From computing to computational thinking: Encouraging creative approaches to problem-solving across the curriculum

26 JANUARY, 2017  ⏰ 15:50 - 16:10

Bett Futures

@margaridaromero

#Vibot #5c21 #CoCreaTIC
#CoCreaTIC mission: Foster techno-cocreative problem-solving and humanistic values through community-based challenges engaging intergenerational participants.

#5c21: 5 key competencies for the 21st century citizenship

#Vibot the robot, an intergenerational book about programming and educational robotics. Available in French and English (paper and online).

Studio #Vibot on Scratch

Community-based challenges: #smarticitymaker #fabville / #r2t2
#CoCreaTIC #5c21

Techno-creative activities for the 21st century competencies

#Vibot

A story for the 7 to 107 years old on robotics and programming
Should kids use technologies?
 Citizens as ICT consumers (Interactive ICT usage)

→ Limits:
Representativity, Obsolescence

Citizens as ICT co-creators (Participatory Knowledge Co-Creation)
Collaborative problem-solving techno-creativity

Is not about the technology (nor its intentions) but about its actual participatory creative use.

 Src: CultOfMac.com
 Src: LadiesLearningCode.com
Should kids use technologies?

Passive-participatory model

15 cocreative activities

Participatory Knowledge Co-Creation

Level 5

15 Learning Activities in Accordance with the Co-Creative Uses of Technologies

Unplugged computing activities

- 01 Programming a robot-kid
- 02 Object-oriented theatre

Creative robotics

- 03 Story creation using a mobile robot
- 04 RoboWolf and the three little RoboPigs
- 05 All-winners robot racing

Creative programming

- 06 Programming "The Three Little Pigs" using ScratchJR
- 07 From storytime to coding-time
- 08 Programming a Gamebook
- 09 The food chain, programmed

Digital comic creation

- 10 Intergenerational creation of an interactive comic

Creative electronics and Makey Makey

- 11 Funny objects that are musical conductors
- 12 Quizz with Makey Makey buzzers
- 13 Code-dancing an exergame

3D Creation activities

- 14 3D modelized bird feeder
- 15 I built my house using Minecraft
Learning to code is not enough!

- Code is part of the literacy required for creative programming

Programming is a human-sensitive decision-making of
1. analysis a (complex) problem-situation;
2. organisation, reduction of the complexity (selecting an angle and the entities to model) and modelling the problem-situation;
3. creating a program (code) through the use of an specific language
4. testing, debugging and maintaining the program.
5 levels of learning to code activities (Romero et al. 2016)

Passive exposure to programming lectures or resources
- Reading and listening online resources about how to code. E.g. “Code Yourself! An Introduction to Programming” Coursera course.

Procedural (step-by-step) programming

Individual content creation through programming
- Content creation through coding. E.g. Creating a solar system in Scratch to show the position of the Earth in relation to the Sun.

Content co-creation through programming
- Content co-creation through coding. E.g. Working in teams to create a solar system in Scratch to show the position of the Earth in relation to the Sun.

Participatory co-creation of knowledge through programming
- Participatory co-creation of knowledge. E.g. Intergenerational (children and elders) co-creation of a Scratch story based on the elders’ memory.

Constructionism level

Socio-constructivist level
#Vibot the robot, an intergenerational book about programming and educational robotics. Available in French and English (paper and online).

Creative programming with Scratch and #Vibot the robot

https://scratch.mit.edu/

Studio #Scratch de #Vibot: https://scratch.mit.edu/studios/1999251/
Creative collaboration as a context-related collaborative process of shared creation, where a solution is collaboratively (co)constructed by a group of persons and considered as original, valuable or useful by a group of reference (Romero & Barberà, 2015).
What kind of activities can engage learners in creative collaboration?

Interdisciplinary community-based **challenges**

**Community**

*Belonging, caring, contributing* (cocreative project), *goodwilling*

**Challenge**

Team-defined and regulated cocreative activity to solve an authentic **complex** ill-defined problem.

Complex ill-defined problems requires, on the one hand, a worthy community-oriented inquiry that could benefit from a design based approach, interdisciplinarity, a diversity of literacies and the 21st century competencies: collaboration, problem solving, creativity, critical thinking and computational thinking.

Noé, age 5, suffers from agenesis of the left hand. The little boy received a prosthesis made by the secondary level students of Soing (France). The artificial hand was realized thanks to a printer 3D.
What kind of activities can engage learners in creative collaboration?

Interdisciplinary community-based challenges

Challenges require a certain degree of complexity to engage learners in a cocreative activity.

Schools avoid complexity by organizing uncontextualized knowledge units according to the curriculum and the disciplines.

Complexity

Related attitudes and skills: curiosity, ambiguity tolerance, systems thinking, abstraction, pattern thinking, error tolerance.
What kind of activities can engage learners in creative collaboration?

Interdisciplinary community-based challenges

Cesar Harada students, at the Hong Kong Harbour School, wanted to contribute to remove plastics from the ocean.

Community
Students oriented to clean the oceans.

Challenge
Build a water-pro robot to sense and collect plastics.

Technological literacy

Code and systems literacy (for programming and building a robot)

Programming and making the robot

Testing and improvement

Making/digital creation

Solution

Analysis of an ill-defined complex problem

Modelling/Design (schema; complexity reduction)

Analysis
Computational thinking as a set of cognitive and metacognitive strategies engaged in the
- analysis and modelling of (complex) problem-situations,
- and the creation and test of digital system to provide a creative solution to the problem-situation.

Romero & Lepage (2016); Romero (2016); Romero, Lepage & Lille (2016)
Should kids use technologies?

Can technologies support creative participation across the lifespan?
Cocreative uses of technologies for education

Intergenerational learning

Robotics, 4th industrial revolution

Learning through game creation

Educational robotics

Creative programming

Creative class

21st century competencies

Society

Educational Curriculum

Computational thinking
Problem solving
Collaboration
Creativity
Critical thinking
Last but not least:

mind the gender gap
Annexes
Techno-Creative activities

○ Critical thinking
○ Collaboration
○ Creativity
○ Problem solving
○ Computational thinking

Romero (2016). Design: Dumont #5c21
#CoCreaTIC publications

**Robotique pédagogique**

- *Vibot le robot*, un conte d’introduction à la programmation et à la robotique

**Apprentissage de la programmation**

- Guide de 15 activités technocréatives

**Compétences 21e siècle**

- Livre ‘Jeux numériques et apprentissages’
- Création de jeux numériques

**Game-based Learning Across the Lifespan**

(Springer)
Creative programming with Scratch and #Vibot the robot

https://scratch.mit.edu/

Studio #Scratch de #Vibot: https://scratch.mit.edu/studios/1999251/
#Vibot the robot, an intergenerational book about programming and educational robotics. Available in French and English (paper and online).
Orchestrating intergenerational creative programming workshops (II)

#Vibot studio on #Scratch

bij jour 30 Mai 2016

Values and attitudes for interdisciplinary community-based challenges

Values for the learning community #5c21

Group:
- Goodwill
- Mutual aid/Assistance
- Equity
- Confidence/Trust
- Interdependence
- Courtesy and calm
- Sustainable development

Learner:
- Hedonism
- Success
- Quality
- Freedom
- Integrity
- Privacy
- Usability
- Autonomy

Individual attitudes related to the 21st century skills #5c21

Critical thinking:
- Curiosity
- Learning orientation
- Social and cultural sensitivity
- Diversity sensitivity
- Autonomy (of action and thought)

Problem solving:
- Determination/Resilience/Perseverance
- Accepting mistakes

Creativity:
- Créattitude or creative link to the world
- Ambiguity tolerance
- Risk taking
- Innovation
- Sense of humour
- Playfulness

Collaboration:
- Sense of initiative
- Flexibility/Adaptability
- Leadership
- Responsibility
- Conflict management

Computational thinking:
- Quality orientation
- Pattern thinking, systems thinking
- Complexity management
- Abstraction and information reduction capacity
- Agile and iterative approach by prototypes
THE MAKER MOVEMENT MANIFESTO

1. MAKING MAKES US HUMAN
2. DO IT TOGETHER
3. PLAY, PARTICIPATE, SUPPORT
4. SHARE YOUR SUCCESS, GIVE BACK
Reshma Saujani:

Apprenez aux filles à être courageuses, et pas à être parfaites

TED2016 - 12:39 - Filmed Feb 2016

32 subtitle languages ▶
View interactive transcript

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# Computational Concepts Supported in Scratch

In the process of creating projects with Scratch, young people develop as computational thinkers. They learn concepts, engage in practices, and develop perspectives they can use to express their ideas with code. This list features fundamental computational concepts that are supported in Scratch.

<table>
<thead>
<tr>
<th>Concept</th>
<th>Explanation</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>sequence</td>
<td>To create a program in Scratch, you need to think systematically about the order of steps.</td>
<td><img src="image1.png" alt="Example" /></td>
</tr>
<tr>
<td>iteration (looping)</td>
<td><em>forever</em> and <em>repeat</em> can be used for iteration (repeating a series of instructions)</td>
<td><img src="image2.png" alt="Example" /></td>
</tr>
<tr>
<td>random</td>
<td>pick random selects random integers within a given range.</td>
<td><img src="image3.png" alt="Example" /></td>
</tr>
<tr>
<td>conditional statements</td>
<td><em>if</em> and <em>if else</em> check for a condition.</td>
<td><img src="image4.png" alt="Example" /></td>
</tr>
<tr>
<td>boolean logic</td>
<td><em>and</em>, <em>or</em>, <em>not</em> are examples of boolean logic</td>
<td><img src="image5.png" alt="Example" /></td>
</tr>
<tr>
<td>variables</td>
<td>The variable blocks allow you to create variables and use them in a program. Variables can store numbers or strings. Scratch supports both global and object-specific variables.</td>
<td><img src="image6.png" alt="Example" /></td>
</tr>
<tr>
<td>lists (arrays)</td>
<td>The list blocks allow for storing and accessing a list of numbers and strings. This kind of data structure can be considered a “dynamic array.”</td>
<td><img src="image7.png" alt="Example" /></td>
</tr>
</tbody>
</table>
What kind of **activities** can engage learners in creative collaboration?

**Interdisciplinary community-based challenges**

<table>
<thead>
<tr>
<th>Community</th>
<th>Challenge</th>
</tr>
</thead>
</table>
| *Belonging, caring, contributing (cocreative project), goodwill* | • Humanistic approach of life, community and education that promotes positive relations, participation and collaboration.  
• Empathy, care and goodwill actions towards the community.  
• Amabile defined challenge as “arising from the intriguing nature of the problem itself or its importance to the organization” (1996, p. 232).  
• Challenge is intrinsically driven. |
What kind of **activities** can engage learners in creative collaboration?

**Interdisciplinary community-based challenges**

- Creative action-oriented empathy for a worthy problem or situation to improve or to solve (going beyond passive awareness or “likes”).
- Identify, select, empathise and engage towards a problem to solve.

**Challenge**

- **Diversity**
- **Complexity**
- **Authenticity**
- **Engagement**
- **Creative activity**
- **(socio/co/self)regulation**
Cesar Harada students, at the Hong Kong Harbour School, wanted to contribute to remove plastics from the ocean.
Cesar Harada students, at the Hong Kong Harbour School, wanted to contribute to remove plastics from the ocean.
What kind of activities can engage learners in creative collaboration?

Interdisciplinary community-based challenges

- **Design thinking approach**
  - Analysis, Definition
  - Ideation
  - Prototype
  - Test

- **Community**
  - Empathy

- **Challenge**
  - Complexity
    - Diversity
    - Authenticity
    - Engagement
    - Creative activity (socio/co/self) regulation

- **Values**

- **Attitudes**

- **Programming, educational robotics, #makered**

- **Programming**
  - Building
  - Electronics
  - Mechanics
What kind of **activities** can engage learners in creative collaboration?

**Interdisciplinary community-based challenges**

- **Design thinking approach**
  - Design is a way to tame complexity (Donald A. Norman)
  - “Design = Navigating complexity with empathy” (@hellomedian)
  - "Why can't things be simple?" Why? Because life is complex." — from "Living with Complexity (Normand)"

- **Challenge**
  - Controlling complexity is the essence of computer programming. — Brian W. Kernighan

- **Complexity**

- **Values**

- **Attitudes**

- **Programming, educational robotics, #makered**
What kind of activities can engage learners in creative collaboration?

Interdisciplinary community-based challenges

- Activities
- Spaces
- Diversity
  - Recognize and value diversity; discuss divergent values when required for the challenge process.

Complexity
- Competencies
- Knowledge
- Literacies
- Languages
- Culture
- Values
- Attitudes

Authenticity
- Value and values: Worthy inquiry and creative project benefiting a person, group or community

Patterns
- Narratives; storytelling
- Game mechanics

Engagement
- (socio/co/self)regulation

Creativity
- (socio/co/self)regulation
L’innovation est facilitée par la coprésence et la mise à disposition d’un espace de co-création participative. LINE pourrait disposer d’un laboratoire co-créatif dans un lieu physique alliant les caractéristiques d’un *makerspace*, d’un *living lab* et d’un *open lab* (Barma, Romero, & Deslandes, 2017; Capdevila, 2013; Mérindol et al. 2016).
Intergenerational creative programming engage participants from different generations and backgrounds together in the process of designing and developing an original work through coding.
Ann-Louise Davidson & Giuliana Cucinelli - Workshop Participants

Margarida Romero - Workshop Organizer

@margaridaromero

https://vimeo.com/157339347
Intergenerational creative programming

https://scratch.mit.edu/projects/79072590/#editor
Orchestrating intergenerational creative programming workshops. **Strategy 1: Ice-breaking roles.**

**Intergenerational learning** through play (Davis, Larkin, & Graves, 2002) and digital creation. **Participatory design of digital games** (Blat et al., 2012; Vanden Abeele & Van Rompaey, 2006) with Scratch.

Senior participants (50+)
Acting as **Narrative directors**, sharing a life experience related to the Social Sciences curriculum.

Younger learners
acting as **Multimedia directors**, creating a digital life narrative (Open Educational Resource)

Learning by real life stories; Learning by creating OER

Digital creativity; Social participation; Heritage preservation
Orchestrating intergenerational creative programming workshops. **Strategy 1: Ice-breaking roles.**
Orchestrating intergenerational creative programming workshops. **Strategy 2: Intergen-Creativity.**
Orchestrating intergenerational creative programming workshops. **Strategy 2: Intergen-Creativity.**
#GC2020
Innovation Fair.

#ACTproject
#CoCreaTIC
#eduJeux
#5c21
Orchestrating intergenerational creative programming workshops. **Strategy 3: Storytelling**

*From storytime to coding time*

*De l’heure du conte à l’heure du code*

#Vibot the robot, an intergenerational book about programming and educational robotics. Available in French and English (paper and online).
In Vibot the robot, granny ADA is the most tech-savvy member of the family!

Nana Ada is a mathematician and a computer specialist. She's named after Ada Lovelace, the first computer programmer in history.

$$\frac{P}{\text{Perit}} = \frac{\pi}{\sqrt{2x^2-1}}$$
#Vibot studio on #Scratch

Margarida Romero

Orchestrating intergenerational creative programming workshops (II)

Jeux numériques et apprentissages

Margarida Romero

Leslie Dumont, Sylvie Daniel, Sylvie Barma, Mariona Ferrer, Valérie Hénaire

Avec la contribution de :
Jean-Nicolas Proulx
Azeneth Patiño
Benjamin Lille
Alexandre Lepage
Silver Gaming activities

- 1 Springer book on **intergenerational gaming**
- 1 handbook on **digital game design**
- 1 **children book feat. a coding-expert granny**
- 1 Summer school (#SGISS15 lead by Romero) and its proceedings
- 3 conference papers
- 2 conferences ‘tracks’ (HCI 2016 lead by Loss, #CIRTA 2016 lead by Romero)
- 6 workshops ... **and a lot of fun !!**
Outcomes: publications #ACTproject #CoCreaTIC

Romero, M., Sawchuk, K., Blat, J., Sayago, S., Ouellet, H. (Eds.), (2016). Game-Based Learning Across the Lifespan. Cross-Generational and Age-Oriented Topics, Advances in Game-Based Learning (Springer). ISBN: 978-3-319-41795-0.


#SmartCityMaker, construction d’une ville avec des matériaux recyclés et des véhicules automates (robots Beebot, Cubelets, mBot, NXT).

Romero, Proulx, Kamga & Lille (TEN2901)
#SmartCityMaker, le restaurant tournant de l’hôtel Concorde avec LEGO WeDo 2.0

Romero (TEN2901)
Coopétition Zone01 à l’Université Laval, des défis de robotique pédagogique (primaire-recrues, junior, senior, WRO)
Vibot le robot, un conte d’introduction à la programmation et à la robotique

Vibot visite le MIT Media Lab
Premiers pas sur #Scratch

Ouvrez le projet Scratch suivant: https://scratch.mit.edu/projects/121266593/#editor

Situation:
Le chat Scratch voudrait savoir le nom des différents robots. Il s'approche d'eux et leur demande leur nom en leur envoyant le message 'DireNomDuRobot'. Votre défi est de programmer l'abeille pour qu'elle dise son nom ('Beebot') quand elle reçoit le message 'DireNomDuRobot'.

Pas à suivre:

N’hésitez pas à demander de l’aide à vos voisin.e.s de table!
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@margaridaromero
margarida.romero@unice.fr
Professor at ESPE Nice
Université Nice Sophia Antipolis
Head of the "Laboratoire d’Innovation et Numérique pour l’Éducation" (LINE)

margarida.romero@fse.ulaval.ca
Associate professor of Educational Technology
Université Laval
#CoCreaTIC leader

#Vibot
#5c21
#CoCreaTIC

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Université Laval
Université Nice Sophia Antipolis
Social Sciences and Humanities Research Council of Canada

@margaridaromero
margarida.romero@unice.fr
Professor at ESPE Nice
Université Nice Sophia Antipolis
Head of the “Laboratoire d’Innovation et Numérique pour l’Éducation” (LINE)

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for the 21st century competencies
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