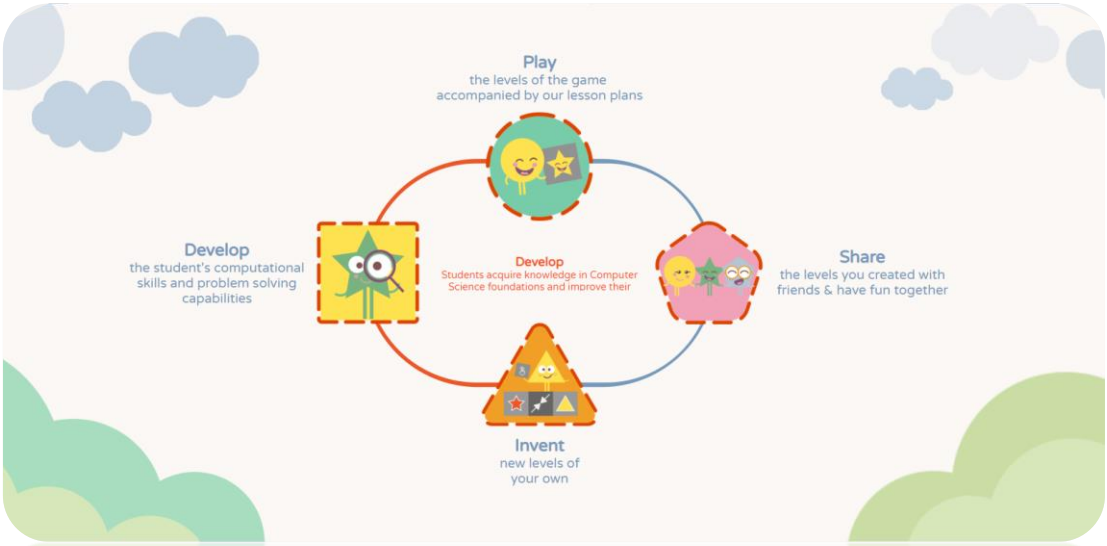
Plethora

Lesson Plan for Teachers



A Game-Like platform that develops Problem Solving and Computational Thinking skills

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Introduction

Plethora is a puzzle-based computer game, which utilizes shapes and rules in order to encourage discovery, understanding and application of “Computational Thinking” skills such as solving problems by dividing them into sub-problems, making use of logical thinking, algorithmic thinking and more. While playing the game, students will assemble and complete logical sentences which constitute “rules” in order to solve given tasks.

The game was created in cooperation between researchers from the Weizmann Institute of Science and CET (Center for Educational Technology), based on the scenario-based execution engine Play.Go. We believe that studying a complex subject effectively is achieved by gradually stimulating the learners’ natural curiosity. Accordingly, the game is composed of levels which increase in difficulty. In each level players are presented with a puzzle which includes an initial state, a goal and a group of logical rules that must be completed in order to achieve the goal. The game is suitable for children ages 8 or above.

By using the Plethora game, we believe students could be instilled with an understanding, based on trial and error, of basic concepts in Computer Science as well as the behavior of complex systems.

The attached Lesson Plans are meant to assist teachers with the teaching process, which includes use of the game in order to create a meaningful and enjoyable learning experience. The Lesson Plans are no more than a suggestion and a conceptual frame for the teacher. They can, of course, be altered to be made to fit the specific time frame and class in which the teaching will take place.

Preparation for lessons

Computers and Infrastructure

Requirements:

- Portable or desktop computers with mice (There is no support for tablets or smartphones at this stage)
- Chrome Browser version 54.0.2840.71 and above
- Connection to the Internet
- Connection to a projector from the teacher's computer

Preparation for the Lesson

It is recommended to review relevant levels of the game before each lesson and identify possible issues that could arise with some of the students.

Lesson 1 - Introduction and Familiarity with the game
(2 Hours)

Concepts

1. Event
2. Cause-and-effect
3. Rule
4. Stop Condition Rule

Goals

The students will:

1. Be familiar with and understand the concepts relevant to this lesson
2. Be able to identify Rules, Events and Results in a game from day to day life, without the use of a computer, as well as in the Plethora game.
3. Be familiar with the Plethora game (Screens, Cards, User Interface).
4. Advance independently in the levels of the “Cause and Effect” subject in Plethora and Know how to complete Rules in the game.

Lesson Structure

Activity	**Duration**
Part 1 – Game without computer	15 min
Part 2 – Discussion of concepts following the game	10 min
Part 3 – Introduction to Plethora	10 min
Part 4 – Independent activity with Plethora	35 min
Part 5 – Class discussion and summary	20 min
	Total: 90 min

Part 1 – Game Without Computer

Game objective: Illustrate the concepts that will be learned in the lesson

15 min

(*If the classroom is crowded other alternatives can be thought of)

- We shall request 8 volunteers: 4 will stand scattered around the classroom and 4 will stand in a line next to the teacher.
- We will explain that the 4 volunteers who are scattered around the classroom will walk slowly in a straight line at some direction and the other 4 will join the game later.
- The goal of the game is to get to a state where all 8 students are in the game.
- Using the projector, we will show the rules of the game by which the students are required to act. The game is allowed to be conducted freely for 3-4 minutes.

Game – Version 1

Initial State:

- ✓ 4 students start walking slowly in a straight line, 4 students stand in a line next to the teacher

Target State:

- ✓ All 8 students are in the game

Rules:

- ✓ When a student **hits** a wall or a desk, he randomly chooses a new direction and walks in it in a straight line
- ✓ When a student **hits** a wall the student first in line joins the game
- ✓ When two students **meet** they **shake hands**

Stop Condition Rule:

- ✓ When the number of students in the game reaches 8, the game ends

- The students return to their seats.
- The students are asked:
  - Look at the game rules. Each rule starts with an “event” which causes another event to occur. The rule links the events in a cause-and-effect relationship.
  - Can you identify the events in each game rule?
- Now we shall move on to another version of the game containing slightly different rules.

- We request 8 new volunteers. Again, 4 will stand scattered around the classroom and 4 will stand in a line next to the teacher.

Game – Version 2

Initial State:

- ✓ 4 students start walking slowly in a straight line, 4 students stand in a line next to the teacher

Target State:

- ✓ All 8 students are in the game

Rules:

- ✓ When a student **hits** a wall or a desk, he randomly chooses a new direction and walks in it in a straight line
- ✓ When a student **hits** a wall he **yells** "Plethora"
- ✓ When a student **yells** "Plethora" the student first in line joins the game
- ✓ When two students **meet** they **shake hands** and return to the line next to the teacher

Stop Condition Rule:

- ✓ When the number of students in the game reaches 8, the game ends

- The game is played twice.
- The students are asked: will the result of the game always be that all 8 students are playing? Could there be another result?
- We alert the students' attention to the fact that there is a certain degree of randomness to the game, and that it is possible that all students will stand in a line next to the teacher and could no longer return to the game.
    - Will the game end in this case? (No, the Stop Condition Rule will not occur).

Part 2 – Discussion of concepts following the game

10 min

Purpose of discussion: Explain the concepts: Event, Rule, Stop Condition Rule

Event, Rule

We shall project on the screen and explain:

Concepts

- Event – a specific action or occurrence
- Rule – A syntax that links events in a cause-and-effect relationship

The students will be asked – Can you think of other situations in day to day life that act according to rules? That is, when the occurrence of an event can cause a result.

Examples:

Rule			
	Cause		**Effect**
when	Traffic light color changes to green	then	The cars start driving
	A finger touches an application's icon on a smartphone screen		The application opens
	The "on" button is pressed on a TV remote		The TV turns on
	A drumstick hits a drum		A sound is heard

Stop Condition Rule

In certain contexts, for instance in certain games, we want to define a rule which would cause the game to stop. Such a rule is called a Stop Condition Rule.

For example, in the game we played, we defined that **when the number of students participating in the game reaches 8, the game ends** – this is our Stop Condition Rule.

Other possible examples -

1. When we run out of lives (In a certain game), the game ends.
2. When the phone's battery reaches 0% - the phone turns off.

Part 3 – Introduction to Plethora

The goal of the activity is to make a brief introduction with the game's interface

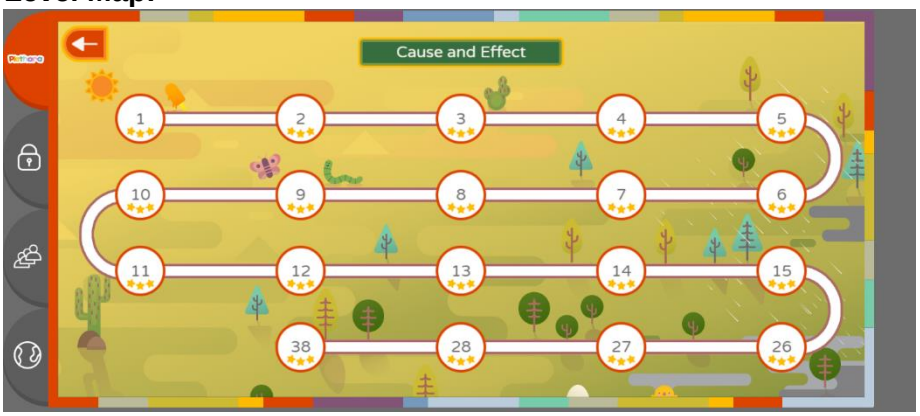
10 min

1. We will explain to the students that in the following lessons we will play a game called "Plethora" (The meaning of the word is "Abundance"). Using the game, we will learn concepts that are related to the way in which we give instructions to a computer (terms like "algorithm", "rules which instruct a computer how to behave" or "algorithmic thinking" can be used based on the level of the class and the students' previous knowledge).
2. We will note that today we will learn about **Events** and **Rules**.
3. We will enter Plethora in one of the two methods explained here and continue the explanation from within the game:
    - Method I - Navigate to the site www.iamplethora.com in a Chrome browser
    - Method II - Unified identification by the Ministry of Education in your country, if applicable.

4. We will introduce the game environment:
    - The game is comprised of levels – The first screen we arrive at after login is the subjects screen, in which we can see all learning subjects. After we choose a subject, we move to the levels map in which we can scroll to see all levels of the game:

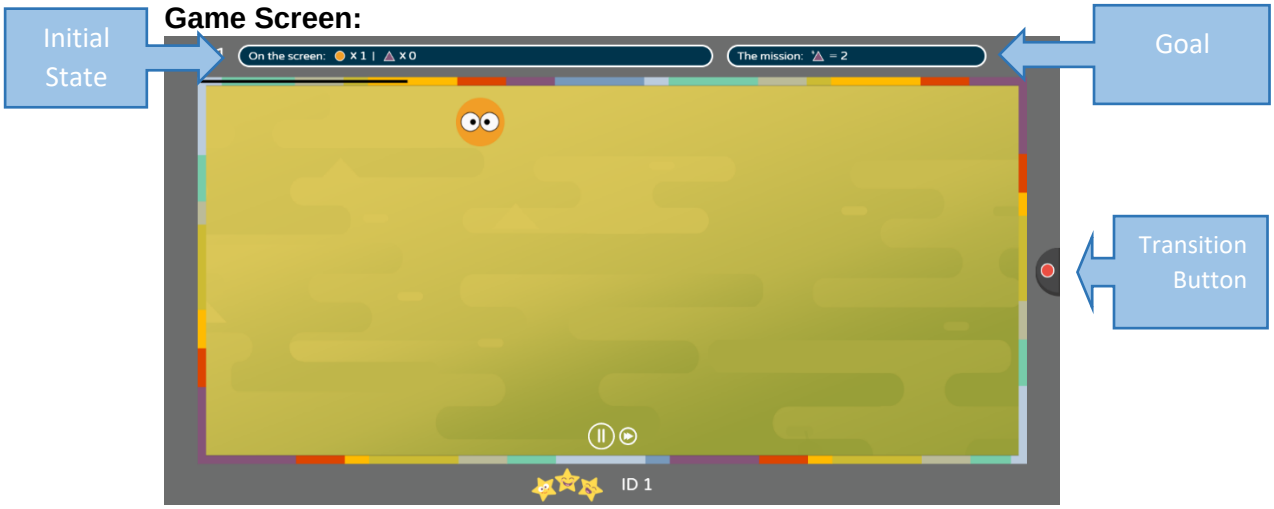
Subject Screen:

Level Map:



- During the game, students will work according to the order of the levels. In each level they will complete the rules so that the goal of the level is achieved.
- The students will be asked to enter the game and solve level 1.
- After they have experimented with the game, we will go over level 1 together and present through it the game environment and the way to achieve the goal:
    1. We will follow the directions which appear in the level itself.
    2. We will emphasize the concepts from which a level is composed:
        - **Initial State**: The stage on which a few shapes are presented.
        - **Goal**: A certain collection of shapes which needs to be on the stage at the end of the level.
        - **Rules**: Upon pressing the transition button at the right side of the screen we are presented with the "**Rules**" screen; The rules represent a collection of given constraints whose completion needs to be such that it causes the system to go from the starting state to achieving the goal.
    3. The completion of the given rules is achieved by dragging "cards" from the collection of given cards on the right to the tile marked with a "?".

Game Screen:



Rule Screen:

4. Upon pressing the transition button, now positioned on the left, we return to the main stage, “The Game”, which will act according to the specified rules.
5. If the completion of the rules succeeded in making the system achieve the goal – the level has been successfully completed and the next level will be unlocked. If not, the level (3) can be returned to by pressing the transition button.

Part 4 – Independent activity with Plethora

Activity goal: To allow students to independently work on rules

35 min

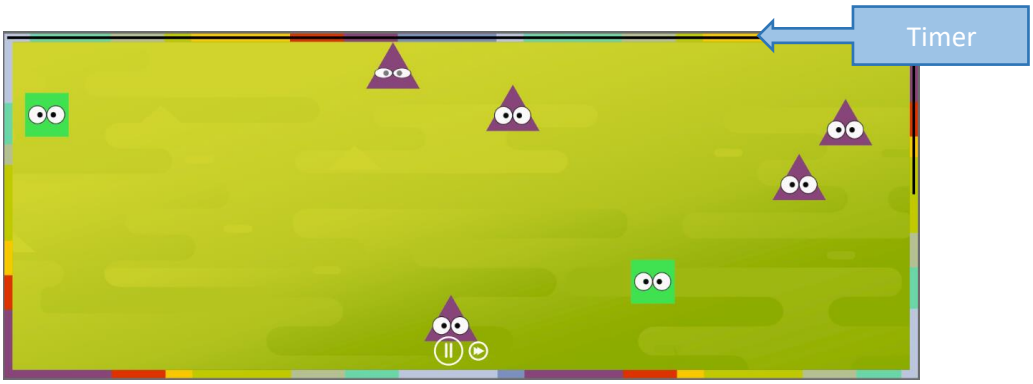
We will tell the students that during the next 35 minutes their objective is to progress in the levels of the “Cause and effect” subject as much as they can.

Part 5 – Class discussion and summary

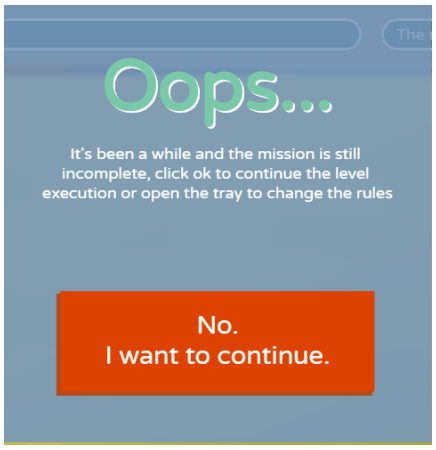
Activity goal: Summarize the material learned in the lesson and reflect on topics that the students were exposed to during the independent work.

20 min

- We will ask the students and discuss with them:
    - What concepts did we learn today? Event, cause-and-effect, Rule, Stop Condition Rule.
- We will solve one of the levels together with the students – either a level they struggled with or the final level in the "Cause and Effect" subject.
    - We will emphasize the following points:
        - **Rule structure** – **when** [cause] **then** [effect]
        - **Event** – what types of events did we see in rules in Plethora?
            - Event in the beginning of the rule – "cause": a shape hits another shape, a shape hits the frame
            - Event later in the rule, after the word 'then' – "effect": a shape is created, a shape disappears.
        - **Stop Condition Rule** – we will ask the students what would have happened if no stop condition rule was defined. In this case the rules would have continued working and the level would never have ended, even if the target was achieved.
        - **"only"** – when the word "only" appears in the target line, the state that must be achieved is one in which the **only** shapes that appear are the target shapes and no other shapes appear on the stage.
        - **Multiple Rules** – when multiple rules appear in a single level, they all act and are tested as long as the level is active until the stop condition rule applies.
        - **Clues** – In some levels a clue is offered to the student if he is struggling with solving it. The clue can be used by pressing the light bulb symbol  . The use of the clue will cost the students one of the 3 stars they accumulate when solving a level.
        - **The Timer** – When the rule tray is closed and the action of the rules is being observed on the stage, a thin black line can be seen progressing on the stage frame – this is the timer.



The end of the timer is a signal to the fact that the rules have been acting for quite some time and the target has yet to be achieved. At this stage the users will be presented with a question and they can choose to either let the rules continue to act or to return to the rule tray and change them.



The timer and the question that appears when it finishes usually raise questions among the students – this is an oppurtunity to present a concept we will meet later on – **randomness** - it could happen that the rules of the level were filled correctly but the shapes, due to the randomness of their movement, did not meet on time so the target was not acomplished. In these cases we can ask the game to continue or to open and close the rule tray in order to re-run the level.

- **Fast Forward and Pause** – the rules can be seen acting on the stage in double speed by pressing the fast-forward button. The movement on the stage can be paused by pressing the pause button.