Chapter 17
A Teaching Sequence Proposal Using Microcontrollers Programmed With BASIC

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ABSTRACT

This chapter presents three electronics-based projects at increasing levels of sophistication. Two of the projects use the PIC microcontroller-based MicroMite chip. One uses the new Raspberry Pi PICO microcontroller board. All three deliver base level units that monitor atmospheric pressure (Projects 1 and 2) and ambient light levels (Project 3). All three communicate bidirectionally with an app on an Android mobile phone via the popular and well supported Bluetooth protocols. In the final technical section of the chapter, the content of those Bluetooth communications are 'pushed' onto a local IoT intranet design. The chapter closes with a brief summary of the STEAM initiatives in Australia plus a brief discussion of the importance of electronics in contemporary life which arguably justifies their inclusion in STEAM curricula content.

INTRODUCTION

In the current age, it is indisputable that Information and Communication Technologies (ICT) have permeated our lives and are ubiquitous in every aspect of our daily routine. Since the early 20th century, technology has been envisioned as and promised to be a perfect tool that will transform the way we interact with learning material, change the way we learn and make teaching sequences more interesting, immersive and successful. In the course of integrating technology with learning sequences there have been many successful stories, but this integration also ended in quite a few disappointments.

Students nowadays are "digital natives" and significantly familiar with many aspects of ICT. It is clearly important for this generation, to acquire the so-called 21st century skills (Geisinger, 2016).

DOI: 10.4018/978-1-6684-3861-9.ch017

Science, Technology Engineering Arts and Mathematics (STEAM) education affordances have been increasingly integrated in modern curricula, aiming to provide students with not only "core" knowledge from the various disciplines but also teach them problem solving skills, critical thinking, creativity, communication skills and in general digital and information literacy (Khine & Areepattamannil, 2019; Taylor, 2016; Xefteris, 2019).

The STEAM framework has been shown to be instrumental in reconceptualizing instructional strategies and models, focusing educators and students on "learning how to think and learning how to learn" (Ge, Ifenthaler, & Spector, 2015). The framework is targeted towards transdisciplinary and multimodal contexts of presenting learning material, combining different learning areas and uncovering hitherto "hidden" relationships among different disciplines (Hayman, 2017).

In this context, the introduction of programming activities in curricula is a promising and highly versatile tool that enables educators to formulate the sought-after transdisciplinary and highly engaging learning activities. There are many approaches and different formulations of courses using microcontrollers or micro PCs to engage students in project based activities under a STEAM framework, tackling different aspects and using one or more modalities such as educational robotics, Arduino, Raspberry Pi etc. (de Souza & Elisiario, 2019; Zhong & Liang, 2016).

In this chapter a teaching sequence is proposed, based on the use of microcontrollers that are programmed using 'Basic'. The core materials of the presented projects include the new Raspberry Pi Pico board and the PIC microcontroller based MicroMite chip. The teaching sequence consists of three projects at increasing levels of sophistication. Projects 1 and 2 deliver an atmospheric pressure monitor and project 3 delivers an ambient light level monitor. All projects communicate bidirectionaly with an Android mobile app via a Bluetooth connection. In the final section, measurements are pushed onto a local IOT intranet. The teaching sequence aims at inducing a problem based learning activity, emphasizing on evaluation of results.

BACKGROUND

STEAM Education in Australia

The Australian Science Curriculum outlines perspectives on how to engage students with material that facilitates basic uni-disciplinary knowledge and skills but also highlights the significance of the acquisition of higher-order skills for functioning in a highly and constantly evolving technology saturated environment. In this, the Australian Science Curriculum provides a roadmap that urges educators to create learning sequences that make use of multiple modalities and engage students in developing inquiry skills through the conceptual acquisition of scientific concepts ("The Australian Curriculum," 2021) In this context, Australia's chief scientist has called for educational reforms that facilitate the students' engagement with STEM disciplines, in order to future-proof Australia's high tech digital workforce (Taylor, 2016).

Although STEAM education aspires to be Australia's nationwide focus for innovation and for arming students with much desired 21st century skills, including the ability to "think smart and creatively, solve problems, take risks, have strong digital skills and collaborate effectively" (PriceWaterhouseCoopers, 2015) it seems there is much to be desired for considering the state of education in the nation's schools, especially at the secondary level, where STEAM based curriculum resources are scarce. A report by