# Unlocking Young Minds: Empowering Primary Students' Computational Thinking with Virtual Reality Creation using CoSpaces Edu

Hsiaoping Hsu

## Introduction

Recognizing the importance of empowering the younger generation with competencies to navigate digital technologies and future uncertainties, promoting coding education has become a key practice (Popat & Starkey, 2019). Teaching Computational Thinking (CT) concepts is critical to coding education (European Schoolnet, 2015). The CT concepts involve breaking down complex problems into smaller and more manageable parts, identifying patterns, abstracting concepts, and developing procedures to solve them (Grover & Pea, 2013; Wing, 2006). CT may serve as a vehicle for children to develop essential skills such as critical thinking, problem-solving, collaboration, and creativity (Vahrenhold et al., 2017). Therefore, the integration of CT across the primary curriculum to support children to become digital learners has been strongly recommended (Butler & Leahy, 2022; Department of Education & Skills, 2022). However, integrating CT into the primary curriculum remains challenging, and several practical issues are still being explored (Fancsali et al., 2022; Wang et al., 2022). For instance, what pedagogical approaches are most effective, and how can we motivate children to engage in CT learning activities? Thus, there is a continued need to explore and develop more pedagogical approaches.

Virtual reality, commonly referred to as VR, is a computer-generated simulation that enables users to experience a three-dimensional (3D) image or a realistic and immersive environment. This is made possible through the use of special electronic hardware such as a head-mounted display or gloves fitted with sensors (Freina & Ott, 2015), which track the user's movements and provide feedback through a variety of sensory inputs including sight, sound, and touch (Kavanagh et al., 2017). It has been widely suggested that VR has great potential in education, particularly for supporting teaching and learning in primary classrooms (Butler & Leahy, 2022; Department of Education & Skills, 2022). Utilizing VR creates a distinctive chance not only to foster CT, but allow students to leverage CT concepts for problem solving in an engaging and interactive environment (Sukirman et al., 2022). For instance, Agbo et al. (2021) involved Nigerian third-level students in a VR learning environment to co design digital games to foster CT concepts. The results suggested that the students were able to gain a number of CT concepts through the game design process. Another study

articulated the experience of creating VR content allows post-primary students to practice CT concepts for solving problems encountered during the project (Raposo & Curasma, 2018). The VR content creation process enables students a number of opportunities to contextually leverage CT concepts in an engaging and interactive way, and it can serve as an effective measure for CT education.

While applying VR to support the teaching of CT concepts is not a brand-new idea, the pre-existing studies mainly concentrate on post-primary and third-level contexts. Therefore, the objective of this article is to present a lesson plan idea on how to enable primary students to apply and develop CT concepts through VR content creation using CoSpaces Edu (https://cospaces.io/edu/). CoSpaces Edu is a web-based tool that permits users to create their own VR content. This platform facilitates the incorporation of user-generated 360-degree images, 3D objects, and coding blocks (similar to Scratch). It is compatible with all modern internet browsers, including Google Chromebooks, and has a companion mobile app for Android and iOS devices. The participation of Carrabane National School in the Virtually Here project with Galway 2020 exemplifies the use of CoSpaces Edu in Irish primary education (Scoil Náisiúnta Seosamh Naofa, 2021). Their 5th class participated in workshops to learn about VR content creation techniques and then used CoSpaces Edu to create virtual scenes around the Dunsandle Castle, aiming to deepen their understanding of the local environment through VR storytelling. This experience enabled the students to think in three dimensions and come up with fresh narratives in the VR environment. Building upon this success, a concrete example in the form of a customizable lesson plan is provided, showcasing how CoSpaces Edu can effectively teach CT concepts while accommodating the unique needs of different schools.

## Lesson Plan

**Title:** Creating a Local VR Tour to Leverage CT Concepts
**Subject Area:** Geography
**Grade Level:** 5th - 6th
**Lesson Length:** 10 hours. The time allocation for each section is as follows: two hours dedicated to the introduction section, seven hours allocated to the development section, and one hour designated for the conclusion section.
**Overview:** This example lesson plan involves children creating a VR tour for their local community with CoSpaecs Edu, starting with an introduction to VR technology and CT concepts and then a project introduction. Children are then divided into mixed-ability groups to research the local community and select a site for creating a

VR tour, learn to take 360-degree photos, record narration, and the CoSpaces Edu techniques. Children then create a draft tour, conduct peer review, compile constructive feedback, and refine their tour, and present it to the class along with sharing their learning outcomes in CT concepts.

#### Learning outcomes

1. Define CT concepts (i.e., abstraction, algorithmic thinking, decomposition, debugging and pattern recognition) and explain their application in a project-based learning setting.
2. Understand what VR is and its application in education and daily life.
3. Use CoSpaces Edu to create a local community tour.
4. Apply and develop geographical investigation skills.
5. Apply and develop the ability to use maps and pictures.
6. Explore and appreciate the people and communities who live and work in the locality.
7. Become aware of the local natural environment and their interrelationship with the lives of people living in these places.

#### Resources

1. Cospaces Edu
2. Google Streetview app
3. Street View Download 360 App
4. Google Cardboard-style VR Headsets
5. Laptops
6. Smartphones
7. 360 Camera (Optional)
8. Whiteboard
9. Projector

#### Assessment

1. Observe the students as they work through the VR project. Take note of how well they applied and demonstrated CT concepts and geographical investigation skills.
2. Evaluate each group's VR project based on how well they demonstrated understanding and appreciation of the local human and natural environments.

## Introduction section

This introduction section begins by introducing VR and CT concepts, followed by

involving children in a VR tour. It then proceeds to explain the project goal of using CoSpaces Edu to create a VR tour representing their local community, emphasizing the application of the CT concepts through the project.

1. **VR Introduction**: ask children if any of them ever had the opportunity to try out VR before? If so, ask them to share experiences and what they did in the virtual world. Briefly introduce the definition of VR, highlighting its ability to generate virtual environments and emphasizing the advantages of leveraging VR for educational endeavors, such as enabling immersive learning experience and enhancing engagement and motivation.
2. **Explore VR**: organize the children into pairs or groups to embark on a VR tour with CoSpaces Edu (for example, they can visit https://edu.cospaces.io/QGG-QMG). After the tour, inquire about the students' experiences and ask them to share their feelings.
3. **Introduction of CT**: inquire whether the children are familiar with the term "computational thinking." If they are, encourage them to provide their own definition. For those who haven't encountered the term, explain that CT refers to a problem-solving approach that involves breaking down complex problems into smaller components, recognizing patterns, abstracting concepts, and developing algorithms or step-by-step instructions to resolve the problem.
4. **Project explanation**: inquire with the students about what aspects of their local community they would like to showcase if given the opportunity to introduce it to the public. Next, clearly define the goal of the project, which is to create a VR tour using CoSpaces Edu to represent their local community. Describe how the children will have to think computationally to design and implement the tour effectively.

**Key Questions**

1. Are you familiar with VR in any way? If yes, what did you do in the virtual environment? How did you feel?
2. Have you had the chance to experience any VR technologies, such as Google Cardboard or Meta Oculus?
3. Have you ever worked on a project where you presented or introduced a local community site?
4. When it comes to showcasing your local community, what specific elements or aspects would you like to include?
5. Have you ever come across the concept of CT? If yes, how would you define the concept?

**Development section**

This development section involves selecting a local community site, planning and designing a VR tour with CT concepts. Students learn to create a VR tour using CoSpaces Edu, adding objects, interactivity, and navigation. They test and iterate by seeking peer feedback and making adjustments, and finally reflect on the tour's quality and the application of CT concepts.

1. **Identify the project goal**: divide students into mixed-ability groups and ask them to select and research a local community site where they are willing to create a VR tour for. Children will conduct research to gather information about the site's history, flora and fauna, notable landmarks, and any other interesting facts that they wish to include in the tour.
2. **Plan and Design**: leading students to create a detailed plan and design for their VR tour involving four different CT concepts:
   - Break Down the Task (decomposition): guide students in breaking down the project task into smaller and manageable jobs and write down them onto a paper. Help them identify the key elements required for a successful VR tour, such as taking and uploading 360 photos the CoSpaces Edu, incorporating interactive objects, recording sound effects and narrations, deciding on the number of scenes, the points of interest they will highlight, and designing navigation paths. Emphasize the importance of decomposition and organizing the tasks in a logical sequence. They should consider the layout, locations, points of interest, and any interactive elements they want to incorporate.
   - Develop algorithms for each task of their VR tour (algorithmic thinking): lead students to create step-by-step instructions using visual representations for each job identified in the previous step. Emphasize the use of clear and precise instructions to ensure that others can understand and replicate the algorithms.
   - Highlight the pattern design principle (pattern recognition): such as recurring color schemes, textures, or even thematic patterns related to specific locations or historical periods. Encourage students to think critically about how patterns can enhance the user experience and create a cohesive tour.
   - Simplify the unnecessary details (abstraction): encourage students to think about which details can be simplified or omitted while still conveying the

essential aspects of the location or theme. This could include abstracting complex objects, textures, or intricate designs.

3. **Learn to create a VR tour**: children learn the necessary technical knowledge and skills to develop a VR tour. This encompasses learning how to utilize tools like Street View Download 360 to extract 360-degree photos from Google Maps, capturing 360-degree photos with a smartphone or 360 camera, uploading 360-degree photos to CoSpaces Edu to create scenes, adding characters, 3D models, videos, sound effects and narration, and programming objects through the block-based coding feature of CoSpaces Edu.
4. **Create the tour**: it is now the students' turn to utilize CoSpaces Edu to construct their own VR tour, enhancing its realism by adding objects and videos, animating objects with block-based coding for interactivity, incorporating audio elements for immersion, and uploading different 360 photos to enable navigation between scenes and trigger events.
5. **Test and Iterate (debugging)**: once the students have created their VR tour, ask them to share their draft tour with another peer group to gather constructive feedback from their peers. They should make any necessary changes and refine the tour referring to peer feedback. Urge them to make adjustments and refinements based on user feedback.
6. **Reflect and Optimize**: facilitate a reflection session where students evaluate their VR tours and reflect on the CT concepts they employed throughout the process.

**Key Questions**

1. What local community site did your group select for creating the VR tour?
2. What specific research did you conduct to gather information about the site's history, flora and fauna, notable landmarks, and interesting facts?
3. How did you incorporate CT concepts into your detailed plan and design for the VR tour?
4. How did you utilize tools like Street View Download 360, smartphone or 360 camera to develop your VR tour?
5. How did you enhance the realism of your VR tour by adding objects, videos, audio elements, and the block-based coding feature of CoSpaces Edu?
6. How did you utilize different 360 photos to enable navigation between scenes and trigger events?
7. What feedback did you receive from another peer group during the sharing of your draft tour?
8. What specific changes did you make to your tour based on the peer feedback?

**Conclusion section**

This lesson concludes with students presenting their VR tours and engaging in a summary discussion to recap the key learning points.

1. **Presentation**: give students the opportunity to present their VR tours to the class or even a wider audience. Ask them to explain the CT principles applied in their projects, highlighting the challenges they encountered and how they overcame them.
2. **Summary**: summarize the key points of the lesson: applying CT concepts, exploring VR's applications, creating a local tour with CoSpaces Edu, developing geographical investigation and map usage skills, and gaining knowledge and appreciation for the local human and natural environment.

**Key Questions**

1. Can you identify any specific examples or instances where CT concepts were utilized during the creation of the local tour?
2. How did you simplify complex problems by focusing on the essential details while ignoring irrelevant information?
3. How did you design a sequence of actions or instructions to complete a task for your VR tour?
4. How did you divide tasks among group members?
5. How did you deal with glitches, inconsistencies, or functionality problems?
6. How did you use pattern design principles to create visually appealing and consistent scenes that enhance overall tour quality?
7. What knowledge and appreciation did you gain about the local human environment through this activity?

## Conclusion

This conceptual paper introduces a project-based learning activity centered around VR technology and CT concepts. By applying CT concepts, students utilize CoSpace Edu to create immersive tours of their local community. This activity not only explores the potential of VR but also fosters a deeper understanding and appreciation of their community. The student-created VR tour serves as lasting representations of the students' achievements and hard work. Reflecting on their journey, students can take pride in their ability to leverage CT to design meaningful virtual experiences. This learning activity ignites curiosity, passion for learning, and equips students with valuable skills and mindsets for the future.

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