

## Isfahan Mathematics House

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The first mathematics house established in Isfahan (Iran) through the cooperation of some Iranian school teachers and university faculties since 1999 (Barbeau *et. al.*, 2009). Currently, there are more than 30 mathematics houses across the country and also more mathematics houses have established in France, Belgium and etc. Recently an international network of Mathematics Houses has been organized at the 13<sup>th</sup> International Congress of Mathematics Education in Germany in 2016 to foster more international collaboration.

Here, we briefly introduce the mission and activities of Mathematics Houses in Iran but mainly we are focused on the Isfahan Mathematics House as a case study.



Fig. 1. Beauty of mathematics!

### A Learning Environment

Mathematics House is an innovative learning center focused on mathematics and informatics education but in a non-curricular way. It is a place for experimental learning through workshops and projects, and subsequent reflection in showcases and mathematics festivals. One prominent example is Isfahan Mathematics House, a center of excellence as a learning environment (Barbeau *et. al.*, 2009, Challenging Mathematics-UNESCO, 2012).

Mathematics house is not in a one-path trail; the environment is designed to foster richer and deeper interactions than the ones commonly seen in schools (Karmzadeh, 2012). It is a learning environment utilizing teamwork and collaboration, where learners

create ideas in the form of collaborative projects and interacting genuinely, since their mathematical works belong to them and are related to real life. Part of the fun is sharing projects, allowing modification and experimentation across projects and teams. Mathematics house is instances of some new and successful form of organization for learning that might emerge out of a new culture. It can be considered as an infrastructure that reduce teaching-learning weaknesses in mathematical sciences, for both teachers and students (Rejali, 2007).

Some of the main goals of mathematics house are: popularizing and developing awareness of mathematical sciences including informatics, expanding mathematical sciences among youth, encouraging team work, supporting interdisciplinary research, studies in history of mathematics, developing skills of problem solving and algorithmic thinking (Rejali, 2009).

These goals are achieved through procuring facilities for non-conventional education, introducing new instructional techniques, encouraging joint and collaborative researches, and welcoming relevant novel ideas.

As an instance, the Isfahan Mathematics House is equipped with some game rooms, mathematics laboratory, a studio for producing audio books for the blinds, a rich library, impressive number of activities such as general expository lectures and workshops, summer camps and annual festivals, teamwork competitions, e-competitions, and developing digital contents.

Information and Communication Technology is an effective tool for developing an attractive environment for mathematical learning. Using this tool, one can develop a platform that many complex concepts can be visualized by diagrams and figures, attractive animations, and most importantly, making games and parametric applications to provide mutual interactions between learners and teaching media, such that they can change the parameters and see the results in figures or in the process of the programs and much easier understand the concepts. Isfahan Mathematics House has organized teams of mathematics educators, mathematicians, scenarists and storytellers, artists, programmers and multimedia experts to collaborate and generate innovative educational contents (Behrooz, 2006).

Also Informatics also is a major domain of activities in the Isfahan Mathematics House which explores in the form of training sessions and workshops, teamwork proj-



Fig.2. Children at Workshop.



Fig. 3. Mathematics Workshop.

ects, contests and festivals and a very special one is informatics to empower visually impaired people. In next section, we will present briefly some of these activities.

## Roads to Innovative Learning

Isfahan Mathematics House is focused more on experimental aspect of mathematics rather than theoretical ones. So, computing features of mathematics including data sciences, statistics, discrete mathematics, algorithmic thinking, practical techniques of mathematical modeling, and exposing mathematical concepts are more brilliant. Isfahan Mathematics House learning environment develop opportunities for training in problem solving and critical thinking beyond formal school curriculum. Enhancement of creativity and innovation bring joy of learning and develop beauty of mathematics for the youth.

Here are some insightful details of Isfahan Mathematics House programs and activities.

1. **Competitions.** There are diverse models of competitions with different goals. Alympiad, Tournament of Towns, Mathematics problem solving day, virtual competition of ideation, statistics competition are relevant competitions (Kindt 2009). In most of these competitions, students should make a model and simulate real life problems. Students should be able to inference and analyze data and provide proper ideas. So they should have dynamic, analytical and creative growth mindset.
2. **Workshops.** Many workshops on introduction to mathematical sciences have been running at the house. These workshops goal is to make students familiar with team work and basic concepts of mathematics such as combinatorics, geometry, number theory, statistics and probability, problem solving, mathematical software and computer applications.
3. **Seminars and Lectures.** There are 6 public expository lectures annually and many special talks for special groups of students, teachers and members of the house, as well as the general audiences. In additions, one of the activities of university students section at Isfahan Mathematics House is that students make independent research on different topics and present the results of their findings in seminars.



Fig. 4. Mathematics Workshop.



Fig. 5. Informatics Workshop.

4. **Publications.** IMH has published several books for enhancing mathematical sciences which can motivate the youth for research and doing scientific activities. Educational CDs also has published such as CABRI along covering geometry in the national curriculum and also the *Mathematics City* CD including audio-visual exposition of mathematical concepts.
5. **Visually Impaired Persons.** At the Isfahan Mathematics House, a group of researchers are developing specific materials for teaching mathematics and computer sciences to the blinds. Isfahan Mathematics House has also supported promotion use of ordinary computer among visually impaired persons through audio systems. Isfahan Mathematics House has an important role in manufacturing hardware and software named GOODFEEL, for conversion musical notes in Braille. Isfahan Mathematics House is also publishing audio books for blind people.



Fig. 6. Mathematics for Blinds.

6. **Project-Based Learning.** Learning by doing is an important strategy at Isfahan Mathematics House which is reflected in project-based learning. High school students, college students as well as teachers working on projects in various fields of mathematics and informatics in teamwork and present the outcomes in seminars and festivals also they may publish results as research papers or books.
7. **Summer Schools.** Summers are great time to bring more attraction to mathematical sciences through summer schools which are organized for high school and college students and teachers too. Various subjects in mathematics and computer science are covered in hands-on and project based fashion. Some supporters such as UNESCO has supported teachers summer schools.
8. **Robotics and Artificial Intelligence.** Robotics is an important activity for high school students at IMH including training and hands-on experiences. Trained groups participating in the national and international robotic contests.

## Modern Secret

Isfahan Mathematics House established in the year 1999 as a non-governmental organization and gradually developed in more than 30 cities around the country. The Union of Mathematics Houses coordinate relation and cooperation between math houses nationwide. There is also collaboration between math houses and many other associations such as Iranian Mathematical Society, Iranian Statistical Society and Mathematics Teachers Associations.

Isfahan Mathematics House has been recognized internationally by UNESCO, ICMI and some other entities. Cooperation with sister institution also has been established and are emerging such as Fontys Research Institute and Freudenthal Institute in the Netherlands, or in France with the Association Animath that coordinates the diversity of existing non-formal educational activities in mathematics and the Instituts de Recherche sur l'Enseignement des Mathématiques.

Isfahan Mathematics House is of great interest of many mathematicians and scientists who has visited IMH. Jan Hogendijk, professor of history of mathematics at the Utrecht University in the Netherland, in an article (Hogendijk, 2008) has mentioned: Isfahan Mathematics House is a modern secret in ancient Isfahan which encourages mathematics awareness among high school teachers and university students who work together with high school projects.

## References

- Barbeau, E.J., Taylor, P.J. (Eds.) (2009). *Challenging Mathematics in and Beyond the Classroom, the 16th ICMI Study*. New ICMI Study Series, p. 53, 56, 75, 88, 89–92.
- Behrouz, E. (2006). Providing mathematics e-contents. In: Hoyles, C., Lagrange, J.-B., Le Hung Son, L.H., Sinclair, N. (Eds.), *Proceedings of the Seventeenth ICMI Study Conference "Technology Revisited"*. Hanoi University of Technology, Vietnam, 37.
- Challenging Mathematics – Mathematics Houses in Iran (2012), *Annex 10 in Challenges in Basic Mathematics Education, UNESCO 2012*, 84–87.
- Hogendijk, J. (2008). Ancient and modern secrets of Isfahan, *Nieuw Archief voor Wiskund.* 5th series, 9, 12.
- Karamzadeh, O.A.S. (2012). The mathematics of mathematics houses (The Snaky Connection). *The Mathematical Intelligencer.* 34(4), 46–52
- Kindt, M. (2009). Re(j)alistic maths. *Nieuwe Wiskrant*, 41–45.
- Rejali, A. (2007). Report on research activities of Isfahan Mathematics House (IMH) for promotion of mathematics teachers in primary schools. *Joint Report by UNESCO and IMH.*
- Rejali, A. (2009). Some activities for popularizing statistics. In: *Statistics Education Session of the Tenth Islamic Countries Conference on Statistical Sciences (ICCS-X) on Statistics for Development and Good Governance.* Cairo, Egypt, 39–43
- Rejali, A. (2011). Statistics competitions in Iran. In: *The Proceedings, The 6th Congress of the World Federation of National Mathematics Competitions.* Riga, Latvia, 149–154.



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