Chapter 7

The Global Change App: The Creative Transformation of Scientific Research

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ABSTRACT

The global carbon and water cycles, and the process of photosynthesis are integral components of any high school science class or university science degree. Despite being intricately linked, these important global processes are often taught in isolation. This disconnection can lead to students having an incomplete understanding of the interconnection of leaf level processes, global cycles, and how they are affected by human activities. The “Global Change” app is an interactive teaching tool that illustrates how the biotic and abiotic systems involved in carbon and water cycling are connected to the stomata, and how human activities are affecting these processes in a meaningful way for students. In this chapter, the authors identify key gaps in students understanding and explain how the app addresses these. Example lessons are provided that encourage student self-inquiry, in a way that allows flexible, interactive learning. The Global Change app demonstrates how creative design and science can be combined to enhance the engagement of students with complex scientific concepts.

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INTRODUCTION

Knowledge about the carbon and water cycles are critical scientific concepts for participating in global climate change discussion. Without an understanding of these cycles and especially comprehension of how human activities impact on these cycles, students lack “preparedness for life” in society (OECD, 2006). Nevertheless, there are still several difficulties in understanding the evidence for climate change not only in students but also in adults (e.g. Robelia & Murphy, 2012). Thus, learning about the global processes and how they are influenced by human activities from a social perspective is a highly relevant topic for students. The *Global Change* app (hereafter “the app”) integrates complex scientific concepts of these ecological processes with design and animation; placing an interactive learning environment to teach these concepts at the fingertips of students and lecturers via their mobile devices. The app is free to download from the iTunes and Google Play stores. In addition, there is a PC version that is ideal for lecturers to use in a classroom setting. The app provides an overview of the physiological function of stomata; the terrestrial interface for the carbon and water cycles, the major components of the carbon and water cycles as well as the main global change impacts that are acting on them. The aim of the app is for it to be used as a teaching support tool for illustrating how the biotic and abiotic systems involved in carbon and water cycling are connected to the stomata, and how human activities are affecting these global processes in an approachable and meaningful way for students. In addition to the embedded content, the app links to external information, including open access peer-reviewed literature; where both students and lecturers can further explore concepts with scientifically robust information to enhance understanding of the connection between the natural world and human activities.

The app is a prime example for teaching scientific literacy, which aims to improve students’ understanding of scientific principles and processes that will enable personal decision-making, and students’ participation in discussions of scientific topics that affect socio-scientific issues (e.g. National Science Education Standards, 2006). The ability of students to make use of these competencies depends on the students’ scientific knowledge, i.e. their content knowledge of the natural world (e.g. carbon and water cycle are connected through stomata), their procedural (e.g. procedures used by scientists to establish scientific knowledge), and their epistemic knowledge (e.g. to understand the reasons for common practice of scientific inquiry (OECD, 2015)). The purpose is not to offer any new information about either cycle or the role of the stomata in the interactions between the cycles; rather, the app provides an interactive educational platform for teachers, students and non-climate-scientists. This chapter provides an overview of the capacity of educational apps on mobile devices, such as *Global Change* to address known students’ knowledge gaps or learning demands about the complex processes of photosynthesis, respiration and the links between the natural world and human activities.

Background

The process of photosynthesis converts carbon dioxide (CO₂) into sugars and photosynthates that are used to increase biomass, exchanging oxygen and water molecules as by-products back into the atmosphere. Photosynthesis is arguably the most fundamental biochemical process on earth, without it life as we know it simply would not exist. Rates of photosynthesis are directly related to transpiration; the biologically mediated movement of soil water through the vascular system of plants, and the transfer of carbon (respiration) to and from (photosynthesis) the atmosphere, which are regulated by the same organs, the stomata (Ferguson & Veizer, 2007).
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