The "Kidumatica" project - for the promotion of talented students from underprivileged backgrounds.

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"There is nothing more unequal than equal treatment to unequal people" -- Attributed to Thomas Jefferson

Abstract: This article describes 'Kidumatica' – a highly successful project for the promotion of talented students from underprivileged backgrounds. In its 11 year run, Kidumatica has evolved into a way of life for its many students, allowing them opportunities to realize their potential, enter advanced academic studies, and successfully enter a society rich in knowledge and achievement. Kidumatica is based on academic research in the fields of excellence, cognition and mathematics education, and on the social principle of equal opportunity for all and one's right to self-realization and aspiration, regardless of ethnic background and socio-economic status. Beyond these social/educational purposes, Kidumatica is also a research model and laboratory for testing new programs and teaching methods for gifted students. The following are the basic premises of the Kidumatica model, its goals and how they are achieved, including the recruitment of club members and the mathematical content.

Background

The economic, scientific, and technological future of a society depends upon identifying and nurturing a cadre of talented youth. In light of this statement, the Kidumatica Youth Mathematics Forum was established in 1998 by the Center for Science and Technology Education at Ben-Gurion University with the aim of advancing the mathematical education of talented youth in the southern region. This region suffers from the highest rate of unemployment in the country, the highest percentage of new immigrants and the lowest average in academic achievement.

Kidumatica, a play on words in Hebrew meaning "advancing math," provides 400 talented pupils from 70 schools and diverse socio-economic backgrounds with academic empowerment and social and cultural support they may not receive otherwise. The participants of Kidumatica comprise an intriguing mosaic of ethnic backgrounds. They are immigrants from North Africa, Asia, Ethiopia, India, Europe, North and South America and the republics of the former Soviet Union, Bedouin Arabs and native born Israelis. Kidumatica helps pupils to become aware of the existence of cultural and social diversity as expressed through clothing, language, mentality, and family background.

All Kidumatica's activities take place in a University campus, where the pupils have access to a wide variety of materials, equipment, computers, and libraries.

Because of its innovation and uniqueness, Kidumatica has rapidly gained a reputation for excellence, and is highly regarded in the professional community.

Kidumatica's Working Assumptions

1. Students with mathematical potential require special attention and one cannot assume that they will simply 'manage on their own' (just as the talent of a promising athlete or musician requires nurturing). This project aims to address this need.
2. Surveys show that the relative percentage of gifted students from underprivileged backgrounds whose talents are fostered is extremely low. This project addresses these students in the region.
3. In the case of the particular area described here, it is important for talented students to remain in their 'natural' environment, especially because of their potential contribution to the other students.

4. On the other hand, it is important for gifted students to be among peers, whose company is socially and intellectually stimulating. Kidumatica therefore does *not* cut students off from their school environment, but draws them together from their various places of residence to create and *additional* social framework, specially designed for the talented.
5. Kidumatica does not compete with the school curriculum. The students continue to study as usual with no premature advancement, and receive in Kidumatica only enrichment and expansion of their formal schooling (see course list).
6. Teaching gifted students requires a specialization that combines a high level of content knowledge, an appreciation of the particular characteristics of gifted students, and a great deal of creativity and enthusiasm. The Kidumatica instructors are trained mathematicians, who, in addition to their extensive practical teaching experience, are knowledgeable in research of both mathematical and general giftedness.
7. Learning, in addition to being attractively presented in a problem based learning approach, must also be fun, so Kidumatica also incorporates activity days, scientifically and socially oriented field trips, the writing of a newspaper, etc.
8. Why teach mathematics? Because mathematics is, in today's society, an indicator of ability and success. Moreover, learning mathematics develops an ability for logical and critical thinking that is applicable to other fields, as well as being relatively non-based in culture and therefore equally suitable for students from different cultural backgrounds.

Theoretical Background on Mathematically Gifted and Talented

Scientific literature differentiates between three types of excelling students: "good learners", "talented students", and "extremely talented students" (Greenes, 1981; Ream & Zollman, 1994). Kidumatica's goal is to reach into the varied communities populating southern Israel, to find and unite excellent students of all three types, promoting each according to his or her own abilities. In achieving this goal, the math club not only provides gifted students with advanced mathematics education, but also provides a social framework for students of varied socio-economic and ethnic backgrounds, uniting them around their shared interest in deepening their mathematical knowledge.

Psychologists agree that academic talent is comprised of a combination of high cognitive abilities, creativity and motivation (Renzulli, 1986; Wertheimer, 1999). This combination is the main pedagogical guideline for the Kidumatica programs. Cognitive aspects include encouraging interest in solving complex problems and elegant solutions, and developing abstraction and generalization abilities (Freiman, 2006; Krutetskii, 1976; Wieczerkowski, Cropley & Prado, 2000; Amit & Neria, 2008). The creative aspects include developing flexible thinking and using a wide-range of mathematical strategies in non routine ways (Koichu & Berman, 2005; Sriraman, 2005). The motivational aspects include developing determination in performing hard tasks, developing ambition, strengthening concentration ability and encouraging willingness to face learning challenges (Middletone & Spanias, 1999).

Kidumatica Activities

All participants share a strong commitment and desire to learn more about math. The Kidumatica after-school activities include: a.Workshops held in the form of twenty groups of approximately 20 students each, twice a week in the afternoon in the university campus, for four hours. b. **"**special activity day" held every fifth week, in which the groups are blended and activities include games, competitions, guest lectures, and a Club Newspaper.c.Research projects with individual guidance. d. Field trips, museum visits, national Olympiads and competitions.

Mathematical Content

Pupils are divided into small groups of about fifteen to twenty students each, who

participate during two activity days, taking two courses-workshops per day. The courses are comprised of specially designed teaching materials, tailor-made for the students' needs and conveyed through a pedagogy based on openness and support. This teaching method, though designed to be "friendly," is by no means carried out at the expense of a strict insistence on mathematical rigorousness and accuracy. The mathematical couses ares extracurricular in order to avoid "competition" with school, and include:

Probabilistic and critical Thinking – Deals with analyzing examples taken from our daily life and developing probability intuition and a critical perception.

Logic – Deals with developing logical thinking in and out of pure mathematics.

Inventiveness – Deals with developing original and inventive thinking, developing imagination and providing techniques in a variety of fields.

Algebraic Laboratory – Deals with the development of quantitative thinking and skills for algebraic techniques and intuition.

The Theory of Numbers – A course designed to develop mathematical thinking in general and the resolution of unconventional problems in particular.

Optimization – Provides a base for multi-directional unconventional thinking, incorporating geometrical methods for solving algebraic problems, and includes the history of mathematics.

Quantitative Sense – Develops a numerical sense and exposes the pupils to methods that are not taught in school.

Geometry as a Tool for Developing Spatial Vision – Deals with the development of spatial and combinatory modes of thinking and three-dimensional visualization.

Problem-Solving Strategies – Deals with structured means for solving non-conventional problems and analyzing model complex situations.

Algorithmic Thinking – Examines the regularity in a series of simple games, devising algorithms for a winning strategy and discovering the regularity behind events.

Data Analysis and Decision Making – Designed to develop the ability to collect, analyze and derive conclusions from real-life situations

Research Projects-Young Researchers: Veteran pupils have conducted research projects, individually supervised by instructors. They either choose topics from a list proposed by the teachers, or alternatively, develop their own research topic pending approval from the supervisor.

Special 'Peeking' Days: Every five weeks, Kidumatica holds special 'Peeking Days', which include group competitions, games, mathematical parties, and mathematical journal writing. On these days, pupils are encouraged to leave their original groups and 'peek' at any other group according to their areas of interest. This opportunity provides students with the added social bonus of getting to know other pupils of various ages.

Field Trips: Pupils participate in educational outings to science museums and research institutes. All of these field trips include a guided tour, hands-on experiments, and various social and educational activities.

Scientific 'Guest' Lectures: Lectures, delivered by leading academic and industrial experts, include such topics as: ecology, environmental science, geology, basic economics, aeronautics, robotics and the connection between music and mathematics.

Optimal Promotion of Excellence: Research shows that mathematically gifted children are interested in challenging assignments, as long as they maintain a delicate balance between the challenge and the achievement (Diezmann & Watters, 2002; Stein, Grover, & Henningsen, 1996, Wieczerkowski, Cropley, & Prado, 2000). Choosing mathematical assignments based on the degree of difficulty allows pupils to experience a sense of triumph and overcome frustration. In order to optimize excellence Kidumatica is divided into 20 distinctive groups based on age, mathematical aptitude and motivation.

Profile of Kidumatica Members

As of 2009, Kidumatica's 470 students, reflect the ethnic diversity of the Negev's population: our students originate from 23 different countries (among them Uzbekistan, Ukraine, Azerbaijan, Belarus, Algiers, Morocco, Tunisia, Argentina, Chile, Romania, France, and India) and speak at home a total of about 11 different languages and dialects (Hebrew, Arabic, Russian, English, Farsi, French, Spanish, Hindi, and more). This diversity is evidence of Kidumatica's spirit of equal opportunity. The Kidumatica students include 57 Bedouin students from various Negev tribes. These students receive special tutoring to help them to overcome any language barriers that could prevent them from competing equally with the Hebrew speaking members of the club ((Amit, Fried, & Abu-Naja, 2007; Neria, Amit, Abu-Naja, & Abo-Ras, 2008).

The Admission Process - Equal Opportunity for All

The process of selecting the students is unique and is based on the social and educational ideology of its directors. Research has shown that scholastic achievement does not always overlap academic talent ((Borland, & Wright, 2000; Ford, Baytops, & Harmon, 1997). There are talented pupils who are unable to express their capabilities within formal frameworks It is also known from enrichment programs in other countries that the population composition in such programs does not always mirror that of the general population. One of the reasons for this is that admission tests usually do not take into consideration cultural distinctions among the various pupils.

To provide an equal opportunity for all the candidates, a three stage process and a unique instrument were developed to examine the pupil's ability to cope with mathematical issues regardless of their school's quality. The validity of this unusual classification process has been proven over the years. The drop-out percentage is negligible (less than 5%) and is due partially to logistical difficulties or overlapping extracurricular activities.

Achievements in Competitions and Further Studies

Competitions are a part of the mathematical community's culture. The benefits for the participants include the gratification of winning, academic growth and development, increased motivation, as well as acquired insights on how to cope with frustration and failure. Over the last years Kidumatica pupils won about 50% of the national and some international prizes. These achievements are unheard of in any mathematical forum and especially in an underprivileged area such as the one in which Kidumatica operates.

University Studies: About 20 Kidumatica junior and high school pupils registered as full-time students in the University's department of Mathematics. In order for them to succeed, they needed mentall and academic support given by the Kidumatica teachers.

Closing Remarks

The Kidumatica model, the popular success of which is evidenced by its longevity and the continual rise in its demand throughout its 11 year run, has proven itself successful academically as well. Its members consistently win major math prizes in state competitions and are significantly represented in state teams for international competitions. The importance of this national and international success is compounded by the fact that Kidumatica's participants hail from underprivileged sectors of the society. In addition to the Kidumatica's cognitive contribution on both the personal and the social level as a nursery for the cultivation of talented minds, it serves the added and equally significant function of a social melting pot for region's diverse population. Once a student enters Kidumatica, ethnic and socio-economic differenced disappear, replaced by challenges to be faced and goals to be reached by all of the club members together.

Kidumatica has not only changed the lives of many of its members, but has created an expanded community of lecturers, researchers, school- teachers, pupils and parents, who have pooled their energies and their resources into the promotion of mathematics education in this relatively disadvantaged area. And – in the words of one of the Kidumatica's more seasoned veterans (five years in Kidumatica) – "we started at the bottom, and today we are at the top of the mathematical

pyramid." There is much left to do and to learn, but every long journey begins with a small step. The Kidumatica Youth Forum is a significant step in the right direction.

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