BioBeo Robot

Co-funded by the European Union

Information

BioBeo Bioeconomy Definition:

"Bioeconomy is a systems-based approach that seeks to replace fossil resources in a sustainable manner with renewable biological resources from terrestrial and marine ecosystems – such as forests, crops, animals, fish, microorganisms, organic waste, and agricultural side streams, to produce food, feed, fibres, energy, bio-based products, and services within a circular economy framework designed to optimise resource use based on a cascading hierarchy of utilisation options. A sustainable and circular bioeconomy requires the application of education and training programmes, scientific research, technology, and innovation with the aim of not only creating economic value, but also regenerating and expanding ecosystems and biodiversity as well as improving the health and the well-being of society. By addressing these systemic changes in the economy, environment, and society, the bioeconomy contributes to achieving a better and more sustainable future where no one is left behind."

Organisation: E3STEM

Country: Greece

Topic: BioBeo robot: a useful assistant that helps students learn what is Bioeconomy.

Narrative: BioBeo robot is a custom-made robot that can be used as a primary school teacher's assistant. In particular, BioBeo robot aims to help students learn in a fun and creative way what Bioeconomy is and why Bioeconomy is so important for our lives and for the environment!

This robot may have a body (hardware) with various mechanisms that enable movement (transport, rotation of the body and of the arms etc). In addition, it has a software so that it can perform various functions. It has a built-in screen to display the "Bioeconomy" application, where users can play interactive games and watch educational videos. A microbit board is integrated into the robot's head to be used in temperature and brightness automation.

When brightness in BioBeo robot's environment increases, the robot is activated and the microbit board displays the icon  on the led screen. Otherwise, the robot turns off and the microbit board displays the icon  . When temperature in BioBeo robot's environment increases, the microbit board displays the word "HOT" on the led screen. Otherwise, the robot turns off and the microbit board displays the word "COLD".

BioBeo robot allows its users, i.e. mostly primary school students and their teachers, to intervene in its construction and mechanical parts (hardware) as well as in its software. Students and teachers can work together to create their own BioBeo robot! Specifically, they can design and build the robot body in a different way and with different materials. They can also modify and/or enrich the robot program with more functions, information, graphics and automations (e.g. measuring air/soil moisture, ph, watering plants etc).

Methodology/ies: Active Learning, Guided Discovery, Talk and Discussion, Problem Solving, Collaborative Learning, Engaging and Interacting with the Natural Environment, Free Exploration of Materials, Learning through Play, Direct Teaching, Inquiry-based, Engineering Design Process

SDG: https://www.un.org/sustainabledevelopment/education/

https://www.un.org/sustainabledevelopment/gender-equality/

Age group: 8-12 years old

Curriculum integration: Environmental Sciences, Biology, Chemistry, Physics, Mathematics, Computer Science, Arts, Bioeconomy Education.

The following themes are addressed by this Material:

Interconnectedness ☒

Outdoor learning ☒

Food Loop ☒

Forestry ☒

Life Below Water

Interconnectedness reflects the role of the biosphere and natural environments in human well-being and holistic health and the undisputed ecological interconnectedness of all living things.
Outdoor learning is active learning in the outdoors where participants learn through what they do, through what they encounter and through
Food Loop encompasses farming, hospitality, retail, and energy production sectors. In terms of the circular economy, it focuses on the
Whilst **forestry** products are increasingly attractive in terms of sustainability, and are a major part of the circular economy, there are
Life below water refers to the conservation and sustainable use of all water bodies (like oceans, and marine resources but also rivers and lakes) for sustainable development.

Learning outcomes for Primary schools

Learning outcomes of Lesson 1

1. Develop an understanding of new terms and vocabulary and use them in dialogue.

2. Discuss the concept of Bioeconomy and the Bioeconomy's 5 themes in the school environment.

3. Discuss the concept of Circular Bioeconomy, using examples for each of the 5 Bioeconomy themes.

4. Be introduced to the Engineering Design process.

Learning outcomes of Lesson 2

1. Be introduced to Computational Science and develop Algorithmic Thinking

2. Experiment with the scratch programming language by altering the PAMK robot's initial software

3. Examine different applications of PAMK robot's software

Learning outcomes of Lesson 3

1. Understand the difference between fixed and variable quantities as well as the concept of automations

2. Experiment with the scratch programming language and the PAMK robot's microbit automations

3. Examine alternative microbit automations

Learning outcomes of Lesson 4

1. Experiment with the use of different building materials, examine and evaluate their strength and performance

2. Experiment with the use of simple and complex mechanisms, examine and evaluate their functionality

Learning outcomes of Lesson 5

1. Be engaged in the Engineering Design process

2. Experiment with the scratch programming language and microbit automations

3. Experiment with the use of different building materials, examine and evaluate their strength and performance

4. Experiment with the use of simple and complex mechanisms, examine and evaluate their functionality

Learning outcomes of Lesson 6

1. Present the Engineering Design process which refers to the development of their custom-made Bioeconomy robot

2. Discuss and explain potential building and programming problems that occurred during the Engineering Design process

3. Suggest alternative and/or more solutions to improve the functions and the possibilities of their custom-made Bioeconomy robot

4. Explain how their “Bioeconomy robot” can help other students understand the concept of the Bioeconomy and how such a smart solution could enhance the Circular Bioeconomy.

Lesson Plans

Lesson Plan 1

Subject(s): Language, STEAM, Education for Sustainable Development, Global Citizenship, Circular Bioeconomy	**Title of Lesson: Introduction to the Bioeconomy** **No. of Lesson 1 of 6**	
Date: Autumn term 2024	**Class: 3rd-6th**	**Time: flexible** **Duration: 90 mins**
BioBeo Theme: Interconnectedness, Outdoor learning, Food Loop, Forestry, Life Below Water	**Keywords/Phrases: bioeconomy, natural resource, bio-based resource, habitat, sustainable, ecosystem, ecological, renewable, interconnectedness, biodiversity.**	

Learning Outcomes (Engage stage):

Participants will be enabled to:

- Develop an understanding of new terms and vocabulary and use them in dialogue.
- Discuss the concept of Bioeconomy and the Bioeconomy's 5 themes in the school environment.
- Be introduced to the Engineering Design process.

Resources/Materials/Equipment: paper, pencils/colouring pencils/crayons/charcoal, internet, projector

Introduction (30 mins): The teacher presents the videos "The Bioeconomy starts here!" & "What is the Bioeconomy?" and asks the class open-ended questions to facilitate discussions about the benefits of Bioeconomy and the Bioeconomy's 5 themes. Students are introduced to the "PAMK robot project" (project framework & details, software) and discuss potential adaptations with their teacher.

Development (40 mins): The teacher explains the steps of the Brainstorming process and introduces students to the stages of the Engineering Design Process. The students watch the videos "How to Make a Robot out of Cardboard (Very Simple)" & "How To Make The Cutest Walking Robot". Then, they work in groups of 3 or 4 to create mind maps of how they could design and construct the body parts and mechanisms of their own robot.

Conclusion (20 mins): Each group of students presents sketches/drawings and ideas regarding the design of the body parts, the mechanisms as well as the potential functions of such a robot.

Reflection on Teaching & Learning: Reflective journal of teacher: Teacher will write down any important statements or key observations of the children's learning as the lesson progresses and the children are in the flow of their tasks and learning experiences. Teacher also reflects on the children's drawings, photos and feedback to teacher think-pair-share activities.

Teacher will answer the questions in journalling after: What did the children do? How did they respond? What were the key questions they asked of the lesson? What works did they produce?

Assessment for Learning:

- Digital evidence
- Documented information: such as notes, photographs, videos, and learning stories, journal written by teacher in lesson flow
- Art works produced by children (co-researchers) and photos of processes
- Pupils' self-assessment: follow on learning with class teacher and parents in the week between each lesson

Literature and links

- Bioeconomy games: https://library.transition2bio.eu/t2b_results?title=&source=Any&language=English&country=Any&contentType=Games&categories=Bioeconomy%20education&bioeconomySector=Any&pageno=1&fbclid=IwAR1A9gQ6SX3SdtSU0PY_z9ScWGI3FpiqyU-QqckNs8Zk6OmYg_JBcH5ixUU
- Bioeconomy strategy: https://research-and-innovation.ec.europa.eu/research-area/environment/bioeconomy/bioeconomy-strategy_en
- Sustainable Development Goals: https://www.un.org/sustainabledevelopment/sustainable-development-goals/
- 'What's Bioeconomy?' - Book for children: https://ec.europa.eu/research-and-innovation/en/research-area/industrial-research-and-innovation/eu-valorisation-policy/knowledge-valorisation-platform/repository/whats-bioeconomy-book-kids
- The "PAMK robot project" project

Lesson Plan 2

Subject(s): STEAM, Computer Science, Education for Sustainable Development, Global Citizenship	**Title of Lesson: A Bioeconomy robot** **No. of Lesson 2 of 6**	
Date: Autumn term 2024	**Class: 3rd-6th**	**Time: flexible** **Duration: 90 mins**
BioBeo Theme: Interconnectedness, Outdoor learning, Food Loop, Forestry, Life Below Water	**Keywords/Phrases: bioeconomy, natural resource, bio-based resource, habitat, sustainable, ecosystem, ecological, renewable, interconnectedness, biodiversity.**	

Learning Outcomes (Explore & Explain stage):

Participants will be enabled to:

- Be introduced to Computational Science and develop Algorithmic Thinking
- Experiment with the scratch programming language by altering the PAMK robot's initial software
- Examine different applications of PAMK robot's software

Resources/Materials/Equipment: paper, pencils/pens, internet, projector, laptop/tablet

Introduction (30 mins): The teacher presents the videos "How to Make a Jumping Game in Scratch | Tutorial" and "How to Make Collectible Items in Scratch | Tutorial" as well as the "PAMK robot's" prototype software to the class and discuss with the students potential adaptations. Students are encouraged to think of and try alternative functions that could also be included in the "PAMK robot's" software.

Development (40 mins): Each group of students experiments with the scratch programming language and interferes with the software either by changing some aesthetic/functional elements or by adding new ones.

Conclusion (20 mins): Based on the above students-software interaction experience, the students and the teacher briefly discuss potential problems in case of altering aesthetic/functional elements or adding new ones.

Reflection on Teaching & Learning: Reflective journal of teacher: Teacher will write down any important statements or key observations of the children's learning as the lesson progresses and the children are in

the flow of their tasks and learning experiences. Teacher also reflects on the children's drawings, photos and feedback to teacher think-pair-share activities.

Teacher will answer the questions in journalling after: What did the children do? How did they respond? What were the key questions they asked of the lesson? What works did they produce?

Assessment for Learning:

- Digital evidence
- Documented information: such as notes, photographs, videos, and learning stories, journal written by teacher in lesson flow
- Art works produced by children (co-researchers) and photos of processes
- Pupils' self-assessment: follow on learning with class teacher and parents in the week between each lesson

Literature and links

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- Bioeconomy strategy: https://research-and-innovation.ec.europa.eu/research-area/environment/bioeconomy/bioeconomy-strategy_en
- Sustainable Development Goals: https://www.un.org/sustainabledevelopment/sustainable-development-goals/
- 'What's Bioeconomy?' - Book for children. https://ec.europa.eu/research-and-innovation/en/research-area/industrial-research-and-innovation/eu-valorisation-policy/knowledge-valorisation-platform/repository/whats-bioeconomy-book-kids
- The "PAMK robot project" project

Lesson Plan 3

Subject(s): STEAM, Computer Science & Educational Robotics	**Title of Lesson: How to design a Bioeconomy robot_the software/automations** **No. of Lesson 3 of 6**	
Date: Autumn term 2024	**Class: 3rd-6th**	**Time: flexible** **Duration: 120 mins**
BioBeo Theme: Interconnectedness, Outdoor learning, Food Loop, Forestry, Life Below Water	**Keywords/Phrases: bioeconomy, natural resource, bio-based resource, habitat, sustainable, ecosystem, ecological, renewable, interconnectedness, biodiversity.**	

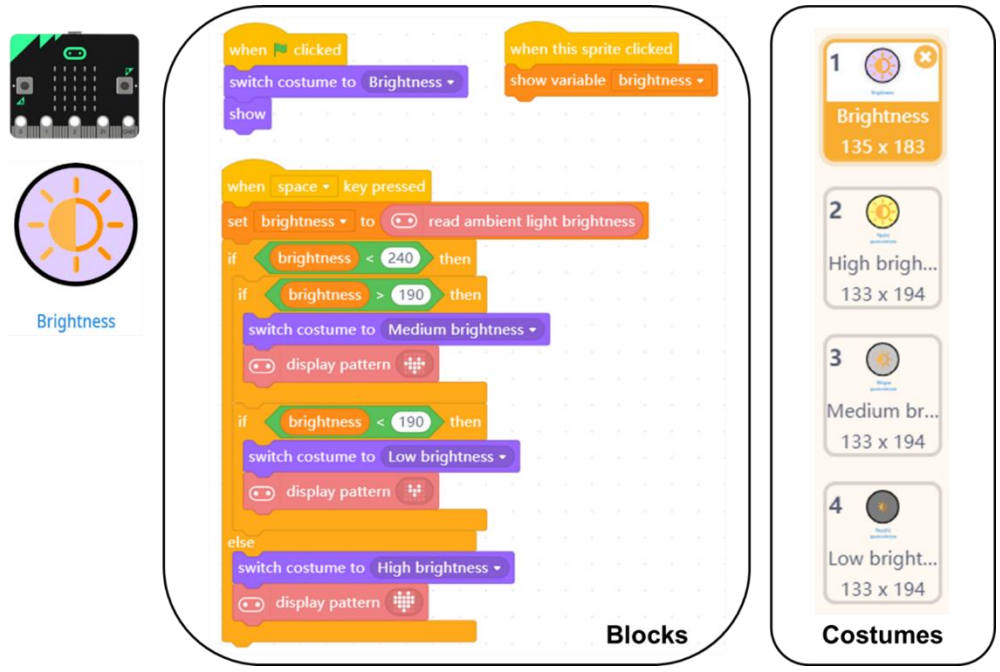
Learning Outcomes (Explore & Explain stage):

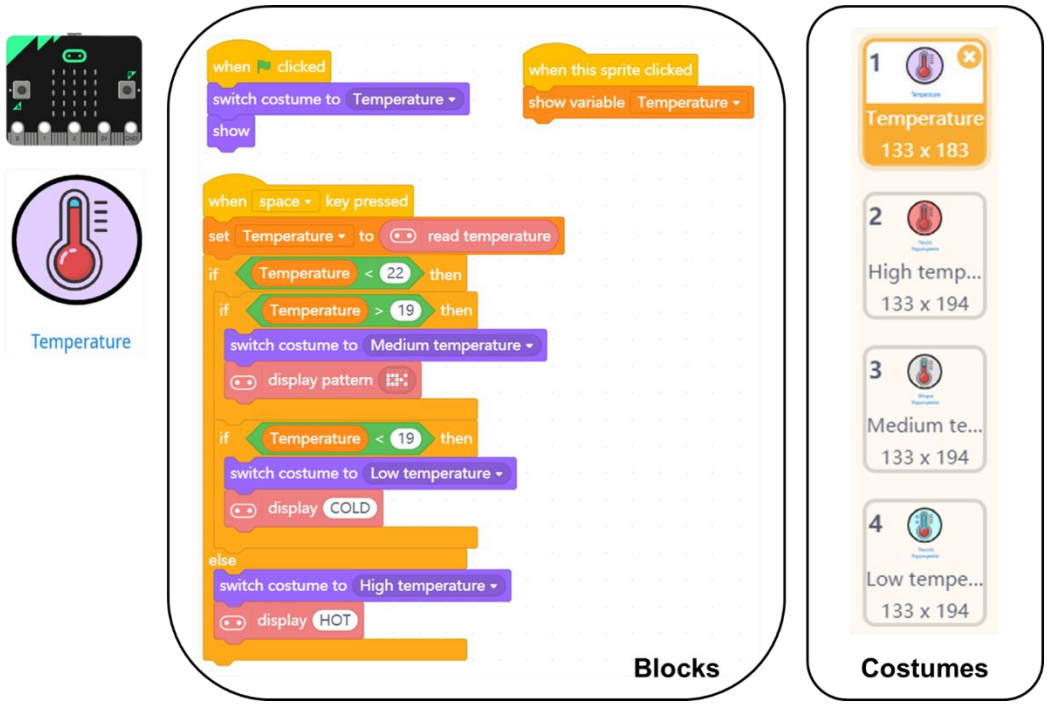
Participants will be enabled to:

- Understand the difference between fixed and variable quantities as well as the concept of automations
- Experiment with the scratch programming language and the PAMK robot's microbit automations
- Examine alternative microbit automations

Resources/Materials/Equipment: paper, pencils/pens, internet, projector, laptop/tablet, microbit board

Introduction (30 mins): The teacher presents the experimental layout of the microbit automations as well as the algorithmic logic and function of the program.





Development (40 mins): Each group of students recreates the above program and experiments with the temperature and brightness automations. Students can interfere with the software either by changing some aesthetic/functional elements or by adding new ones. Experimentation and changes regarding the PAMK robot's initial software are also further encouraged.

Conclusion (20 mins): Based on the above students-software interaction experience, the students and the teacher briefly discuss potential problems in case of altering the microbit automations or adding new ones.

Reflection on Teaching & Learning: Reflective journal of teacher: Teacher will write down any important statements or key observations of the children's learning as the lesson progresses and the children are in the flow of their tasks and learning experiences. Teacher also reflects on the children's drawings, photos and feedback to teacher think-pair-share activities.

Teacher will answer the questions in journalling after: What did the children do? How did they respond? What were the key questions they asked of the lesson? What works did they produce?

Assessment for Learning:

- Digital evidence
- Documented information: such as notes, photographs, videos, and learning stories, journal written by teacher in lesson flow
- Art works produced by children (co-researchers) and photos of processes

- Pupils' self-assessment: follow on learning with class teacher and parents in the week between each lesson.

Literature and links

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- Bioeconomy strategy: https://research-and-innovation.ec.europa.eu/research-area/environment/bioeconomy/bioeconomy-strategy_en
- Sustainable Development Goals: https://www.un.org/sustainabledevelopment/sustainable-development-goals/
- 'What's Bioeconomy' - Book for children: https://ec.europa.eu/research-and-innovation/en/research-area/industrial-research-and-innovation/eu-valorisation-policy/knowledge-valorisation-platform/repository/whats-bioeconomy-book-kids
- The "PAMK robot project" project

Lesson Plan 4

Subject(s): STEAM, Building Science & Educational Robotics	**Title of Lesson: How to design a Bioeconomy robot_the hardware** **No. of Lesson 4 of 6**	
Date: Autumn term 2024	**Class: 3rd-6th**	**Time: flexible** **Duration: 120 mins**
BioBeo Theme: Interconnectedness, Outdoor learning, Food Loop, Forestry, Life Below Water	**Keywords/Phrases: bioeconomy, natural resource, bio-based resource, habitat, sustainable, ecosystem, ecological, renewable, interconnectedness, biodiversity.**	

Learning Outcomes (Explore & Explain stage):

Participants will be enabled to:

- Experiment with the use of different building materials, examine and evaluate their strength and performance
- Experiment with the use of simple and complex mechanisms, examine and evaluate their functionality

Resources/Materials/Equipment: paper, pencils/pens, internet, projector, building materials (building blocks, beams, gears, wheels etc)

Introduction (30 mins): The teacher presents some ideas of how the body of a Bioeconomy robot could look like (e.g. drawings included in the PAMK robot project, photos/videos of simple custom-made moving robots etc). Guided by the teacher and given the sketches/drawings produced in Lesson 1, the groups are requested to search the web for ideas and ways to construct the body of a custom-made Bioeconomy robot.

Development (40 mins): Each group of students selects the building materials in order to create the basic hardware design (materials and mechanisms) of the custom-made robot. The students create drawings presenting the materials, mechanisms and automations that they plan to include in the final product. The students experiment with the various building materials (e.g. building blocks, plates, beams, wheels, axles, gears etc) as well as the function of different mechanisms (e.g. levers for the robot's hands, wheels instead of legs, pulleys etc) and alter their designs accordingly.

Conclusion (20 mins): The groups write down the main constraints and possibilities of their building model. Then, the teacher discusses with the students existing/potential problems regarding their building model.

Reflection on Teaching & Learning: Reflective journal of teacher: Teacher will write down any important statements or key observations of the children's learning as the lesson progresses and the children are in the flow of their tasks and learning experiences. Teacher also reflects on the children's drawings, photos and feedback to teacher think-pair-share activities.

Teacher will answer the questions in journalling after: What did the children do? How did they respond? What were the key questions they asked of the lesson? What works did they produce?

Assessment for Learning:

- Documented information: such as notes, photographs, drawings, videos, and learning stories, journal written by teacher in lesson flow
- Art works produced by children (co-researchers) and photos of processes
- Pupils' self-assessment: follow on learning with class teacher and parents in the week between each lesson

Literature and links

- Bioeconomy games: https://library.transition2bio.eu/t2b_results?title=&source=Any&language=English&country=Any&contentType=Games&categories=Bioeconomy%20education&bioeconomySector=Any&pageno=1&fbclid=IwAR1A9gQ6SX3SdtSU0PY_z9ScWGI3FpiqyU-QqckNs8Zk6OmYg_JBcH5ixUU
- Bioeconomy strategy: https://research-and-innovation.ec.europa.eu/research-area/environment/bioeconomy/bioeconomy-strategy_en
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- The "PAMK robot project" project

Lesson Plan 5

Subject(s): STEAM, Building & Computer Science, Educational Robotics, Engineering Design process	**Title of Lesson: How to design a Bioeconomy robot_the final product** **No. of Lesson 5 of 6**	
Date: Autumn term 2024	**Class: 3rd-6th**	**Time: flexible** **Duration: 120 mins**
BioBeo Theme: Interconnectedness, Outdoor learning, Food Loop, Forestry, Life Below Water	**Keywords/Phrases: bioeconomy, natural resource, bio-based resource, habitat, sustainable, ecosystem, ecological, renewable, interconnectedness, biodiversity.**	

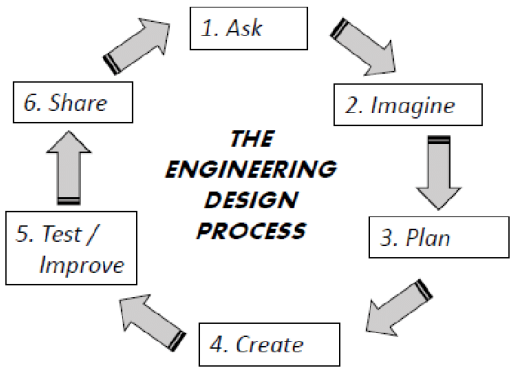
Learning Outcomes (Explore & Explain stage):

Participants will be enabled to:

- Be engaged in the Engineering Design process
- Experiment with the scratch programming language and microbit automations
- Experiment with the use of different building materials, examine and evaluate their strength and performance
- Experiment with the use of simple and complex mechanisms, examine and evaluate their functionality

Resources/Materials/Equipment: paper, pencils/pens, internet, projector, microbit board, microbit sensors, building materials (building blocks, beams, gears, wheels etc)

Introduction (15 mins): The teacher presents the stages of the Engineering Design process to the students and encourages them to be engaged in the engineering design process of a custom-made Bioeconomy robot.



The Engineering Design Process. Source: (Muñoz-Rujas, Diez Ojeda, Greca, & Montero, 2019)

Students are asked to think about and answer questions, such as:

- What size should the robot's building model be?
- What building materials and mechanisms can be used?
- How could the design of the robot's building model be?
- Which are some main constraints and possibilities regarding the robot's building model?
- What could the robot's software include in terms of features and functions?
- What kind of microbit sensors/automations could be used in the custom-made robot model?
- Which are some main constraints and possibilities regarding the robot's software and automations?

Development (80 mins): In this lesson students work in their groups in order to prepare, as a team, the hardware and software of a custom-made Bioeconomy robot. Each group is requested to select the materials and mechanisms needed to build the robot's body as well as to create the software and automations of the robot. Students can customize and/or further develop the "PAMK robot's" software. Moreover, they can customize the microbit automations and they can even create new ones to add in their robot.

Conclusion (25 mins): The groups test their model (hardware & software) and -with the help of their teacher- make improvements and alterations, if needed.

Reflection on Teaching & Learning: Reflective journal of teacher: Teacher will write down any important statements or key observations of the children's learning as the lesson progresses and the children are in the flow of their tasks and learning experiences. Teacher also reflects on the children's drawings, photos and feedback to teacher think-pair-share activities.

Teacher will answer the questions in journalling after: What did the children do? How did they respond? What were the key questions they asked of the lesson? What works did they produce?

Assessment for Learning:

- Digital evidence
- Documented information: such as notes, photographs, drawings, videos, and learning stories, journal written by teacher in lesson flow
- Art works produced by children (co-researchers) and photos of processes
- Pupils' self-assessment: follow on learning with class teacher and parents in the week between each lesson

Literature and links

- Bioeconomy games: https://library.transition2bio.eu/t2b_results?title=&source=Any&language=English&country=Any&contentType=Games&categories=Bioeconomy%20education&bioeconomySector=Any&pageno=1&fbclid=IwAR1A9gQ6SX3SdtSU0PY_z9ScWGI3FpiqyU-QqckNs8Zk6OmYg_JBcH5ixUU

- Bioeconomy strategy: https://research-and-innovation.ec.europa.eu/research-area/environment/bioeconomy/bioeconomy-strategy_en
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- The "PAMK robot project" project
- Muñoz-Rujas, N., Diez Ojeda, M., Greca, I., & Montero, E. (2019). Application of the Engineering Design Process within the STEAM frame to the determination of heat capacities in liquids. XI Congreso Nacional y II Internacional de Ingeniería Termodinámica. Spain. Retrieved from https://www.researchgate.net/publication/333998494_Application_of_the_Engineering_Design_Process_within_the_STEAM_frame_to_the_determination_of_heat_capacities_in_liquids

Lesson Plan 6

Subject(s): STEAM, Building Science & Educational Robotics, Education for Sustainable Development, Global Citizenship, Circular Bioeconomy	**Title of Lesson: How to design a Bioeconomy robot_the hardware** **No. of Lesson 6 of 6**	
Date: Autumn term 2024	**Class: 3rd-6th**	**Time: Flexible** **Duration: 120 mins**
BioBeo Theme: Interconnectedness, Outdoor learning, Food Loop, Forestry, Life Below Water	**Keywords/Phrases: bioeconomy, natural resource, bio-based resource, habitat, sustainable, ecosystem, ecological, renewable, interconnectedness, biodiversity.**	

Learning Outcomes (Evaluate stage):

Participants will be enabled to:

- Present the Engineering Design process which refers to the development of their custom-made Bioeconomy robot
- Discuss and explain potential building and programming problems that occurred during the Engineering Design process
- Suggest alternative and/or more solutions to improve the functions and the possibilities of their custom-made Bioeconomy robot
- Explain how their "Bioeconomy robot" can help other students understand the concept of the Bioeconomy
- Explain how such a smart solution could enhance the Circular Bioeconomy

Resources/Materials/Equipment: Paper, pencils/pens, internet, projector, microbit board, microbit sensors, building materials (building blocks, beams, gears, wheels etc), powerpoint or canva (optional)

Introduction (5 mins): The teacher reminds the students of the presentation requirements regarding the custom-made model of the Bioeconomy robot. The time for each presentation can be 5-10 minutes, depending on the number of students in the class.

Development (60 mins): Each group of students focuses on one of the 5 Bioeconomy themes and using the content created in the previous lessons, creates a relevant short presentation. In the presentation groups are asked to include the engineering design process followed to create their own "Bioeconomy robot" and explain how their "Bioeconomy robot" can help other students understand the concept of the respective Bioeconomy theme.

Conclusion (25 mins): The groups present their projects. Then, the students and the teacher discuss the content of the presentations and suggest alternative and/or more solutions to improve the functions and the possibilities of a Bioeconomy robot. Smart educational solutions, such as the Bioeconomy robot project, are an important part of the drive to support 21st century primary education. Complex issues, such as Bioeconomy, can be examined by young children through creative and contemporary educational processes and means.

Reflection on Teaching & Learning: Reflective journal of teacher: Teacher will write down any important statements or key observations of the children's learning as the lesson progresses and the children are in the flow of their tasks and learning experiences. Teacher also reflects on the children's drawings, photos and feedback to teacher think-pair-share activities.

Teacher will answer the questions in journalling after: What did the children do? How did they respond? What were the key questions they asked of the lesson? What works did they produce?

Assessment for Learning:

- Digital evidence
- Documented information: such as notes, photographs, drawings, videos, and learning stories, journal written by teacher in lesson flow
- Art works produced by children (co-researchers) and photos of processes
- Pupils' self-assessment: follow on learning with class teacher and parents in the week between each lesson

Literature and links

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- The "PAMK robot project" project

Parental engagement

Parental engagement is crucial for maximising the educational benefits of the BioBeo robot activity. Here are some tips to enhance parental involvement:

Before implementing the activity:

The teacher can organize and host an orientation session or workshop for parents to introduce them to the BioBeo robot project and its educational objectives. More specifically, the teacher can provide an overview of the project, explain the main stages, goals and requirements of the activity, its significance in teaching Bioeconomy as well as potential ways of parents' active participation. In this session/workshop the teacher can discuss with the parents the project's role in fostering a creative learning environment and can also share informational materials, such as pamphlets or digital resources. Finally, the teacher should ensure that parents understand the hands-on nature of the project and the potential impact on their child's education and encourage them to actively participate in the construction and design of the BioBeo robot alongside their children. This collaborative effort not only enhances the learning experience but also strengthens the parent-child relationship.

During implementation:

Interactive workshops can provide parents the chance to learn about the hardware and software components of the BioBeo robot. The learning process can include hands-on sessions where parents and students work together to assemble and program the robot, fostering a sense of teamwork. Within this framework parents will be able to see the developments in their child's BioBeo project. This can include showcasing different robot designs, highlighting software modifications and discussing the educational content the students are engaging with.

Resources and guidance can be given to the parents who want to actively participate in the software modification aspect of the BioBeo robot. This may include tutorials, coding workshops, or guidelines on enriching the educational content.

An online platform or group could also be created, so that parents can share ideas, ask questions and collaborate on issues regarding the BioBeo project. This virtual community can serve as a hub for discussions, troubleshooting, and sharing success stories and promote open communication between parents and their children about the BioBeo project and its educational value.

Moreover, emphasis should be given to the alignment of the BioBeo project with the school curriculum. The teacher can provide parents with information on how the project contributes to their child's overall learning experience, ensuring they see the educational value in the activities.

After implementation:

The teacher can organize a final event where parents and other guests (e.g. students and teachers of other schools, local communities etc.) can witness the end results of the BioBeo project. This can include demonstrations of the robots created by different groups, presentations on software modifications, and discussions about the educational impact on the students.

National Curricula and Policy/SDG Connections:

The Bioeconomy robot project is inspired by the "PAMK robot", a STEAM & Educational Robotics project of primary school students which was awarded in the 5th Open Technologies in Education Copetition 2023 | "Green- Open – Equal", in Greece.

The lessons of the Bioeconomy robot project are connected with the SDG 04, 09, 12 and 13.

Goal 04 is about ensuring inclusive and equitable quality education and promote lifelong learning opportunities for all[1].

Goal 09 is about seeking solutions to build resilient infrastructure, promote sustainable industrialization and foster innovation. Economic growth, social development, climate action as well as education are heavily dependent on investments in infrastructure, sustainable industrial development and technological progress[2].

Goal 12 is about ensuring sustainable consumption and production patterns, which is key to sustain the livelihoods of current and future generations[3].

Goal 13 is about climate change. Climate change is caused by human activities and threatens life on earth as we know it. With rising greenhouse gas emissions, climate change is occurring at rates much faster than anticipated. Its impacts can be devastating and include extreme and changing weather patterns and rising sea levels[4].

The lessons can be applied to the Skills Labs module in Primary Education (ages 8-12). Provided some alterations and further content development, the lessons can also be applied to Skills Labs module in Secondary Education (ages 12-15). The Skills Labs is a new, innovative school module which focuses on the cultivation of soft and digital skills. The Skills Labs' main goal is the cultivation of skills necessary for a rapidly changing world. These skills include both fundamental life skills related to health, safety, and social interactions, as well as more elaborate skills related to education and life-long learning. Particular emphasis is placed on the 4Cs of 21st century skills – communication, collaboration, critical thinking, and creativity – along with digital skills. The Skills Labs module is designed to promote and bring into effect the UN Sustainable Development Goals, with particular emphasis to Goal 4.7 and has gathered significant attention from international bodies such as UNESCO. It was awarded the Global Education Network Europe (GENE) Global Education Award (2020/2021)[5].

[1] https://www.un.org/sustainabledevelopment/education/
[2] https://www.un.org/sustainabledevelopment/infrastructure-industrialization/
[3] https://www.un.org/sustainabledevelopment/sustainable-consumption-production/
[4] https://www.un.org/sustainabledevelopment/climate-change/
[5] https://eurydice.eacea.ec.europa.eu/news/greece-21st-century-skills-labs-ergastiria-dexiotiton