Assessment of the applicability of R&IC technologies

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Outline

- R&IC technologies overview
- Assessment of the applicability of the technologies in schools
- Criteria for technologies relevance
- Conclusions

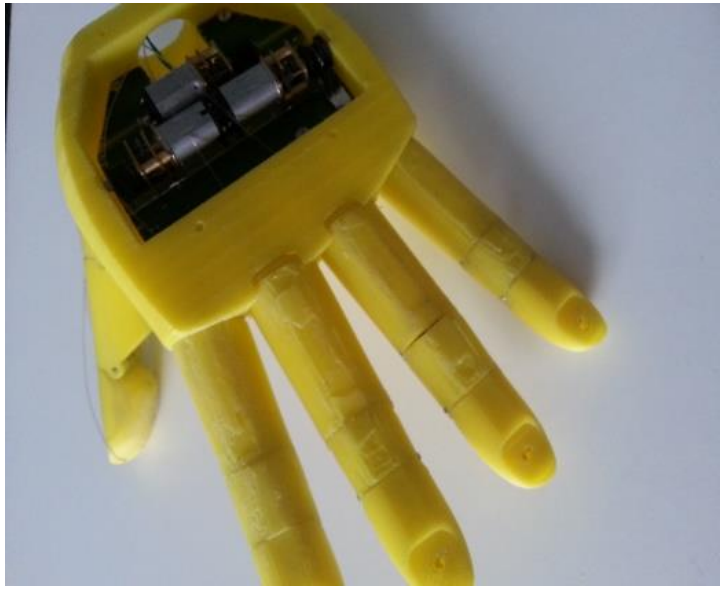
Assessment of **R&IC** technologies - Indicator 3 (A2)

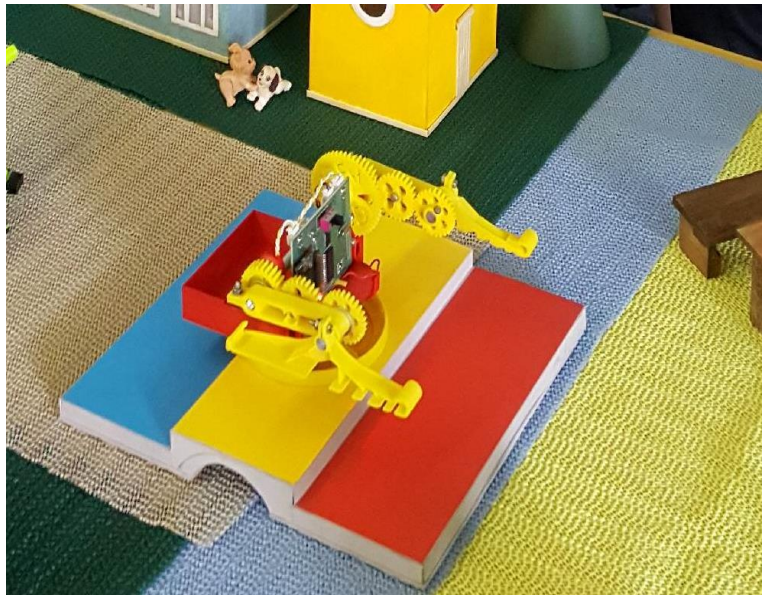
Formal Education	Non-Formal	Special Education
Humanoid Robots – NAO (Peper)		
Non-humanoid - Artificial anthropomorphic robotic hand, Walking Robot		
Robot components - Cubelets, Dash and Dot, Lego Mindstorms		
Motion sensing devices - MS Kinect Sensor, LEAP motion		
Virtual Reality/ Augmented Reality - Microsoft HoloLens, VR Oculus Rift glasses. Samsung Gear VR headset		
EEG based brainwave devices – MindWave, Insight/EPOC of EMOTIV		

Humanoid Robots – impact in education

- Using learning applications to make complex lessons simple
- First steps in controlling robot's sensors, motors and audio/visual modules.
- Create simple animations and behaviors in specific graphical language – first steps in programming with test codes/scripts on a simulated robot or directly on a real one
- **Learning by exploration**
- **Programing Humanoid Robots - in its specific graphical language, C++ or Python. Allows to create very complex behaviours, e.g. interaction with people, dance, send e-mails, vision recognition, etc.**

Non-humanoid Robots





https://www.facebook.com/robo.academy.bg/videos/vb.251819688556629/306415453097052/?type=2&theater

Non-humanoid Robots – impact in education

- First steps in mechanical and control system of an artificial human hand.
- Easy lessons for understanding teleoperation and wireless robot control.
- Using of a wireless glove.
- Explore ideas how to add new 3D printed actuators or parts, sensors, motors or communication modules.
- Explore a non-humanoid robot in overcoming vertical slopes or high steps.
- Natural curiosity and creativity by exploration.

- **Appropriate for innovative research and scientific achievements in the field of robotics, communications, control and sensors. Explore controlling of fingers and palm joints by controllers like Raspberry Pi, iOS or Android. Mobile programing. Explore navigation and nonstandard movements.**
- **Learning by experimentation, however pupils need to be supervised by scientific consultants (mentors).**

Robot components

Cubelets are small colour coded cubes that pupils magnetically stick together to form a variety of simple robots

https://www.youtube.com/watch?v=YPAOCOJibfQ

BRINGS TOGETHER PHYSICAL AND DIGITAL PLAY

DASH & DOT ROBOTS - robots that can sense, think and act

https://youtu.be/LA9py48X6_o

Lego Mindstorms 10+ (16+) - Lego kits are the most commonly use according to the survey. Official LEGO Education site:

https://education.lego.com/en-us

Robot components – impact in education

- Engaging and intuitive. Hands-on learning. Cubelets - ideal start into computational thinking in Robotics.
- Make complex lessons simple - for early coding, sequencing, looping, conditional coding, changing directions, problem solving, collaboration, sensors coding, emotion learning, etc.
- Promote natural curiosity, creativity and learning by exploration. The first programmable robot of a kid above 4 years old.
- CLASSROOM PACK - educational accessories that can be purchased to support art, music and engineering.
- **Explore ideas in Robotics. Appropriate for training, innovative research and scientific achievements in the field of Robotics, communications, control and sensors**
- **Programing Cubelets by Google's visual programming language - Blockly and Cubelets Flash to program Cubelets using the C language.**
- **Dash and Dot - Blockly notepad application - by inserting in a sequence already defined blocks.**
- **Programming in the EV3 Programming tool and transmitting the program from the App/Programming software to the robot's EV3 P-brick.**

ROBOTLAB lessons: CLASSROOM PACK examples

1. Ready solutions for how to apply Dash and Dot in education are available: DASH AND DOT CLASSROOM PACK
https://www.robotlab.com/store/dash-dot-classroom-pack
Includes: 6 Dash robots, 6 Dot robots, 6 Launchers, 6 Building Brick Connector Sets (4 connectors per set), 6 Accessory Packs, 6 Challenge Card Box Sets, 1 Learn to Code Curriculum Guide. Block coding on four different iPad apps to control their robots
2. CUBELETS CLASSROOM PACK : building 3- and 4-block robot constructions
https://www.robotlab.com/store/classroom-pack

Outline

- Remember definition of a robot
- Build Drive Bot with Distance SENSE

Objectives

Students will practice flexible thinking by redesigning their robots for different jobs.

Assessment

Teachers look for:
Students rotate individual Cubelets within a robot
Students switch the order of blocks in their robot
Students remember the goal they are designing for, View Google Doc

Motion-sensing devices

MS Kinect Sensor

LEAP motion device

Discovering the Secrets of the Universe with VR + Embodied Learning

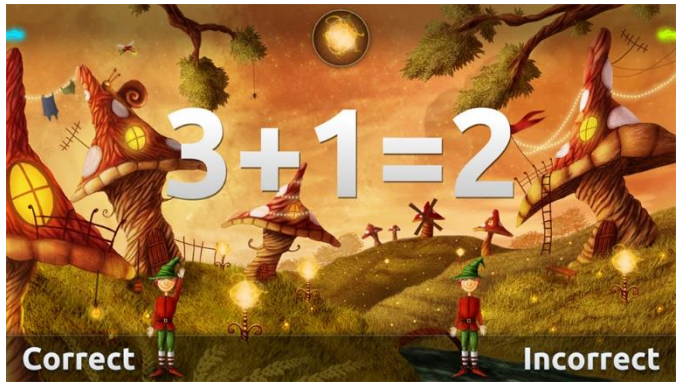
Leap motion supporting medical education
https://www.youtube.com/watch?v=THueMLRohH8

Attracting games - Jumpido

- Physical Exercises: there is nothing that kids like more than jumping and having fun - Jumpido harnesses all this energy for learning.

https://www.youtube.com/watch?v=DiZTas10r4g&feature=youtu.be

- The best way to learn math is when children constantly experiment and discover new things! Using the Kinect Motion Detection Device, pupils need to solve math problems and use their bodies to answer to tasks.



Motion-sensing devices– impact in education

- Developing sensorimotor skills (fine and gross) by real physical movements.
- Controlling robots and digital objects on screens by body movement - trainers and monitoring tools to practice skills in art, sport, science.
- Natural curiosity in exploration supports Embodiment-based Learning - external perceptions for better knowledge construction. Using mind in a physical way and visualize movements on the screen support memorizing.
- Neuroscience claims: Promoting more movements in children resulting in exponential neuronal growth in the brain.
- VR + Leap motion - best application in medical education.
- **Developing applications by MS Kinect SDK, by LeapC (a C-style APIs), for bringing gesture controls to everyday computing or games**
- **Produce high-quality 3D scans**
- **Retrieve data via gestures**
- **Virtual reality interactions**

Virtual/Augmented Reality

Microsoft HoloLens headset- the first self-contained, holographic computer, enabling your digital content to interact the world around you. Mixed reality with HoloLens brings people, places, and objects from your physical and digital worlds together.

https://www.microsoft.com/en-us/hololens

HoloTours -https://www.youtube.com/watch?v=Ql5aWF0vURc

Samsung Gear VR (2017 edition) - one of the low-cost Virtual Reality devices with a very good quality. Create a real sense of presence.

https://www.youtube.com/watch?v=ZiDOFc2dorI&feature=youtu.be

Oculus Prologue - explores emotional engagements in the realm of VR. Creates immersive experience with story beats and progression of events to evoke emotional reactions from players. Used various methods including *movement, mechanics, and visual and audio components.*

Virtual Reality/ Augmented Reality technologies - Impact in Education

- To make complex lessons simple by immersing in the world of holograms with new way of interactions and teamwork.
- New way of interactions: pupils are completely cut off from their local environment visually and they are able to see an instructor/teacher, each other and also to interact.
- Engaging headset for VR educational apps. Explore places and science: Learning by experience. Can be created a wide range of experiences:

  -3D Geometry in the Classroom. Pupils will be seeing the same model but from different viewpoints.

  -Medical Science Training areas relating to anatomy and physiology.

  -Bringing a view of the earth and space, history, geography, biology.
- New way to create and collaborate. Art hands-on.
- Oculus mobile platform transforms student's GALAXY smartphone into a portable VR device that lets experience anything & anywhere
- Learn by practice, natural curiosity and exploration.
- Free apps can be found: https://unimersiv.com/best-educational-apps-samsung-gear-vr/

Virtual Reality/ Augmented Reality - impact in non-formal/special education

- **Explore ideas. Learning by exploration in a new dimension of creativity and teamwork**
- **Natural curiosity in 3D programming.**
- **How to create and work with holograms in relation to the world around pupils.**
- **Using HoloLens SDK applications for building mixed reality. SDK uses Visual Studio with the Windows 10 SDK. In case of don't having a mixed reality device - HoloLens emulator. Build and test mixed reality apps**
- **A new dimension of creativity and teamwork by Oculus Mobile SDK.**
- **SDKs programming and test very simple applications for Oculus VR glasses and thus to "learn by exploration".**

By native SDKs programming apps in special education can be developed for:

-Social experience

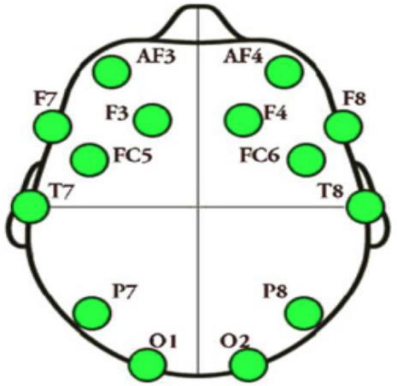
-Education

-Entertainment

EEG based brainwave devices

Insight/EPOC of EMOTIV

https://www.youtube.com/watch?v=bposG6XHXvU



- NeuroSky Mindwave Mobile

https://www.youtube.com/watch?v=2Qp

EEG based brainwave devices (MindWave, Insight/EPOC)-impact in education

- A portable devices with dry electrodes and easy calibration such as MindWave Mobile 2 of NeuroSky could be used for demonstrations in learning biosensors and biometrics.
- EMOTIV devices are not meaningful to use in formal education. It has wet electrodes and complex software. It requires an informed consent from parents.
- **Learning by exploration. Creativity.**
- **Programing in Python, C# or C++ for gaming applications, training or mental, cognitive and emotionally self-assessing. Curiosity in neuroscience.**

Report on the most appropriate technologies
Indicator 4 (A2)

Most appropriate technologies in Preschool and Formal Education according to 4 age groups (5-6; 7-9; 10-12; 13-16) and based on 8 different criteria:

- Low cost and reliability
- Intuitive for teachers and require lowest training
- Can support visual orientation and mobility skills
- Can support cognitive skills and problem solving
- Can support cooperative play and promote socialization
- Can support developing empathy and improve emotional intelligence
- Can support progress on self-management (autonomy, competence, engagement, motivation and curiosity)
- Can serve as teachers

Formal Education	Most Appropriate Technologies			
Criteria	Age: 5-6	Age: 7-9	Age: 10-12	Age: 13-16
Low cost and reliability	Artificial anthropomorphic robotic hand Non-humanoid Walking Robot MS Kinect Sensor Cubelets Humanoid Robot NAO	LEAP motion device Artificial anthropomorphic robotic hand Non-humanoid Walking Robot MS Kinect Sensor Cubelets Dash and Dot Lego Mindstorms Humanoid Robot NAO	LEAP motion device Artificial anthropomorphic robotic hand Non-humanoid Walking Robot Non-humanoid Walking Robot MS Kinect Sensor Cubelets Dash and Dot Lego Mindstorms Humanoid Robot NAO	LEAP motion device Non-humanoid Walking Robot Oculus Gear VR glasses MS Kinect Sensor Dash and Dot Cubelets VR Oculus Rift glasses Insight brainwave device Lego Mindstorms Microsoft HoloLens Humanoid Robot NAO
Intuitive for teachers and require lowest training	Non-humanoid Walking Robot Artificial anthropomorphic robotic hand MS Kinect Sensor Cubelets Humanoid Robot NAO	Non-humanoid Walking Robot Artificial anthropomorphic robotic hand Cubelets MS Kinect Sensor Humanoid Robot NAO Dash and Dot	Non-humanoid Walking Robot Cubelets MS Kinect Sensor Dash and Dot	Non-humanoid Walking Robot MS Kinect Sensor VR Oculus Rift glasses Oculus Gear VR glasses Microsoft HoloLens
Can support visual orientation and mobility skills	MS Kinect Sensor Humanoid Robot NAO	MS Kinect Sensor LEAP motion device Humanoid Robot NAO	MS Kinect Sensor LEAP motion device	MS Kinect Sensor VR Oculus Rift glasses + LEAP motion device Microsoft HoloLens Oculus Gear VR glasses

Formal Education	Most Appropriate Technologies			
Criteria	Age: 5-6	Age: 7-9	Age: 10-12	Age: 13-16
Can support cognitive skills and problem solving	Humanoid Robot NAO Non-humanoid Walking Robot MS Kinect Sensor Artificial anthropomorphic robotic hand Cubelets	Humanoid Robot NAO Non-humanoid Walking Robot MS Kinect Sensor Artificial anthropomorphic robotic hand Cubelets Dash and Dot	Non-humanoid Walking Robot Lego Mindstorms Humanoid Robot NAO MS Kinect Sensor Programming non-humanoid robots Cubelets Dash and Dot	Non-humanoid Walking Robot Lego Mindstorms Oculus Gear VR glasses VR Oculus Rift glasses Microsoft HoloLens Cubelets
Can support cooperative play and promote socialization	Non-humanoid Walking Robot Cubelets	Non-humanoid Walking Robot Cubelets Dash and Dot	Non-humanoid Walking Robot Lego Mindstorms Humanoid Robot NAO Cubelets Dash and Dot	Non-humanoid Walking Robot Lego Mindstorms Microsoft HoloLens interactions
Can support developing empathy and improve emotional intelligence	Humanoid Robot NAO Non-humanoid Walking Robot Cubelets	Humanoid Robot NAO Non-humanoid Walking Robot Cubelets Dash and Dot	Humanoid Robot NAO	Microsoft HoloLens interactions Humanoid Robot NAO
Can support progress on self-management (autonomy, competence,	Cubelets Non-humanoid Walking Robot Artificial anthropomorphic robotic hand	Cubelets Non-humanoid Walking Robot Artificial anthropomorphic robotic hand	Humanoid Robot NAO Lego Mindstorms Cubelets MS Kinect Sensor	VR Oculus Rift glasses+ LEAP motion Oculus Gear VR glasses Lego Mindstorms Microsoft HoloLens

Conclusions

- Our new findings how to contribute in enhancing the education are based on the traditional idea that pupils learn by experience and interactions with the world.

- When this experience is impossible or expensive, innovative technologies can offer hands-on and an illusion of real-life interactions and exploration of places, objects and ideas.