communicate.
7. Learning how to use the senses and establishing a relation between them.
8. Establishing interest and eagerness toward mathematics.
9. Learning teaching calculation for use in every day life.
10. Learning ways of solving problems in order to face the real life problems.
11. Applying mathematics in other sciences.
12. Applying measuring tools (meter (tape), special containers, scissors, etc.)

Appendix 4

Opinion Polls

Poll results of one of the workshops on working on goals.

Summarized opinion of participants in second instructional workshop for acquaintance with goals of mathematics instruction in primary school

Row	Cases	Very Good	Good	Medium	Weak	No response
1	Goals of the workshop were clearly determined	28	4	1	_	_
2	Goals and contents of the workshop were congruent.	22	11	_	_	_
3	There was enough time for discussion and exchange of views	9	13	8	2	1
4	Participants were allowed to express their own ideas.	19	12	1	_	1
5	Vocational need of participants and content of the workshop were congruent	20	11	1	_	1
6	The time of the workshop was suitable (July)	20	8	5	_	_
7	There was enough time far doing each activity	12	17	3	1	_
8	Place of the workshop was suitable	12	13	7	1	_
9	Equipments of the workshop were sufficient.	11	15	7	_	_
10	Organizers had enough power in leading the workshop.	31	2	_	_	_
11	**What were the problems of the workshop?** **- In the group, teachers of each grade were not familiar with other books.** **- Time for expressing ideas in the group was not enough.** **- Books of five grades were not enough in the groups.** **- Time was limited and tool of instructional aid were not enough.** **- Presenting resources in the workshop was not enough and there was no film during the workshop.**					

Row	Cases
12	**What were administrative problems of the workshop?** **- Space of the workshop was not suitable** **- Participants did not have any knowledge about topic of the workshop before their attendance.** **- Overhead screen was unsuitable.** **- The Mathematics house was in the far distance of our houses.**
13	**In your opinion, which other workshops about mathematics in primary school should be planned by the Mathematics House?** **- Presenting modern methods of teaching in different grades.** **- Expressing approaches to objectives.** **- Establishing workshops for other subjects and continuity of these workshops.** **- Administering a sample practical teaching.** **- Acquaintance with new and various methods of teaching.** **- Method of lesson-by-lesson teaching for mathematics.** **- Establishing workshops for modern methods of teaching in successful countries.** **- Holding the workshop for all teachers, especially deprived areas.** **- Showing the film of superior (excellent) teaching.** **- Holding workshop for learning the method of applying mathematical tools and instructional aid.** **- Using ideas of the author of text books and inviting them to participate in the workshop.** **- Introducing more books and using computer, music and game in the workshop.** **- Holding book fair and, if it is possible, selling mathematics books** **- Acquainting teachers with mathematics books.** **- Instructing methods for holding a mathematics workshop.**

Row	Cases

14	Do you want to add more comments?
	Please do:
	- Make some sample of mathematics questions during the workshop.
	- Create mathematical activities for outside the classroom.
	- Continue this workshop during the year.
	- Show films of ideal teaching methods.
	- Clarify goals for all teachers.
	- Introduce Mathematics House in schools.
	- Attract students to Mathematics House.
	- Admit the primary school graduates to Mathematics House.
	- Study and follow up weaknesses of mathematics instruction.
	- Form continuous sessions for interested teachers during the year.
	- Show us a sample of cooperative teaching method in real classrooms.
	- Increase time of the workshop, say to 4 days or one week.
	- Introduce ICT to teachers.
	- organize workshops for mathematics in relation to other fields.

Appendix 5

Report on concepts' workshop

Report on workshops on mathematics concepts for primary school teachers[5].

After observing problems and difficulties that students have on concepts of mathematics in intermediate and high schools and by visiting primary schools, the researchers at IMH decided to hold workshops on mathematics concepts which are being taught at primary schools for groups of teachers and study the results. Since teachers of primary schools in Iran are mostly high school graduates from different fields of studying, while they should have enough knowledge of mathematics, empirical sciences, social sciences, literature and other courses, it is common that some teachers have lack of sufficient knowledge on basic concepts of mathematics for teaching in primary school (especially mathematics concepts of primary school). Note that in each class of primary school all courses are being taught by one teacher

These workshops were in the format of some activities which pursued these goals:

Understanding the notion of collection, membership, non-membership, detecting type of collections, acquaintance with the notions of subset, well-defined sets, deduction, one-to-one correspondence, equivalence sets, finite and infinite collections, acquaintance with notions of union and intersection of sets, difference and complement of sets, notions of number and numbering, notions of geometry like point, line, area, types of lines, line segments and angle's bisections, polygons, height and median and bisector and the method of drawing them, the notion of perimeter, area, symmetry, etc.

These workshops were established by the help of the society for primary school teachers in order to achieve the following goals:

1) Enhancing scientific knowledge of primary school teachers.
2) Exercising the process of learning and teaching in cooperative method.
3) Correcting instructional and scientific problems of primary school teachers.

At the end of the workshop, we had an opinion poll from participants. We use this opinion for development of the workshop.

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[5] Quoted from the article "Report on workshop of Instructing mathematics concepts for primary school teachers", Fatemeh Hani Tabaei Zavareh, Presented at 8th Iranian Mathematics Education Conference IMEC-8 (2006)

Some results from discussions during the workshops of concepts' instruction

For answering the question "Give an example of a set" most teachers expressed following collections:

A= set of stationeries

B= set of flowers

C= set of kitchen-wares

Giving these examples, following questions remained unanswered:

- Does a feather belong to the set A? Can we write with a feather?
- Does a piece of wood belong to the set C? Can we blend food with a piece of wood?
- Are these examples appropriate for a set?

The result was in general, a set should be well-defined.

Beside these, most teachers thought that members of a set should be of the same genus or have a common property. In their opinion, examples like {O, Hasan, 4} or {X, E, 4} are not sets.

We think that this misunderstanding is due to the reason that such examples are not in the text-books.

The answer of this question "Does the chair you sit on, belong to the set of the teachers?" was rarely negative.

When they were asked to write the collection of first alphabet used in the words Adel, Earth, Mohammad and Ali, they accepted {A, E, M, A} and did not consider {M, E, A}. But, after long discussion, they reached to the conclusion that {M, E, A} is the correct answer, because the alphabet A is the same in both places. This discussion leads one of the teachers into a wrong conclusion that the set of 8 similar flowers in the text book consist of only one element.
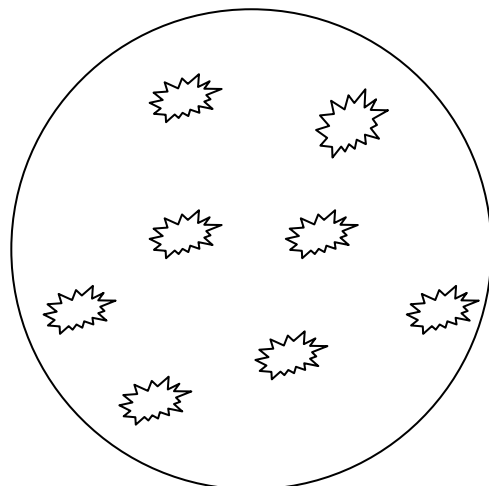
To correct this impression, we started playing with 3 needles of the same size and asked them to count these needles. This game solved this misunderstanding.

Although some teachers knew that the set {1, 2, 3} and {Ali, Hossein, Hasan} are not equal, but they stated the following statement for defining two equal sets: two sets are equal, if they have equal numbers. This mistake is due the fact that, those teachers have misunderstood the meaning of sets with its number.

This misunderstanding definitely will be imposed to the mind of their students. One of the problems is that teachers do not study the manual for their teaching.

Can they learn these concepts by themselves without any instruction? And use them in the class? It is interesting to know that: According to students and their families, a good and active teacher is a teacher who finishes the book on March and repeats it again and again, and they are not interested in teachers who work deeply in teaching the meaning of mathematical concepts to the kids. In these workshops we had to deal with this fact many times.

One of the results that we obtained from these workshops was that we need to establish a preparation for teachers even during their in-service life.

Carrying out workshops of mathematics concepts by Isfahan Mathematics House was a positive experience, whose effect should be observed in primary school classes.

The participants also expressed the followings:
- ✓ *Prior to this workshop, we used to talk about active teaching and team working, but we were not exposed to the method for doing so, but in this workshop we learned how to do it, because we actually practiced the method.*
- ✓ *I will definitely use what I have learned from the workshop in my classes.*
- ✓ *We had some experience of team working, and we tried to apply it in our classes, but what we have learned from this workshop, changed our habit.*
- ✓ *It was interesting for me that organizers of the workshop asked everyone to participate in the discussion and no one could escape from participation.*
- ✓ *I have participated in many in-service programs, but this one was different.*
- ✓ *Although, this workshop held on a holiday, we eagerly participated in the sessions, due to its usefulness.*