

PART IV: Cinematography & Mathematics

AGE RANGE: 13-15

TOOL 34: APPROACHING NON-FORMAL MATH THROUGH THE MOVIE “X+Y”

C.I.P. Citizens In Power



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Educator's Guide

Title: Approaching Non-Formal Math through the movie 'X+Y' (also known as "A Brilliant Young Mind")

Age Range: 13-15 years old

Duration: 1h 30 minutes

Mathematical Concepts: Word problem, sequence, math patterns, approach math through a game, non-formal mathematics.

Artistic Concepts: Cinematography

General Objectives: The students, through a non-stressful environment, will get acquainted with mathematical word problems introduced through a recent movie, starring a young boy of around their age. Thus, the general objective is to make a mathematical problem (given through the TASK section) more interesting and playful, since it will have been introduced through a cinematography play.

Instructions and Methodologies: There are no complicated or varying instructions here nor specific methodologies to be followed, beyond giving the small introduction on the relationship between mathematics and cinematography, reading the plot of the movie; maybe if time permits, discuss on how a young boy with autism who recently lost his father still pursues his dream of participating in a global contest with other math prodigies. Subsequently, children can read the biography of the real person, watch the trailer of the movie, and finally get involved with solving the actual mathematical problem approached within the movie. It's being noted that, for the mathematical task, students are being gradually led to systematize a strategy for solving the problem. The solution is given through the young protagonist of the movie within a 2 minute video clip.

Resources: The tool is based on the biography of the actual child whose story is presented through the movie, the trailer, the plot and the tasks. You will need internet access and a laptop or desktop device, and any type of playing cards for the mathematical task given in the end.

Tips for the educator: The film is quite recent, interesting and easily captures the attention.

Desirable Outcomes and Competences:

- Make learning and mathematical word problems fun,
- Develop conceptual understanding and reasoning skills through Math Word problem solving over memorization and rote learning.

Debriefing and Evaluation Questions: As part of reflection and/or formative assessment (=in order to improve the tool for the next time according to the students' background, interest, exact age, country's culture, students' prior knowledge etc) you can use these cards sometimes called EXIT CARDS either by a hard copy made from before or simply by posing these statements on board and the students write the answers on a paper which they will leave preferably anonymously while exiting the room. The specific formative strategy is called 3,2,1. For more strategies you can visit:

<https://www.bhamcityschools.org/cms/lib/AL01001646/Centricity/Domain/131/70%20Formative%20Assessments.pdf>

3-2-1	
Write 3 things you liked about this activity	<ol style="list-style-type: none"> 1. 2. 3.
Write 2 things you have learned	<ol style="list-style-type: none"> 1. 2.
Write 1 aspect for improvement	<ol style="list-style-type: none"> 1.

Introduction

According to Polster (2012), there are more than 700 movies related to mathematics to a large or smaller extent. Movies are considered as an injection of moments of fun, which can be used into courses in an attempt to make the learning of mathematics enjoyable and interesting for the young audiences. For this task, a movie starring a 9 year old boy with autistic spectrum was chosen, called 'A Brilliant Young Mind', also known as 'X+Y'.

This movie has been chosen as tinder, for mathematical word problems to be solved by the students. According to the literature, story/word problems cause difficulties for a lot of students because of their complexity (Jonassen, 2003; Lucangeli, Tressoldi, & Cendron, 1998; Schurter, 2002 cited by Jitendra et al, 2007). Mathematics tasks that involve story-context problems are much more challenging than no-context problems (Cummins, Kintsch, Reusser, & Weimer, 1988; Mayer, Lewis, & Hegarty, 1992; Nathan, Long, & Alibali, 2002 cited by Jitendra et al, 2007); but story problems are considered to be vital for helping children make connections to different meanings, interpretations, and relationships to several mathematics procedures (Van de Walle, 2004 cited by Jitendra et al, 2007).

The movie

Biography

Butterfield's character Nathan is based on real-life mathematical genius Daniel Lightwing (born 1988), who has Autism Spectrum Disorder. Daniel James Lightwing is now a co-founder of the London-based Internet/Gambling business Castella Research, which uses high-frequency trading inspired methods to place bets on sports exchanges. He was previously a web backend developer for the London offices of Google. In 2006, he represented the United Kingdom at the International Mathematical Olympiad (IMO) in Ljubljana, Slovenia, where he won a silver medal. His experience at the IMO was described in the 2007 BBC Two British television documentary, *Beautiful Young Minds*, and the 2014 British dramatic film, *X+Y* (released in the United States as *A Brilliant Young Mind*).

Retrieved from: https://en.wikipedia.org/wiki/Daniel_Lightwing

Plot of the movie '*A brilliant Young Mind*' aka '*X+Y*'

It is about a young boy called, Nathan Ellis, who is considered a prodigy. He has just lost his father in a car accident. Nathan is diagnosed with autism early in the film. He was only able to connect normally with his father whilst he sees his mother only as his caretaker rather than his parent. In her attempt not to distract him from his studies, his mother enrolls him in advanced classes at a new school. There, he comes under the protection of teacher Martin, also a math genius, who suffers from a serious disease called multiple sclerosis. Martin can see himself in Nathan, as he was once a talented young mind in mathematics, who gave up because of his illness. For seven years, Martin has been preparing Nathan to compete in the International Mathematical Olympiad, a prominent high school competition consisting of the world's best young mathematicians, where he ends up doing well enough to attend with 15 other British teenagers in Taiwan.

During the competition, because he is out of his comfort zone, his social anxieties almost paralyze his performance. Nathan is coming close with a female Chinese

student, Zhang Mei, who gradually helps him adjust to his new surroundings and helps him fight his fears.

When returning to England, Zhang stays with Nathan and his mother, who is pleasantly surprised to find that Nathan's behavior has altered to the better site. Things rapidly unravel when Zhang's uncle catches her in Nathan's room one morning and falsely accuses them of being in an intimate connection. This causes Zhang to depart from the competition. Nathan, who loves Zhang, is torn between her and the Olympiad. When the exam begins and he is surrounded by hundreds of students, a question triggers memories of his dead father, which in combination with his recently lost love, creates an emotional overload. Nathan rushes out of the exam hall with Martin and his mother in haul. His mother, Julie finds him in a café, where they discuss of his emotional overload. They embrace at last, and then Julie drives Nathan to the station to bring back Zhang Mei.

The movie trailer



You can view the Trailer through the link:

<https://www.youtube.com/watch?v=MK7IJR2O638>

Glossary

Autism Spectrum Disorder (ASD): is a lifelong developmental disability defined by diagnostic criteria that include deficits in social communication and social interaction and restricted, repetitive patterns behavior, interests or activities. Initial signs and symptoms typically are apparent in the early developmental stage; however, social deficits and behavioral patterns might not be recognized as symptoms of ASD until a child is unable to meet social, educational, occupational or other important life stage demands. Functional limitations vary among persons with ASD and might develop over time.

Retrieved from: American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 5th ed. Arlington, VA: American Psychiatric

Baio, J. (2014). Prevalence of autism spectrum disorder among children aged 8 years-autism and developmental disabilities monitoring network, 11 sites, United States, 2010.

IMO: The International Mathematical Olympiad (IMO) is the World Championship Mathematics Competition for High School students and is held annually in a different country. The first IMO was held in 1959 in Romania, with 7 countries participating. It has gradually expanded to over 100 countries from 5 continents. The IMO Board ensures that the competition takes place each year and that each host country observes the regulations and traditions of the IMO.

Retrieved from: <https://www.imo-official.org/>

Multiple Sclerosis: Multiple sclerosis (MS) is an unpredictable, often disabling disease of the central nervous system that disrupts the flow of information within the brain, and between the brain and body.

Retrieved from: <https://www.nationalmssociety.org/What-is-MS>

The Math behind the Movie

Glossary

Word problem: In science education, a word problem is a mathematical exercise where significant background information on the problem is presented as text rather than in mathematical notation. As word problems often involve a narrative of some sort, they are occasionally also referred to as story problems and may vary in the amount of language used.

Retrieved from: [https://en.wikipedia.org/wiki/Word_problem_\(mathematics_education\)](https://en.wikipedia.org/wiki/Word_problem_(mathematics_education))



TASK

Math task, as approached in the movie:

Twenty random cards are placed in a row; Some of them are face up and some others are faced down (random case). A move consists of:

- Turning a faced down card face up and
- turning over immediately the card which is on the right.

Show that this process must ALWAYS terminate (with all the cards facing up).

Note: (1) The word “ALWAYS” indicates that regardless of which card your starting point is, the process should terminate with all the cards facing up.

(2) CAUTION: If only one card is finally left facing down to be faced up the move will not be considered as complete as there is no additional on its right to be immediately turned and complete the move.

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TIP: Let's try to depict the problem by using real cards

- (i) Work in small groups of 2-3 students. Try to give the problem a try with a smaller number of cards (e.g. with 8 cards). Initially, let's suppose that we have 8 cards in a row all face down.
- (ii) What happens if you try to increase the number of cards. Can you give it a try with 12 cards phasing down?
- (iii) What happens if you try to increase more the number of cards. Can you give it a try with 20 cards phasing down?
- (iv) Have you identified a repetitive pattern which has led you towards the proof in all the previous steps? Any generalisations or conclusions detected? Would the solution apply if you had an odd number of cards?
- (v) Give 0 to face up cards and 1 to those which are faced down. Which is the numbering (sequence) of the initial row?

- (vi) Taking into consideration that you should always start a move from a faced down card (1), take a random pair of adjacent cards. Which are the possible initial numbers (sequence) that those cards could have? How those initial numbers (sequences) could change after a move?
- (vii) Using the result of (vi) could you come up with a generalised conclusion?
- (viii) Watch this part of the movie to check whether you have come up with a solution.



LEARN MORE...

If you want to further investigate on the topics addressed in this tool, you may go through the following links:

For Mathematical Problem Solving:

Jitendra, A. K., Griffin, C. C., Deatline-Buchman, A., & Sczesniak, E. (2007).
Mathematical word problem solving in third-grade classrooms. *The Journal of Educational Research*, 100(5), 283-302. doi:10.3200/JOER.100.5.283-302

For the Autistic Spectrum Disorder Information can be obtained from:

American Psychiatric Association. Diagnostic and statistical manual of mental disorders. 5th ed. Arlington, VA: American Psychiatric.

Baio, J. (2014). Prevalence of autism spectrum disorder among children aged 8 years-
autism and developmental disabilities monitoring network, 11 sites, United States, 2010.

For more information on Multiple Sclerosis

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