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Description automatically generatedSchool of Computer Science and Statistics

MycroForest – Exploring the use of a microworld to teach about economic viability of climate aware forest management.

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of the requirements for the degree of

*Master of Science in Computer Science*

**Declaration**

I, the undersigned, declare that this work has not previously been submitted as an exercise for a degree at this, or any other University, and that unless otherwise stated, is my own work.

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1.    I did not make use of AI tools in the work described in this document, including the preparation of the document itself.   
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GAYATHRI GIRISH NAIR

Name

August ??, 2024

**Acknowledgements**

**Abstract**

Ever since industrialization, CO2 levels in our atmosphere have continued to rise at an unnaturally fast pace due to anthropogenic activity. Today, forests absorb 30% of global annual emissions [1] and are integral to combating climate change. But they are also fragile so education about forest management is important. This is especially true for those in the 15 to 24 age group as they constitute decision makers of tomorrow who will inherit the planet and the challenge of rapid climate change. The Cities and Climate Change Project by the Intergovernmental Panel on Climate Change (IPCC) suggests that individuals in this category are have a strong sense of accountability, and are open to change [2]; thereby making climate change education very important for that group.

Several tools exist [3-7] to teach about ideas related to climate change and/or forests. They are either scientifically accurate decision-making aidsor more abstract yet informative educational games that tackle multiple problems at once which while informative, can be distracting and/or overwhelming. Further, most of them cater towards adults with few focussing on younger learners.

Effective education depends on learner engagement and education technology tools based on microworlds have been proven to be successful at achieving this [8-11].

Mycroforest, as proposed here, is a web based microworld aimed at teaching young adults about the connection between forest management and CO2 levels in the atmosphere. The tool enables learners to take on the role of a forest owner in a virtual world. They may draft management plans involving felling trees to sell wood or planting trees. Consequences of plans are reflected on the composition of the forest, CO2 levels in the atmosphere, and the learner’s bank balance. Using the tool, learners can be set challenges of increasing complexity ranging from maximising income from the forest to devising a plan which optimises carbon capture while also generating income.

Under the hood, Mycroforest is composed of a simulation, a set of UI components, and input variables. The simulation models growth of trees and the carbon cycle using an object oriented approach. This is a greatly simplified representation of the real-world. Key challenges faced in design and implementation included designing a simulation that reflects patterns seen in nature, drafting a user friendly interface to best support possible effective learning scenarios, and developing the app using the NextJS framework.

The Mycroforest teaching tool was evaluated after use at a 2 hours session with 10 Transition Year students on the [TAP Bridge2College Programme](https://www.tcd.ie/trinityaccess/schools/secondary/bridge-to-college/) at Trinity College Dublin. Feedback was also obtained from tutors at the event. Overall, response to the app is largely positive with student finding it “informative”, “fun” and “simple to use”.

Overall, Mycroforest is a web based teaching tool where students take on the role of a forest owner and put their own forest management plans to the test while striving to meet challenges set around learning scenarios and in the process, learn about the importance and difficulty of sustainable forest management in a constructivist fashion.

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# Introduction

This section documents the motivation for this project and its goals. Referencing style adopted, and ethical compliance is also discussed here.

## Motivation

Currently, we are amidst a climate emergency caused primarily due to our heavy dependence on fossil fuels which shows no signs of significant decline. There are multiple reasons for our global collective failure to reduce carbon emissions including economic, geo-political, psychological, and sociological factors. Climate change negatively impacts almost all life on Earth given increasing temperatures, ocean acidification, desertification, and greater prevalence of extreme weather events, which in turn, would negatively impact society by leading to forced human migration, increased mortality, and possibly increased tension between nations under varying circumstances or at different stages of development and wealth [12]. Such environmental and socio-economic impacts of climate change may also disrupt key industries, particularly agriculture [12], as productivity suffers. [13]

Given that today, climate change is considered an existential threat to humanity, it has been identified that global transformative change involving changes to fundamental technological, economic and social factors that underpin direct drivers like fossil fuel usage, as was suggested at the UN Climate Change Conference COP26 in Nov 2021, is essential to successfully mitigate this problem in time. Such large scale drastic yet necessary changes are unlikely to happen via government efforts alone. It would require a shift in collective mindset and understanding between all stakeholders and key decision makers. [13] This is why, correct education targeted key demographics like the youth is crucial to combating climate change.

Furthermore, there is a need to reinforce awareness about the urgency of the situation. So far, worldwide responses to government policies have been lukewarm at best despite several climate negotiations. It is important to realize that, given the extremely difficult to model non-linear dynamic nature of Earth’s climate, there exists a very real risk of unexpected catastrophic changes catching us off guard despite our best climate modelling efforts. Given current trends and models, the global average temperature is predicted to rise to between 2.1 and 3.9 °C by the end of the century which is expected to trigger several planetary tipping points from beyond which, restoration of natural systems become extremely difficult if not impossible. [13]

Enhancing existing carbon sinks or creating new ones is among three suggested courses of actions against climate change to avoid a dire future with the others being reduction of greenhouse gas (GHG) emissions and modification of Earth’s energy balance. [13] TO DO … Forests absorb around 30% of current global emissions. They are thus among most important and arguably most readily manageable carbon sinks. A carbon sink is any mechanism that absorbs more carbon than it releases to effectively remove carbon from the air such that it does not contribute towards global warming. [14]

TO DO … Carbon Dioxide (CO2) is an important GHG that is a key driver of global warming. [12]

## Goal

## Referencing

This document adopts the Numerical style of referencing with EndNote to manage literature connected to Microsoft Word for inserting citations and the Bibliography.

## Ethics

The tool was used by (N=20) TY students for a period of 1.5 hours as part of a two-day workshop, within the Bridge2College programme, exploring different aspects of climate change. Ethical approval for researching different aspects of the Bridge2College programme had been granted by the School of Computer Science & Statistics.

# Background (start each chapter on a new page)

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### Climate Change Education (optional)

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# Bibliography

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# Appendices

## Survey Instruments Used

## Use of GenAI in this Work