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Gamification of Blended Learning with Challenge Unicorder™

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*I hear and I forget;
I see and I remember;
I do and I understand.*

-- Confucius

TL;DR

IPT Challenge Unicorder Method and System allow learning by doing things and (visually) logging about that

+ lot more things such as:

- Real time monitoring of learners' performance
- Providing immediate feedback and rewarding significant students' achievements
- Commencing support actions when needed
- Adapting the difficulty of missions to students' abilities
- Facilitating storytelling by automatic story-line publishing

Agenda for This Session

- Active learning in context: Situated, Project & Problem-based Learning
- Blended learning: tracking and feedback problem
- IPT Unicorder Integral Game-Based Learning Design (IGBLD) Method
- IPT Challenge Unicorder™ System
- Preliminary results
- Conclusions


Complete Action: 2

Attach encoders


Please enter status text and picture

Status Text

Encoders attached



Capture Picture



Complete Action Cancel

the main board with provided battery and nuts as

The Problem

- A fundamental problem of traditional lecture-based education is that the **learning process is ex-aggregated from its natural “life” context**, and artificially implanted into classroom settings.
- Often there is a **mismatch between the skills needed in real-life and knowledge taught**, ICT – increasing rate of technology changes.
- Education should be teaching students **how to learn, think and collaborate effectively**, instead of just transferring knowledge.

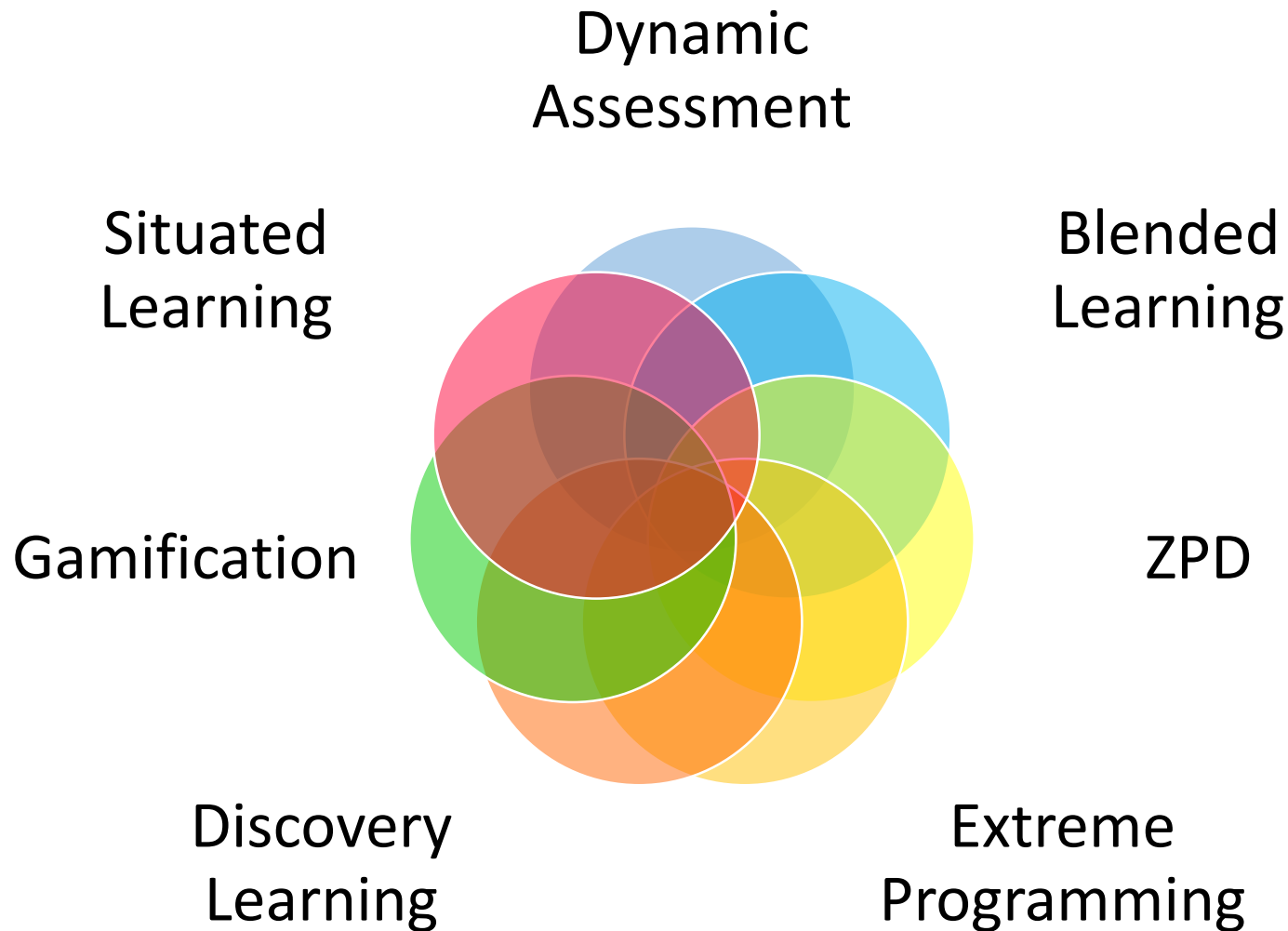
Why Active Learning?

- **Active Learning (AL)** – collaborative learning, problem/project-based learning, situated learning, learning by discovery, etc.
- **AL advantages** – positive motivation, deep learning, long term retention, lifelong learning, taking responsibility for own development, increased transfer of skills
- **Results from US President's Council of Advisors on Science and Technology report "Engage to Excel"** – AL rises attendance from **57 to 75 percent**, engagement from **45 to 85 percent**, and “the students learned **twice as much** based on test results as the students in the traditional section”.

High Quality Blended Learning (HQBL)

- **HQBL** blends not only traditional classroom activities with computer-based/mediated ones, but aims to achieve **coherent high quality Learning Experience (LX)**.
- **What should be blended?** – learning technology + different capabilities (affordances), aspects, perspectives, principles, and types of activities.
- **Models and practices for blended learning delivery** – “flipped classroom”, “stations/labs rotation model”, etc.
- Basis for **Unicorder™ Integral Game-Based Learning Method (IGBLD)** proposed

Unicorder Integral Game-Based Learning Design (IGBLD) Method



Three Main Hypotheses of IPT Unicorder™

- All human activities can be **modelled (reframed) as games**.
- Games are **interactive simulations** in physical, virtual or augmented reality environments.
- Games involve **learning/reinforcement** component, as well as **affective (emotional)** component.



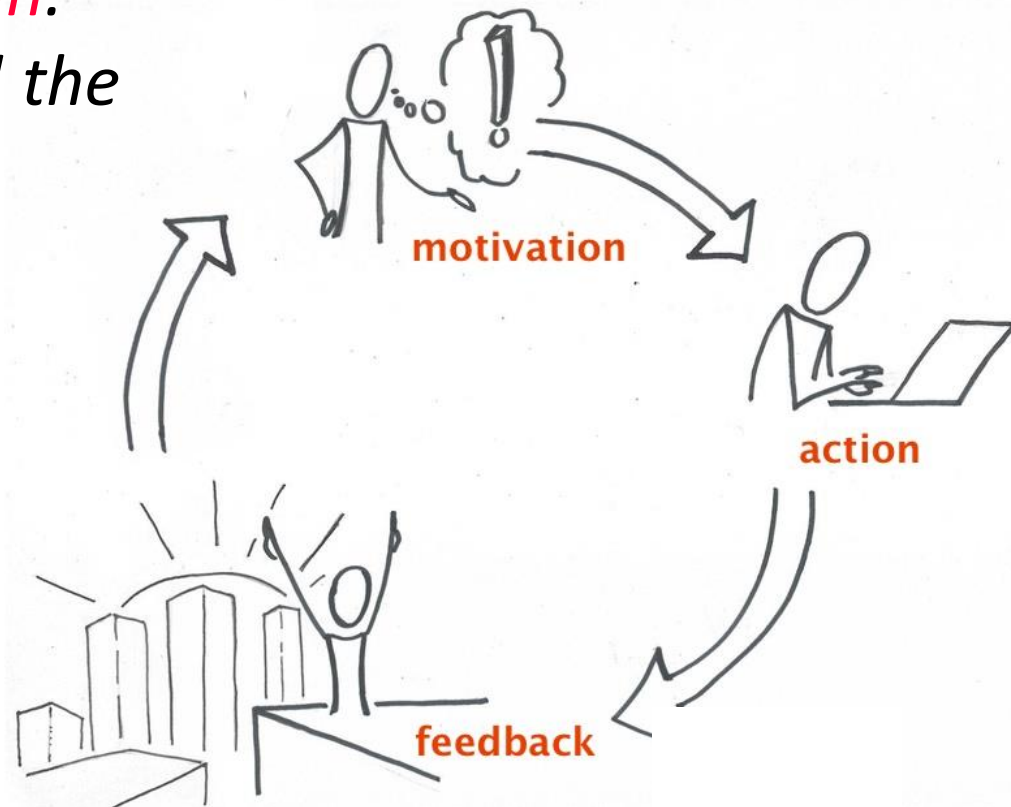
Gamification and Game-Based Learning

- Better motivation through enjoyment and pleasure
- Interactivity, immediate and rewarding feedback;
- Effective learning through intense emotional involvement
- Continuous challenges pushing learners' abilities
- Structuring learning experience through well-defined rules
- Fostering communication and interaction
- Personalized & adaptive learning process
- Learning from own mistakes
- Creativity and imagination development by problem solving

Game-Based Learning is Holistic

*“In every job that must be done,
there is an **element of fun**.
You find the fun and snap! the
job is a game.”*

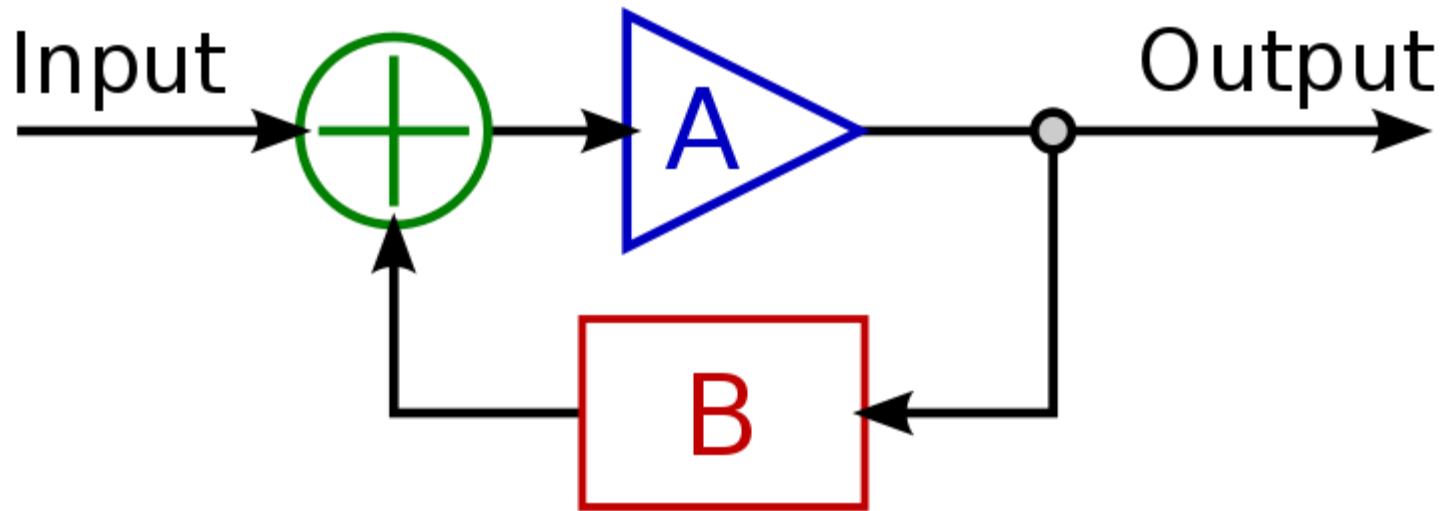
-- Mary Poppins



Games are Most Natural Form of Learning



Cybernetics



*A branch of mathematics dealing with problems of control, recursiveness, and information, focuses on forms and the **patterns that connect**.*

-- Gregory Bateson

88 b

- [illegible]

Patterns That Connect: Map & Territory

- **Cybernetic loop connection** (may be more than one) going from territory to map and back simultaneously
- **Dynamically changing pattern** of informational transformations (or maps that are mapped to other maps and so on).
- **(Meta-) Learning Levels** 1, 2 and 3



Implications for *Unicorder GRM* and *IGBLD*

- In order our model and method to be ecologically sound, they need to include the whole cybernetic system: **learners + instructor + other participating agents + context + their interaction**
- **Pleuroma** and **creatura** interact constantly and dynamically influence each other. This type of dynamic influencing can be called **learning in case of creatura** (discrete models and ideas), and it is constant and immanent part of the their interaction. The **nature (pleuroma) is also influenced** of what agent has learned, through agent's **actions in the external environment**.

Implications for *Unicorder GRM* and *IGBLD*

- The learning can happen on multiple levels – modelling the external environment (level 1), meta-cognitive learning (level 2), and meta-meta cognitive learning (level 3).
- The constant interaction of pleuroma and creatura can be modeled as a game, the rules being existing inherent constraints in both entities – natural laws in case on pleuroma, and existing previous dominant models and ideas, in case of creatura.

Gamification to Learning Domain Translation

- Challenges --> learning goals
 - Levels --> learning path
 - Points, feedback --> positive reinforcement
 - Leaderboards --> learning analytics
 - Badges --> recognition and a sense of accomplishment
(reserved for significant achievements only)
 - Competition --> compare achievements with other teams
 - Collaboration --> between the players in the team
-
- Gamification techniques could be employed to design engaging and productive Learning Experience (LX).
 - Games & gamification usually have strong focus on performing problem-solving activities in concrete contexts (situations).

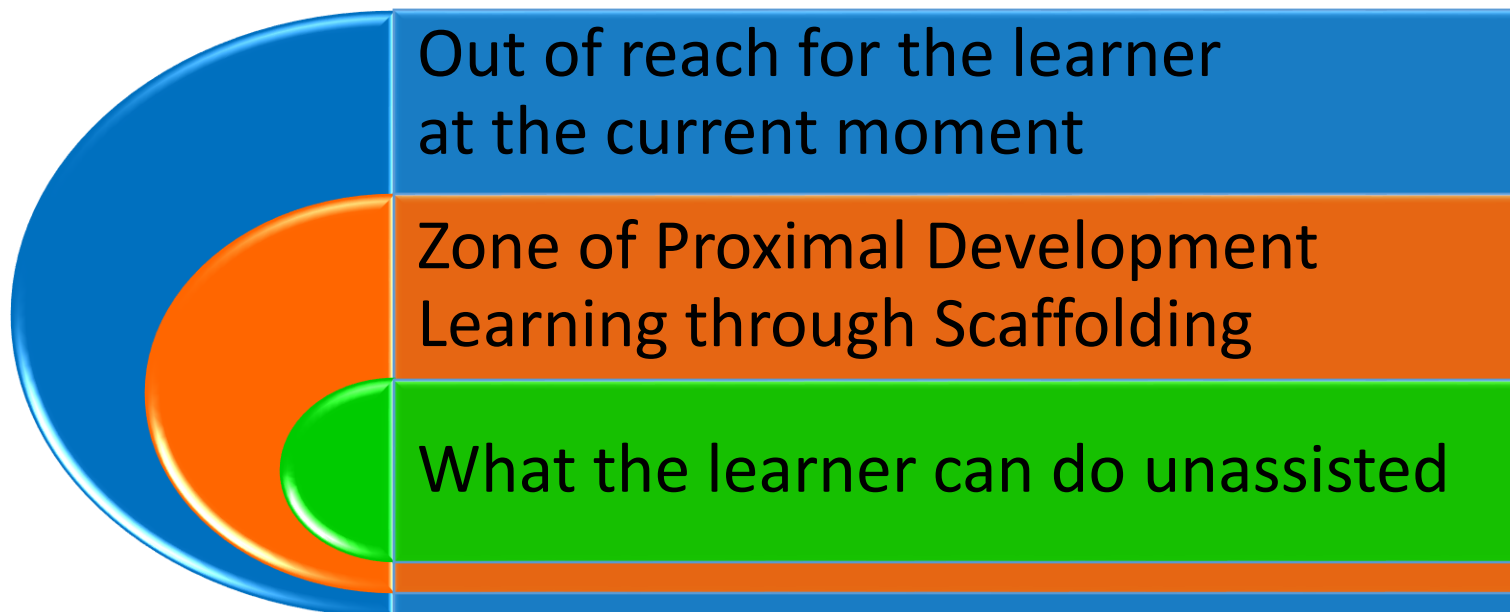
Mechanics, Dynamics, Aesthetics [Hunicke et al.]

- **Mechanics** – elements a player can interact with: story, points, levels, leaderboards, badges, challenges, quests
- **Dynamics** – interaction with the elements: onboarding, feedback & reinforcement, engagement loops, customization
- **Aesthetics** – the feelings player experiences:
 - Sensation – game as sense-pleasure
 - Fantasy – game as make-believe
 - Narrative – game as drama
 - Challenge – game as obstacle course
 - Fellowship – game as social framework
 - Discovery – game as uncharted territory
 - Expression – game as self-discovery
 - Submission – game as pastime

Vygotsky's Zone of Proximal Development

Def: “the distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers”

-- Lev Vygotsky



Dynamic Assessment - I

- **Dynamic assessment** is an interactive approach to psychological or psychoeducational assessment where intervention is embedded within the assessment procedure
- Usually it includes a **pre-** and **post-tests** in order to estimate the **effectiveness of intervention for particular learner**
- Based on **Vygotsky's ZPD principle**, developed by Reuven Feuerstein, supported by Joseph Campione and Ann Brown, John D. Bransford, Howard Gardner and Robert Sternberg
- Number of dynamic assessment procedures proposed:
 - Budoff's **learning potential assessment**,
 - Campione and Brown's **graduated prompts approach**
 - Carlson and Wiedl's **testing-the-limit method**

Dynamic Assessment - II

- By embedding the instructional material within assessment procedure, these methods allow for **dynamic estimation of abilities** and more **accurate prediction of learners' difficulties**
- **Interventionist** and **Interactionist** dynamic assessment
- Why not try to combine strengths of both approaches by providing students with predefined **tasks called “missions”** that are **tracked in real time by the system**, and at the same time allowing both the students and instructor to **initiate a learning support transactions (LST)** freely during the mission accomplishment.

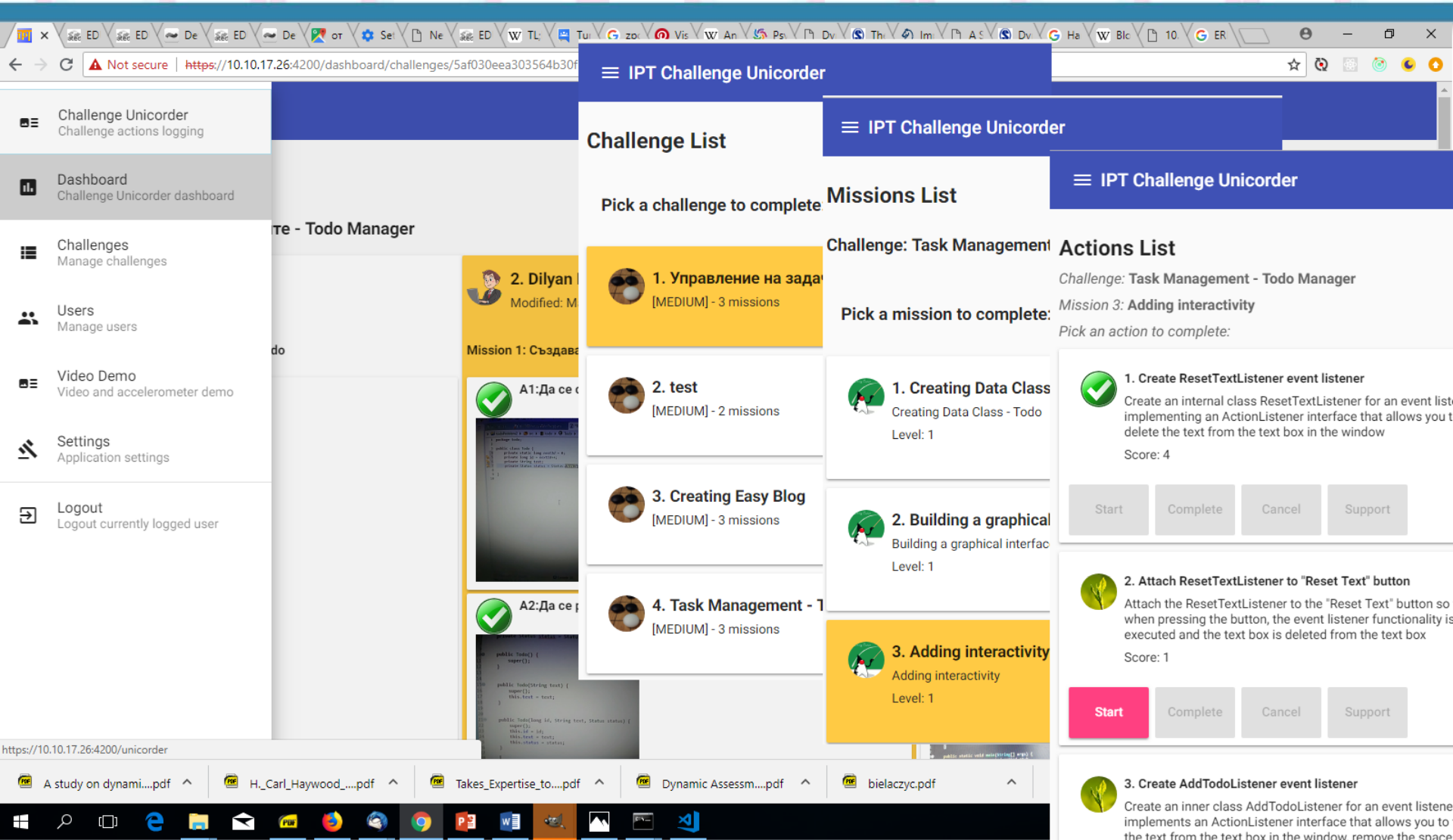
IPT Challenge Unicorder Method & System

- Developed by IPT – Intellectual Products & Technologies Ltd.
- Allow learning by constructing things and (visually) logging about that
- Real time monitoring of learners' performance
- Providing immediate feedback and rewarding significant students' achievements
- Commencing support actions when needed

Unicorder™ IGBLD Method

- The **situated learning perspective** and group **learning by doing** practice
- Learners are usually divided in **small groups** (3-5 persons)
- Each group receives a particular task called “**Challenge**”
- The **Challenges** include **Missions** that require different skills and knowledge to be successfully accomplished (15-40 min)
- Each **Mission** consists of concrete **Actions**, which structure the learning process from one side, and from the other allow receiving **detailed real-time feedback** about student/group **progress, current status**, and **potential blocks** and problems to be addressed by the instructor

IPT Challenge Unicorder™



Unicorder Integral Game-Based Learning Design (IGBLD) Method

Design the **sequence of Actions** (steps), necessary to accomplish each Mission for each game role (and to **achieve corresponding learning objectives**), sequences may be **adaptively constructed** with some Actions enabled only if performance is sufficiently high, each role could have different RSGs and sequences of Actions to accomplish the Mission, these **sequences can be linear or non-linear**;

4. Qnko
Modified: Jan 23, 2019 - 17:35:53

Mission 1: Assemble the Curiosity Robot

- ✓ A1: Open LEGO MINDSTOR Edition
- ✓ A2: Assemble the Robot Gri
- ✓ A3: Assemble Robot Wheels
- ✗ A4: Assemble Robot Body

Mission 2: Learn to Survive

- ✗ A3: Allow Curiosity to sense

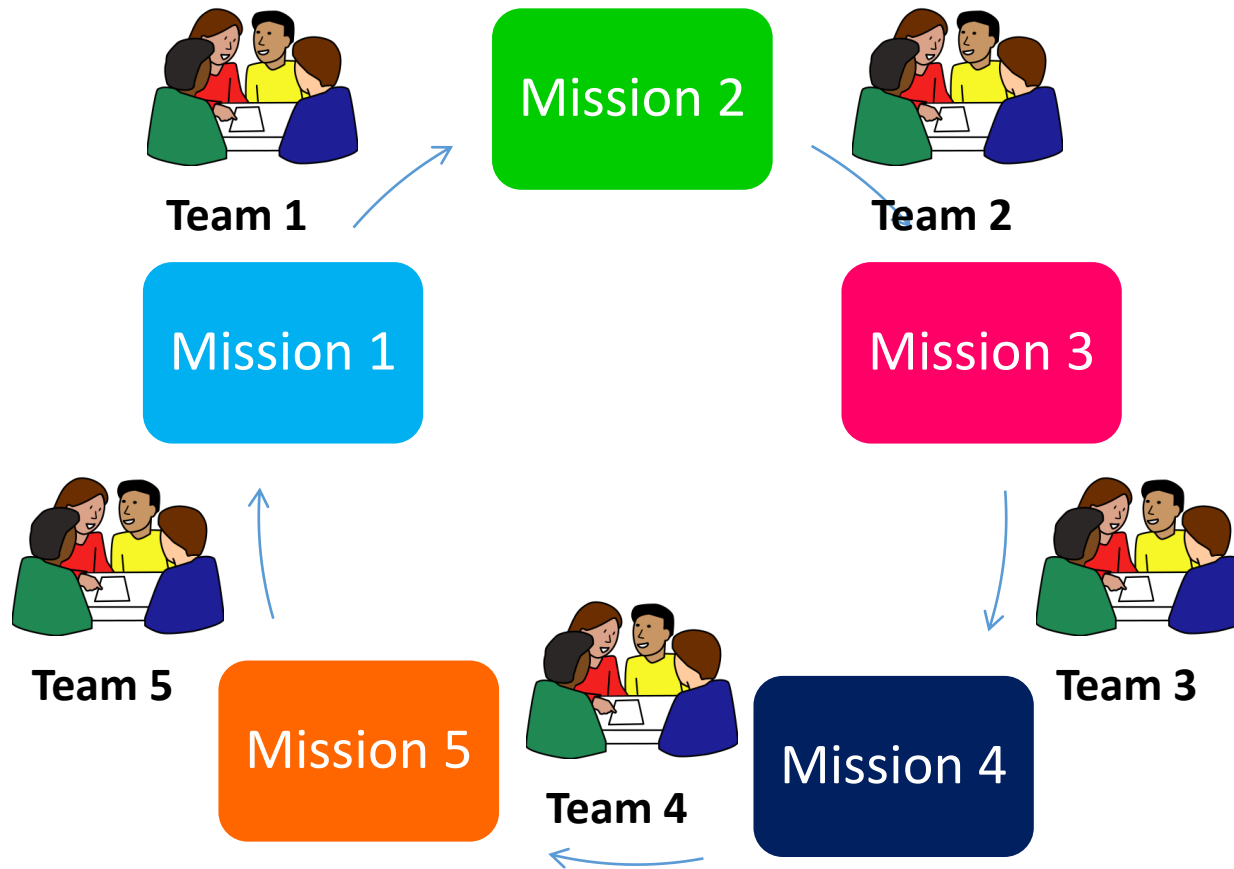
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Mission 2: Learn to Survive

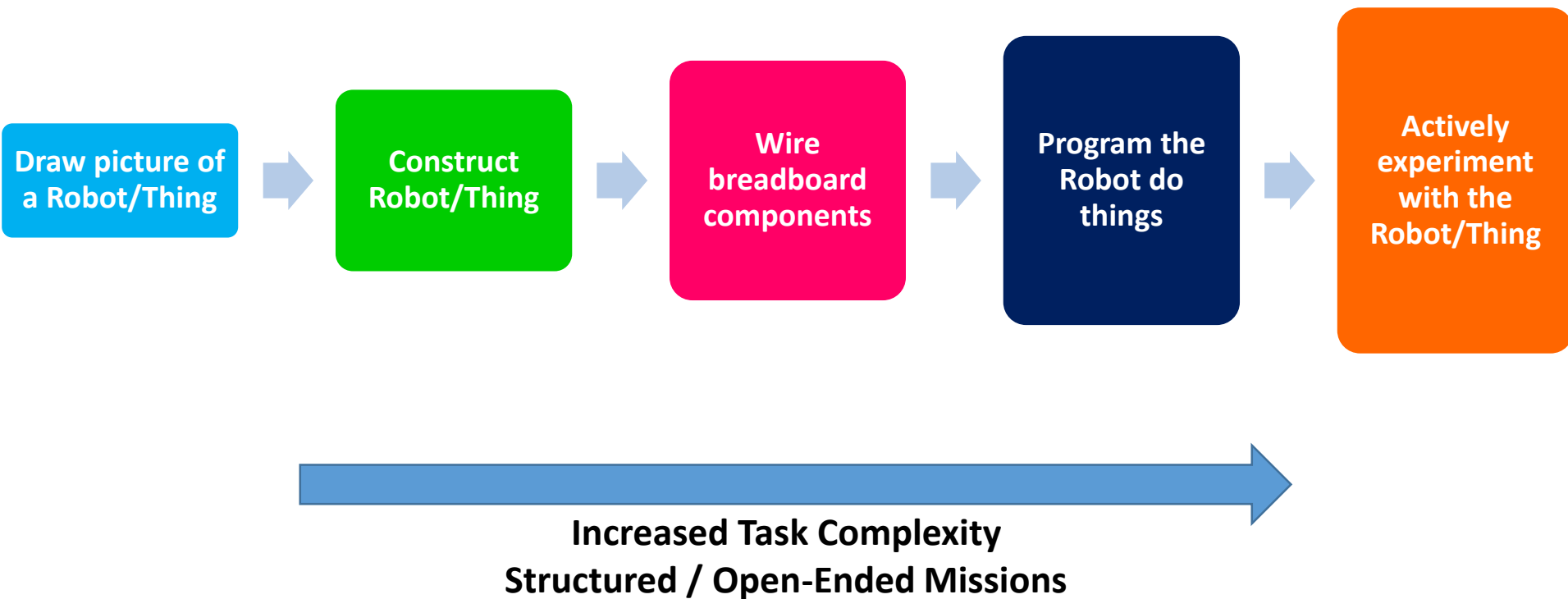
- ✓ A1: Clone GitHub repository
- ✓ A2: Copy and import hello-lejos project Ready
- ✓ A3: Allow Curiosity to sense obstacles

Stationts/Labs Rotation Model

Independent Missions of Similar Difficulty

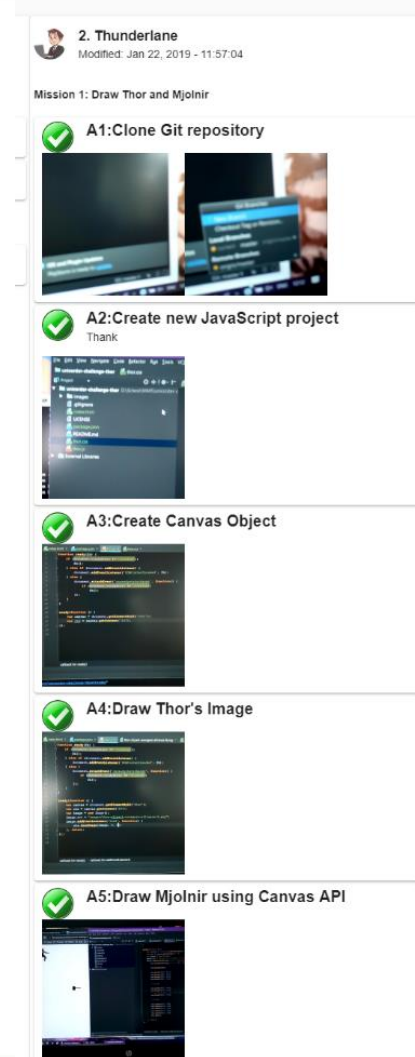


Stations/Labs Queue Model



The Role of Challenge Unicorder™

- Unicorder allows to make the PICs of players (learners and instructor) more **easy to observe** by asking them to blog their actions, believes, questions, intentions, and attitudes.
- **Easily** – using mobile picture statuses
- It makes the **learning process more transparent** and effective by allowing the instructor to monitor learners' detailed progress using **Unicorder Dashboard**, and to provide immediate feedback.



IPT Challenge Unicorder™

- Challenge Unicorder tries to determine the learners' potential to acquire new skills by implementing **learning analytics** – statistically comparing the **time necessary** for student or group of students to accomplish certain **concrete “learning by doing” actions**.
- Using **Unicorder™** students **continuously log mission results** in a transparent and easy way, by blogging the status of each action as short **status text, picture or combination of them**.
- Instructor receives this data **in real time** on a **dashboard**, together with **basic statistic data** computed by the system based on historical data about learning actions accomplishment by previous learners or teams

IPT Challenge Unicorder™

- The live data can estimate the individual **learner or team potential to accomplish the action**, and can suggest the instructor a need for **learning transaction (LT)**
- LTs can be accomplished in both **online** (using Unicorder) and **face-to-face**, as preferred by instructor
- Based on **learning statistics computed in real-time**, Challenge Unicorder offers also a possibility for instructor to dynamically enable certain **“Easter egg” actions and missions** in this way **dynamically adapting** both the structure and sequence of learning tasks

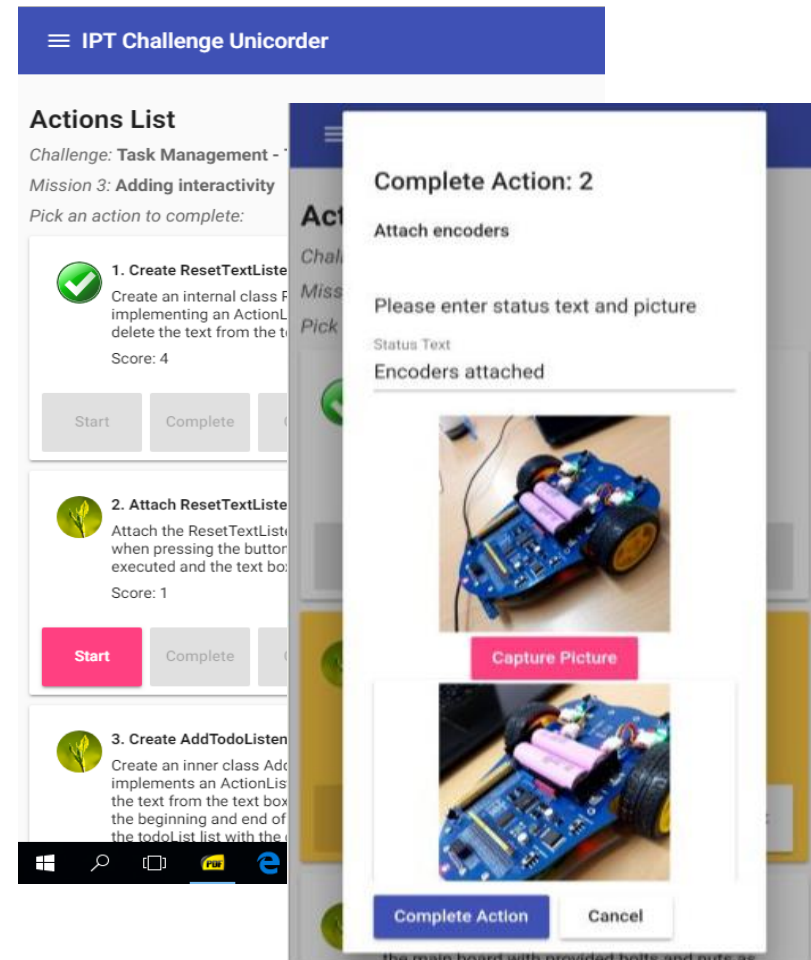
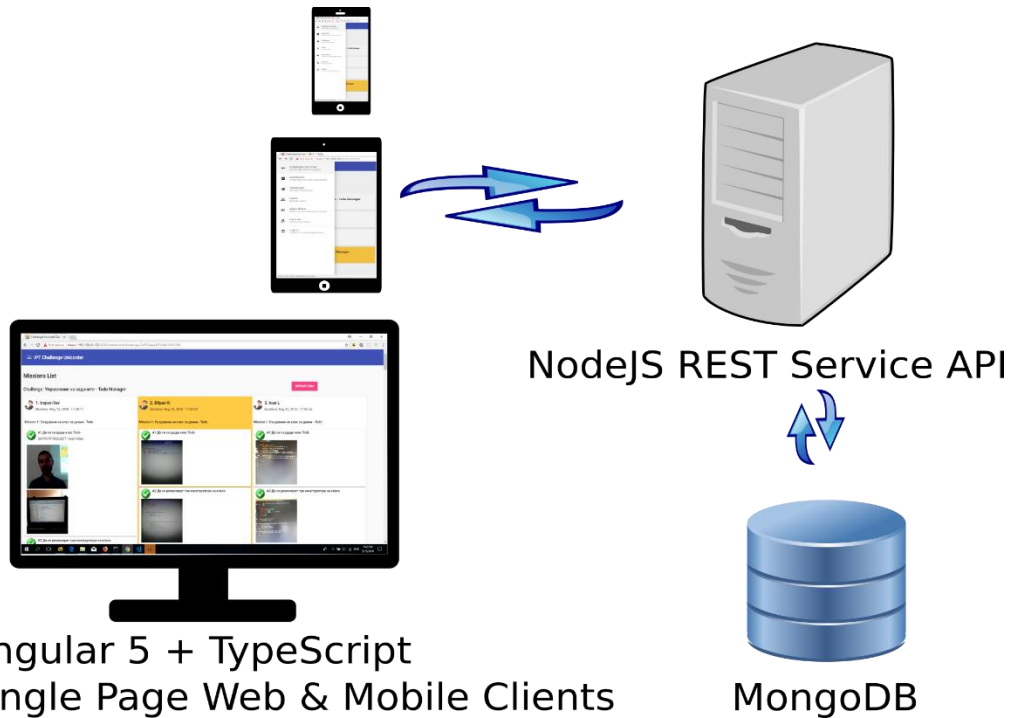
Game Mechanics, Dynamics & Aesthetics

- **Challenges** – difficulty dynamically adapted according to the real-time performance metrics. Leaderboard and point system allows comparing own team performance with others
- **Fellowship** – addresses by providing opportunities for group problem solving in small teams.
- **Fantasy** and **Discovery** – fostered by mixing open-ended activities (only if performance level of group/participant is sufficiently high) in which participants should explore the problem domain and share their findings
- **Sensation** and **Expression** - stimulated by including direct physical object manipulation tasks such as drawing pictures of things to be built, robot/ smart things construction, etc.

Game Mechanics, Dynamics & Aesthetics

- **Retrospective meeting (Extreme Programming)** – each team presents its story of individual experiences, difficulties and achievements (**already recorded visually using Unicorder**), to reflect on what has been learned, and to formulate goals and problems for further exploration.
- Challenges and missions **connected with real world**, and **learners' individual values and interests**.
- **Asking the learners** in advance about their **interests** and **ideas**, and try to develop challenges in line with them.
- Even better **ask students to help in challenges preparation**
- Or there may be some **challenges proposed exclusively by students** to their peers (**daring peers to try to complete them**)

IPT Challenge Unicorder™ System



Preliminary Results

- **IPT Challenge Unicorder** active learning method and software are **works-in-progress**, and there are no conclusive evaluation results available yet about their effectiveness in real classroom settings.
- We have done some preliminary alpha testing with **11-th grade students** from **National Mathematics High School “Prof. Lubomir Chakalov”**, Sofia.
- The Challenge Unicorder software was tested with **two groups** of students – **9 students** in total. The students were using the Unicorder software individually with a challenge (goal) to develop a desktop application using Java Swing technology, including 16 actions.

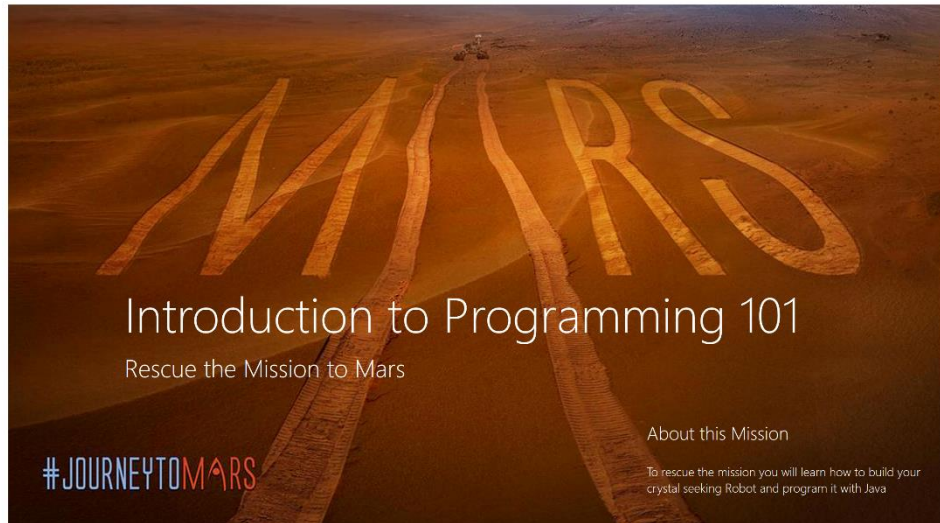
Results from Unicorder Alpha Testing

	Minimal	Maximal	Average
1.1. System Interface	2	5	4
1.2. Usability	2	5	3.55
1.3. Content	3	5	4.44
1.4. User Experience (UX)	3	5	4.33
2.1. Interactivity	3	5	4.22
2.2. Motivation	2	5	3.55
2.3. Instructor support	3	5	4.44
2.4. Timeliness of support	3	5	4.44
2.5. Degree of learning	3	5	3.88
2.6. Immediate feedback	3	5	4.5
2.7. Long-term retention	3	4	3.56
2.8. Results demonstration	3	5	4.33

Conclusions

- IPT Challenge Unicorder active learning method and software are **works in progress**.
- According to preliminary results, the system was **well accepted and considered useful by students**, because of the **immediate feedback** and **improved support by the instructor**.
- There were **suggestions about the system interface** and functionality we try to implement in the next version.
- Directions for further improvement – more advanced **learning analytics** and **dashboard data visualizations**.
- More experimental data needed to estimate the system **effectiveness, usability**, and to **optimize the user experience** in production settings.

Intro to Programming: Rescue Mission to Mars

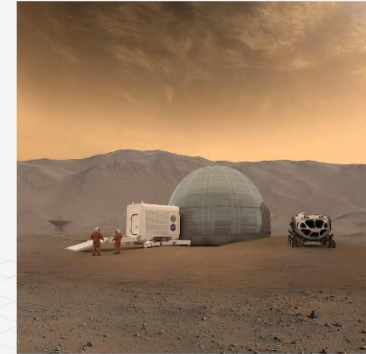


Year 2030: Rescue the Mission to Mars

A **human mission to Mars** has been the subject of [science fiction](#), [aerospace engineering](#), and scientific proposals since the 19th century. The plans comprise proposals to land on [Mars](#), eventually [settling on](#) and [terraforming the planet](#), while utilizing its moons, [Phobos](#) and [Deimos](#).

The [exploration of Mars](#) has been a goal of national space programs for decades. Preliminary work for missions that would involve [human explorers](#) has been undertaken since the 1950s, with planned missions typically being stated as taking place 10 to 30 years in the future when they are drafted. The [List of crewed Mars mission plans](#) shows the various mission proposals that have been put forth by multiple organizations and [space agencies](#) in this field of [space exploration](#). Plans have varied from scientific expeditions in which a small (2 to 8) group visits Mars for a period of a few weeks or year, to the permanent [colonization of Mars](#).

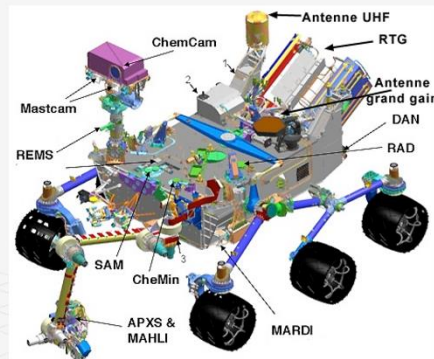
In the 2010s, numerous American, European, and Chinese agencies were developing proposals for human missions to Mars. In 2018 SpaceX [Falcon Heavy](#) was used to send a test payload beyond the orbit of Mars. Around 2025 they have developed and tested the technologies. In 2027 there was conducted the first human mission to mars.



History of Mars Exploration



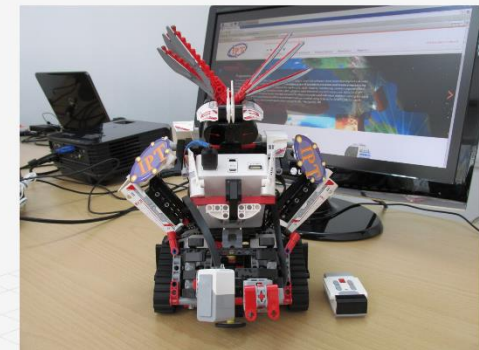
Recently a scientist from your team has found an unusual type of radioisotope crystals capable of producing a lot of energy. It was proposed that in order to survive you can use an old robot from one of the first unmanned missions to Mars – the Curiosity to harvest the crystals. It was used in early 2010s for preliminary exploration of the planet, but after that the Curiosity robot has been disassembled.



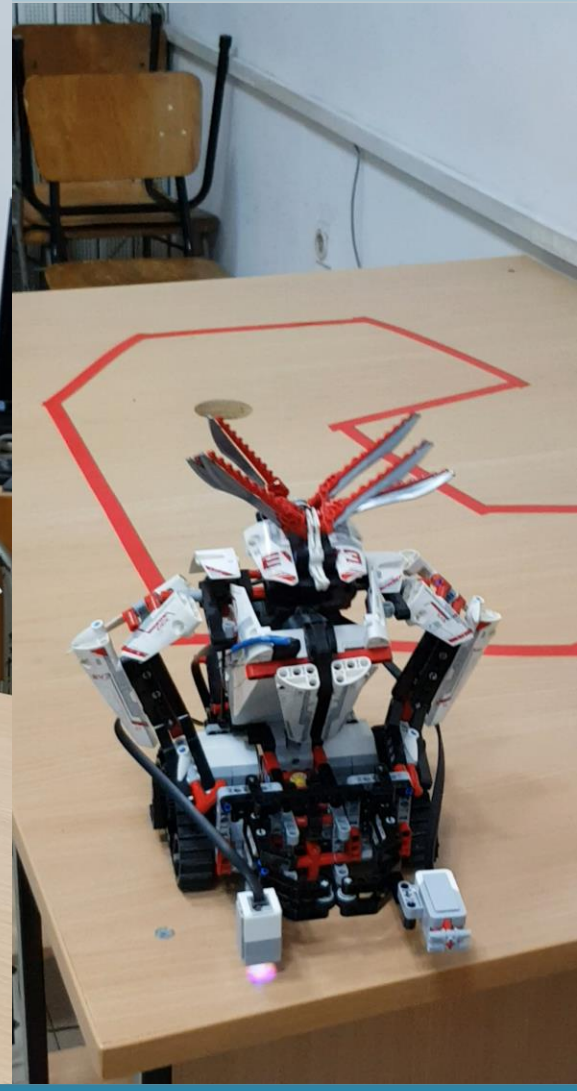
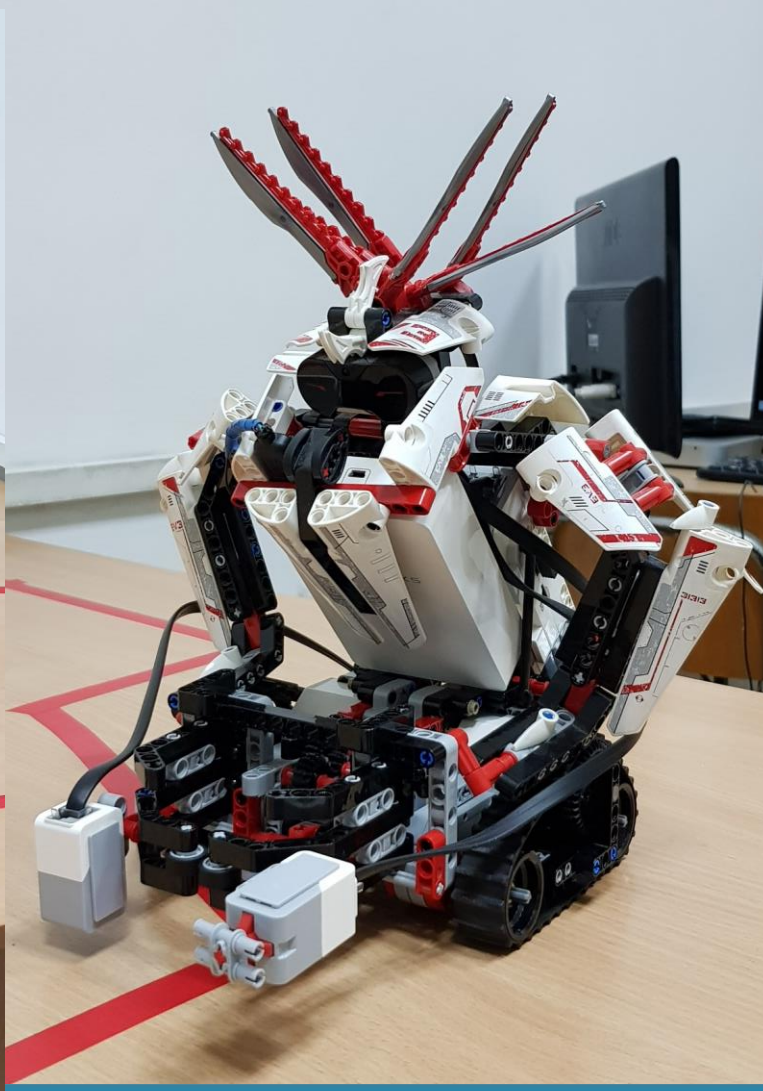
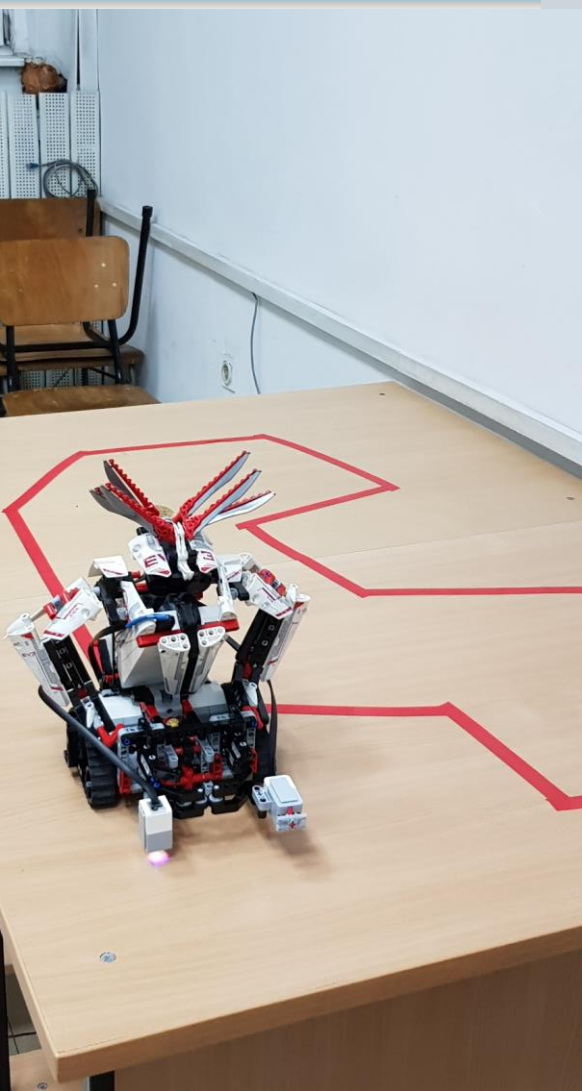
History of Mars Exploration

So your team's first task is to assemble the **Curiosity robot** again, and program it to find and bring the energy crystals. But the task is not simple because it was programmed on now considered ancient (since 1990s) Java language, and nobody from your team has experience with it. It will require to work as a team to build the robot on time, before the oxygen and food run out.

You will use new **Unicorder device** in order to log all your activities and ask for help from NASA base station. Now you will receive instructions how to use new Unicorder devices.



Intro to Programming: Rescue Mission to Mars



Thank's for Your Attention!



Trayan Iliev

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