Competitive Mathematical Activities as a Device for Creative Interaction and Micro-Social Mobility

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A **workshop proposal:** In the workshop we shall experience, discuss and reflect on competitive mathematical activities. The following paper comprises three (unequal) parts: an introduction, three examples of activities and a short discussion.

Introduction:

Competitive Mathematical activities are carried out in the Kidumatica Mathematics Club which takes place at Ben-Gurion University in the south of Israel. The club consists of 400 talented students between the ages of 10 and 16, participating twice a week in an after-school special program. The club members come from varied socio-economic layers, ethnic backgrounds, cultures and religions: among them are Jews and Moslems, new immigrants and native born Israelis, some of them are very poor and others come from established families.
A research based program has been developed in the Kidumatica Math Club, aimed towards the development of logical reasoning, combinatorial thinking, quantitative sense and visual abilities, as well as learning problem solving strategies, optimization methods, basics of number theory and highlight the cultural aspects of mathematics. The students are working in small groups with excellent teachers, creating micro-scientific teams. However, boundaries still exist between different groups and social layers. One of the goals of Kidumatica is to erase those boundaries and blend different groups. Competitive mathematical activities have been found to be successful in achieving this goal.

Working assumptions:

In order to motivate students to participate in competitive activities, a number of elements should be taken into account:

1. The activity should include an element of fun and joy.
2. The rules of the activity should be clear and simple so that the emphasis will be on the math and not on the rules.
3. The mathematics involved should contain an element of surprise, challenge and yet it should be accessible to most students.
4. Skillful management of the competition process.
5. A supportive and democratic atmosphere by peers and tutors.

Group, pair and individual competitions

Bellow we shall illustrate examples of competitive mathematical activities of three different types: a) Group competitions (between two groups or more). b) Competitions in pairs. c) Individual competitions.

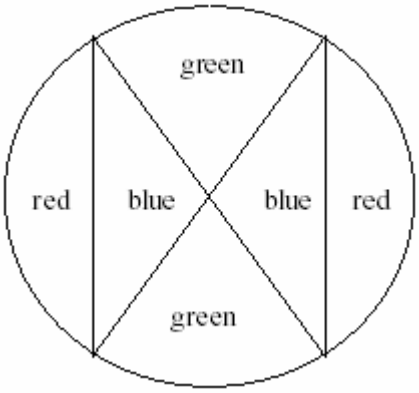
a) Group competitions: Mathematical Hockey:

Two groups, each group contains 6 players: 3 "strikers", 2 "defenders", 1 "gate keeper" and the rest of the group is cheering for the players. The two groups are competing against each other. The Hockey disc is in fact a non-routine mathematical problem. The idea is that the problem will be

solved by the "strikers", they are the first front. If they fail, it is passed over to the "defenders" on the second front and if
they do not succeed in solving the problem, it is passed over to the third front, the "gate keeper". Failing to solve the problem on the third front is a "goal" and the "fine" is one point. Succeeding to solve a problem means the di sc goes to the competing group, which is then confronted with an extra problem .The purpose for each group is to minimize their number of "goals", and maximize the other group's "goals" (the exact rules regarding the relation between the two groups will be given in the workshop).
The winning group is the one with the least number of "goals".
The Mathematical Hockey has not only a cognitive aspect but also a strong social one; the structure of each group, choosing the players and assigning the tasks is determined by all members of the group, in an efficient and democratic way.

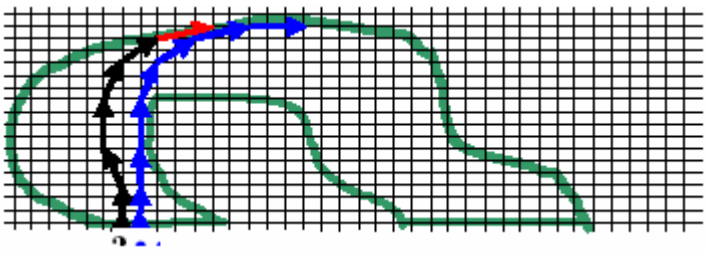
Below are two examples of problems presented in the Mathematical Hockey game:

1. Mrs. Rambo loves pets. All of her animals, except 2 are dogs. All of them except 2 are cats and, all of them except 2 are parrots. All the rest of them are-cockroaches!
   How many animals of each kind does Mrs. Rambo have?
2. A clock has been colored in 3 different colors according to the picture below. Which color takes up the most space? Explain! !



Mathematical hockey includes constent dynamics. A large number of students is in a constant state of allert. In addition, barriers between different groups disintegrate for the sake of a joint purpose.
This game has been proven to be very successful and is also carried out these days outside the math club program

b) A strategic game for two: Car race:
The game is designed for 2 players. Each player must develop a strategy which will help him/her, in his/her turn, to move forward along the squares on the grid, while blocking his/her co-player.
Rules of the game: **1.** Progress is made by moving from one square to the other along the grid. In the beginning the players are allowed to move only to the attached square, in a vertical or horizontal direction. Further on during the game, they can choose to decrease or increase their number of steps. 2. It is forbidden to step out of the boundaries of the grid. 3. A player cannot move to a square which is occupied by his co-player. **4.** The winner is the player who crosses the finishing line using the smallest number of steps.



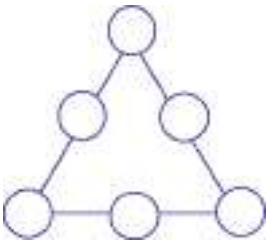
In the session we will experience and then discuss the scope of winning strategies, .

c) **Individual competition: Weight Lifting:**
Rules: The student is presented with a reservoir of approximately 100 non-routine problems, in 10 different levels of difficulty presented as weights; the weight presents the difficulty of the problem, ranging from "very light weight"- 30kg which is in fact the easiest level of difficulty, followed by the "Light weight"- 50kg which is a slightly higher level of difficulty, and so on, up to the "heaviest weight"- 120kg, which is the highest level of difficulty.
The student starts by solving either a "very light weight" problem (the easiest level of difficulty) or a "light weight" problem. A correct solution of the problem grants him the option of moving on to a heavier weight problem, meaning, he is confronted with a problem of a higher level of difficulty.
The student is given two opportunities to solve each problem; failing both times will bring him back to the starting point-regardless of the level he has reached. There is no time limitation and the final score is according to the weight the student has succeeded in lifting. In order to win, the student needs not only to know the math and demonstrate creativity, but he must also know how to evaluate his abilities rationally and act accordingly.

Examples for problems presented in the "weight lifting" game:

1. Place each of the following numbers 31, 32, 33,34,35,36

   (each number only once) in the 6 circles of the triangle, so that each side will add up to 100.



2 Find the smallest natural number which fills the following conditions: If we divide it by 3, the remainder is 3. If we divide it by 5, the remainder is 3. If we divide it by 8, the remainder is 1.

3. Build an anti-magic square, in which each line, column or diagonal, adds up to different results.

<u>In conclusion:</u>
There is great potential in competitive activities as a social medium as well as a creativity promoter, which is not yet materialized.
Competitive activities have social, affective and cognitive extra value in the field of mathematics education. It develops skills of cooperative work as well as aspiration for success and excellence. Building a systematic alignment for using this potential must stand as a top educational goal.

We would like to share our experience and success in this field with our colleagues in the workshops, and discuss further directions in the development, implementation and research on competitive mathematical activities.