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
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
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**
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
“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

Image source: https://blog.iterate.no/2013/10/31/hitchhikers-guide-to-gamification/
Games are Most Natural Form of Learning
A branch of mathematics dealing with problems of control, recursiveness, and information, focuses on forms and the patterns that connect.

-- Gregory Bateson
Pleuroma and Creatura

- **Pleuroma** – includes the external natural things-as-such (continuous and analog)

- **Creatura** – their reflection in the mind (ideas, models and representations describing differences in the form of discrete information).
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

- Out of reach for the learner at the current moment
- Zone of Proximal Development
  - Learning through Scaffolding
- What the learner can do unassisted
Dynamic Assessment

- **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.

- Interventonist 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™

Challenge List

Pick a challenge to complete

1. Управление на задачи
   [MEDIUM] - 3 missions

2. Dilyan
   [MEDIUM] - 2 missions

3. Creating Easy Blog
   [MEDIUM] - 3 missions

4. Task Management - 1
   [MEDIUM] - 3 missions

Missions List

Pick a mission to complete:

1. Creating Data Class
   Creating Data Class - Todo
   Level: 1
   Score: 4

2. Building a graphical interface
   Building a graphical interface
   Level: 1
   Score: 1

3. Adding interactivity
   Adding interactivity
   Level: 1
   Score: 3

Actions List

Challenge: Task Management - Todo Manager

Mission 3: Adding interactivity

Pick an action to complete:

1. Create ResetTextListener event listener

Create an inner class ResetTextListener for an event listener that implements an ActionListener interface which allows you to delete the text from the text box in the window.

Score: 4

2. Attach ResetTextListener to "Reset Text" button

Attach the ResetTextListener to the "Reset Text" button so when pressing the button, the event listener functionality is executed and the text box is deleted from the text box.

Score: 1

3. Create AddTodoListener event listener

Create an inner class AddTodoListener for an event listener that implements an ActionListener interface that allows you to delete the text from the text box in the window, remove the space...
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;
Station/Labs Rotation Model

Independent Missions of Similar Difficulty

- Mission 1
  - Team 1
  - Team 5

- Mission 2
  - Team 2

- Mission 3
  - Team 3

- Mission 4
  - Team 4

- Mission 5
  - Team 5
Stationts/Labs Queue Model

Draw picture of a Robot/Thing  →  Construct Robot/Thing  →  Wire breadboard components  →  Program the Robot do things  →  Actively experiment with the Robot/Thing

Increased Task Complexity
Structured / Open-Ended Missions
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.
• 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.
• 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

NodeJS REST Service API

Angular 5 + TypeScript
Single Page Web & Mobile Clients

MongoDB

Actions List
Challenge: Task Management - Mission 3: Adding interactivity

1. Create ResetTextList
Create an internal class that implements an ActionList and delete the text from the text box.
Score: 4

2. Attach ResetTextList
Attach the ResetTextList when pressing the button executed and the text box cleared.
Score: 1

3. Create AddTileToList
Create an inner class AddTileToList that implements an ActionList and adds the text from the text box to the beginning and end of the nodeList list with the ID passed.

Complete Action: 2
Attach encoders

Please enter status text and picture
Status Text:
Encoders attached

Capture Picture

Complete Action
Cancel
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

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

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 2010s) 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 Unicosder 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 Unicosder devices.
Thank’s for Your Attention!

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