Vo 20200531 0925 🡪 LT PL DE by Website

**Current status of curricular considerations**

This just a sampler of impressions, experiences and comments from participants and associates.

The considerations are basing on Non Formal Learning Environment (elective subjects and courses) and a group of approximately 8 students in 4 teams with one weekly lesson of 90-120 minutes.

Material considerations:

- LEGO®-Mindstorms Education EV3 is quite expensive (470 € new, ~300 € second hand) to buy, but

- it seems to save a lot of money in questions of destruction (normally no misconnection possible)

- it saves a lot of time concerning preparation by the instructors (students start directly with the box)

- it allows controlling the completion of material within 30 min by checklist

- rechargable battery is included, just a charger (10 €) is necessary

- it does not need more than 42,5 cm x 31 cm x 15 cm for one durable well structured box

 (A large ready construction needs further 42,5 cm x 31 cm x 30 cm for storage, but that´s it.)

LEGO®-Mindstorms Education EV3

- is integrating construction and programming competencies as well

 (Nonetheless an instructor is free to offer ready built objects, if just programming is the goal.)

- basing on well structured modular parts

- almost no tools necessary

- sufficient precision for models beneath the level of engineering

- offers reliable step by step construction manuals integrated in the software

- offers a simple graphical programming-system – almost no reading competencies necessary!

- works bidirectional:
 triggers actors and shows connection and current status of sensors and actors on screen of PC/Laptop

- allows to integrate individual sound, text and graphic-creations

- with minimal help by a course instructor children from 6 years on seem to be able to start

- the tasks are possible to become differenciated in modular jobs

- the difficulty may increase up to education of engineers in their second year at university

- higher languages may be used, like SCRATCH or PYTHON or… C

- OpenRoberta can be used by additional firmware (using micro-SD slot), offering simulation as well

- above the preformed construction tasks and ready to use programs modifications are possible

- Existing LEGO®-technic bricks and beams are integratable

Although the material offers tasks for hundreds of lessons and opens a world for own ideas for thousands of hours, we must accept, that young students should experience a lot of different courses in different subjects during 4 years.

In case of semester-related competing offers in sports, music, arts, technics, literature etc. the students could (should) choose 8 different courses from the 5th up to the 8th form. A school should push the students, to choose different courses, in order to open their eyes for lifetime open minded attitude.

Although this postulate, students have been recruited for 2 years in this project, in order to study basics, experience different material and cooperate with foreign students all over Europe. A contradiction? Not really! Indispensible components from the conditions of the ERASMUS+ Program are mobility, visits and hospitality, cultural, sportive and regional studies up to cooking, having meals and festivities together. This means, ERASMUS+ projects integrate different offers from school´s usual range of services.

Nevertheless a „normal“ course in basical ICT-Robotics-Ethics should not last longer than half a year.

This is following the comment of one of our participants, who – although quite bright in constructing and programming – is beginning to feel bored after half a year, particularly since he seems to pretend, that he was misunderstanding the conditions of duration in participation in the project. Nevertheless his opinion shall be respectfully summarized at this place: ½ year intensive course using graphical language offers enough basics. Extending contents might be offered separately. During 4 years 8 different additive courses should be available for children.

So, how to structure ½ year with approximately 20 weeks of about 90 minutes per session?

**01 Unboxing, Connecting Charger, Assorting Parts, Starting Software, Checking Sensors and Actors**

- Try 1st Program with „Wait for Touch of Switch“ and „Run Large Motor for 5 seconds“.

- Try 2nd Program with Wait for Colour Red and Run Medium Motor for 3 Circles.

- Try 3rd Program with Wait for Distance less than 10 cm and cause sound of a barking dog.

 - Try 4th Program with Wait for Distance more than 10 cm and show GO on the Display.

**02 Follow** **LEGO®-MINDSTORMS EV 3 Software for Vehicle-Assemblage** independently in **46 steps**!

- Keep material well organized for quick success!

- Prevent connector of Brainbrick against damage; install a 90°-cable permanently!

**03 Programming of Robot-Vehicle**

- Drive the robot-vehicle a dedicated distance!

- Stop in front of a barrier!

- Stop at dedicated colour!

- Make noise when stopping!

**04 Let´s dance!**

- Drive the robot-vehicle a dedicated trace.

- The robot-vehicle is dancing special steps.

- The robot-vehicle reacts on colours.

**05 Looping?**

- RED traffic-light; Robot-vehicle stops.

- … on YELLOW roaring motor noise.

- … starts on GREEN traffic-light.

- Loop is necessary, otherwise restart of program after every stop

**06 Managment for Lego® - Projects and implemented Programs**

- How to **downlod** a **PROJECT**

- How to **mangage PROJECTS and PROGRAM-files in the PC**

**Changefolder** vs **Personal Folder**

- how to **manage** **PROJECTS and PROGRAM-files** in the **BrainBrick**

**Teacher´s robot welcomes participants:**

“Hello, Yessi!”, “Hello, Vladimir!”, “Hello, Rita!”, “Hello…!”

WelcomeParade may be a **Download-Example**.

It may become tried out, modified with own soundfiles.

or

programmed with **LEGO®-MINDSTORMS EV 3 Software** from the beginninglike **self-developed.**

The teams may **assemble** the **gripper** onto the Robot-Vehicle and try to **program** its **function.**

Discuss Dis-/Advantages or job-consequences for employees and clients in nursing services!

**07 Have you got own ideas? I**nvent**, C**onstruct, **A**ssemble, **P**rogramme, **T**est, **R**efine

- Temperature related [Fan](http://www.ict-robotic-ethic.de/index_htm_files/20191024%20FanTemp.mp4) (needs additional Temperature Sensor!)

- Robot stops in a [certain area](http://www.ict-robotic-ethic.de/index_htm_files/20191024%20StopDistance.mp4); 10 trials

- Robot stops at [RED](http://www.ict-robotic-ethic.de/index_htm_files/20191024%20StopRED.mp4)

- Let the robot wink with the fork

- Robot as a barking [Guard Dog](http://www.ict-robotic-ethic.de/index_htm_files/20191024%20Guarddog.mp4)

Each team refers progress, obstacles and solutions to the others.
 Discuss Dis-/Advantages or job-consequences for security guards and watch-dogs!

**08 If-clause** in a program needs a **Switch!**

- **Linefollower** (how and where to mount the sensor; how to adjust velocity of adaptation?)

Alternatives: Extraordinary Experiments with additional Sensors (available differentiation):

- **On the route** (defined trace)

- **Robot-Musician** (Melodie from Brainbrick)

**- Refugee** (Robot rolls away, when it´s warmer than 32°C.)

**- Noise-Sensor** (Basics, Clap-Switch)

**09 Create a Key by Code** and **Explore the Display**

**- ColourKeyCode can**

- starta **motor** (triggering noise from BrainBrick)

- trigger a **fork-movement**

- open a **bar**

- **unlock** a door etc.

**-** Fan uses Temperature-, Colour- **and** Soundsensor for a serial code

- **Display can** show

- text

- signs

- individual graphics

**10 Robot-Vehicle for Parcel-Service**

 - Robot recognises colour of a parcel
 - Bar is going down
 - Robot is pulling/pushing the parcel to a defined adress

Discuss Dis-/Advantages or job-consequences for employees and customers in parcel services!

**11 Our Robot is organizing coloured boxes automatically**

- Assembling the Coloursorter following the LEGO®-Software

- [Fill/ Recognize](http://www.ict-robotic-ethic.de/index_htm_files/20200109%20Col%20Sort%20Fill.mp4) Colours; [Sort](http://www.ict-robotic-ethic.de/index_htm_files/20200109%20Colo%20Sort%20work.mp4), following the Array-Structure of the original LEGO®-Program

**Additional Differentiaton for Christmas**

- Music-Device**(Jingle Bells)**

Discuss Dis-/Advantages or job-consequences for employees in ware-houses!

**12 Modification of Colour-Sorter in Construction and Programme**

- Place the Colour-Sensor above the edge of the ramp, where the boxes leave the shutter

 - Create a programme ***without arrays***, just using integrated switches in a loop

 - If possible, add comments concerning the function of program-steps.

Discuss Dis-/Advantages or job-consequences for employees and customers in ware-houses!

**13 Robot-Arm**

- Assembling the Robot-Arm following the LEGO®-Software

- Try the Robot-Arm, following the original LEGO®-Program

**Additional Differentiaton** by **individual** **constructions** or **modifications 🡪 14**

Discuss Dis-/Advantages or job-consequences for employees in industrial production!

**14 – 15 Engineers improve, integrate and innovate inventions**

- **Forklift**
 Some different constructions with content of the box or additional parts.
 Try out lift´s positions by using the Block-Execution step by step.
 Add emergency-stop-switches.

- **LineFollower** **Keep distance** by stops; using Ultrasonic-Sensor
 **Adapt velocity** by Cruise-Control; using BrainBrick´s Control Buttons

 **Driverless car adapts velocity** to a slower one, using **variable SPEED**, **data-store** and **-transfer**

Discuss Dis-/Advantages (Safety, Comfort, Reliability) in public traffic!

- **Robot-Arm**  Write your own program for the Robot-Arm
 Modify the Robot-Arm with Remote and IR Sensor
 Modify the Robot-Arm with position of coloursensor at the gripper
 Install automatical recognition of brick´s colour; shifting bricks to colour-related destinations.

Discuss Dis-/Advantages or job-consequences for employees in industrial production!
Discuss Dis-/Advantages or job-consequences for employees and clients in nursing services!

- Individual **Display Design**Discuss Dis-/Advantages or job-consequences for employees and clients in super-markets!

**16 – 17 Sequential activities of Robots, Interaction of Robots, Relation between Robots**

 **Robot Arm puts empty Coloured Containers from A to B or C
 Vehicle transports empty Coloured Containers towards the Colour-Sorter
 Colour Sorter is spitting coloured Bricks into the coloured Containers**

**18 – 19 Finishing Reports by Comments on Modified Constructions and on Programs**

**Videos like Paycheck or ExMachina as trigger for Discussions concerning Ethics**

**20 Demonstration for parents-evening, course-advertisement for interested or potential students.**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| System | costs | challenge | ready to use? | dimen-sionalaccuracy | storage system | Adresseesor ageof users | con-structing | pro-gramming | success | differen-tiation |
|  | … €expensivebalancedcheap | too difficulttoo simpleeasymotivatingadequate | noalmostyes | perfectsufficient for…poor | perfectgoodusablechaoticmissing | preschool4 – 6primary school6 – 10secondary10 – 18voluntary16 - 20university18 - … | nojust assemb-lingyes | noyessystemlanguage | instantlyquicklyneeds patience | narrowpossiblewidemodular |
| LEGO®mindstormsEV3 EDUCATIONEV-G graphical blocks will be kept also in LEGO®CLASSROOM from spring 2020 on, wrote Chris in LEGO®CHAT 20200330 | 470 € new300 € usedBalanced in relation to practical-ness | adequate by differen-tiation | ~ 10 €chargerneededor e.g.home version 31313 needs 6 AA Cells | sufficientfor school | Quitegood | from playing, to contructing and program-ming6 – 90 | yesperfectly guidedor individual | Simple graphics; almost without reading up to Scratchand higher | Quickly,depends on the tasks | Wide by modular jobs and individual programs |
| fischer technic® | Balanced in relation to quality | adequate | Yes, butneeds to by compo-nents, power, software | really good, almost industrial | missing;needs to be boughtextra | Construc-tingAnd program-ming10 – 80 | yes | Logic Flow-ChartSPS\* | Quickly,depends on the tasks | Wide by individual programs |
| CALLIOPE | cheap | Easy,except filestorage | Yes,start-programloaded |  | nicesmallbox | 6 – 60  | No  | YESNEPO likeSCRATCH,PYTHON,JAVA | Quickly | Wide by individual tasks |
| CALLI:botby knotech | cheap | depending on task | Just assemble 10 min; well guided | perfect | Ecol. +cardboardbox, buttoo small for assem-bled car | 6 – 60 | Not really | YESNEPO likeSCRATCH | Quickly | Wide by individual tasks |
| Cozmo | Expensive | Startsplaying | yes |  ./. |  perfect |  8 – 12  | no | Colour-Keys;notechnicalsense;just game | Quickly | notechnicalsense;just game |
| SIOS®MODULBUS | Expensive | depending on task | profes-sional assem-bling is part of the job | mechanical accuracy of engraver sufficient models | missing | Vocational school,university | ready built modelsup to own creations with elec-troniccompo-nents | Special Plat-forms | Depen-ding on Task | By choice of model or task |
| FESTO® | Expensive | VocationalProfes-sional | profes-sional assem-bling is part of the job | Industrial durable Quality | Profes-sional | Vocational school,university | from model up to engineertasks | SPS\* | doubt-less, because of selected users | Quite specialadresseesdepending on jobs |

\*SPS (speicherprogrammierbare Steuerung) = PLC (Programmable Logic Controller)