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 beginning like **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? Invent**, C**onstruct, **A**ssemble, **P**rogramme, **T**est, **R**efine

- Temperature related Fan (needs additional Temperature Sensor!)

- Robot stops in a certain area; 10 trials

- Robot stops at RED

- Let the robot wink with the fork

- Robot as a barking Guard Dog

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**

- start a **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 Colours; Sort, 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?	dimensional accuracy	storage system	Adressees or age of users	constructing	programming	success	differentiation
	… € expensive balanced cheap	too difficult too simple easy motivating adequate	no almost yes	perfect sufficient for… poor	perfect good usable chaotic missing	preschool 4 – 6 primary school 6 – 10 secondary 10 – 18 voluntary 16 - 20 university 18 - …	no just assembling yes	no yes system language	instantly quickly needs patience	narrow possible wide modular
LEGO® mindstorms EV3 EDUCATION EV-G graphical blocks will be kept also in LEGO®CLASSROOM from spring 2020 on, wrote Chris in LEGO® CHAT 20200330	470 € new 300 € used Balanced in relation to practical-ness	adequate by differen-tiation	~ 10 € charger needed or e.g. home version 31313 needs 6 AA Cells	sufficient for school	Quite good	from playing, to contructing and program-ming 6 – 90	yes perfectly guided or individual	Simple graphics; almost without reading up to Scratch and higher	Quickly, depends on the tasks	Wide by modular jobs and individual programs
fischer technic®	Balanced in relation to quality	adequate	Yes, but needs to by compo-nents, power, software	really good, almost industrial	missing; needs to be bought extra	Construc-ting And program-ming 10 – 80	yes	Logic Flow-Chart SPS*	Quickly, depends on the tasks	Wide by individual programs
CALLIOPE	cheap	Easy, except file storage	Yes, start-program loaded		nice small box	6 – 60	No	YES NEPO like SCRATCH, PYTHON, JAVA	Quickly	Wide by individual tasks
CALLI:bot by knotech	cheap	depending on task	Just assemble 10 min; well guided	perfect	Ecol. + card board box, but too small for assem-bled car	6 – 60	Not really	YES NEPO like SCRATCH		Quickly
Cozmo	Expensive	Starts playing	yes	./.	perfect	8 – 12	no	Colour-Keys; no technical sense; just game	Quickly	no technical sense; 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 models up to own creations with elec-tronic compo-nents	Special Plat-forms	Depen-ding on Task	By choice of model or task
FESTO®	Expensive	Vocational Profes-sional	profes-sional assem-bling is part of the job	Industrial durable Quality	Profes-sional	Vocational school, university	from model up to engineer tasks	SPS*	doubt-less, because of selected users	Quite special adressees depending on jobs

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