Chapter 17

Aquaponics Project-Based Learning at the Secondary School Level: Cross-Curricular Learning in Biology, Chemistry, and Mathematics

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ABSTRACT

Authentic learning is a powerful means of creating a reason for why the information being learned is important to the older student. Situational interest stems from being stimulated by new things. However, as children grow mentally and emotionally, situational interest is replaced by individual interest. As educators, we often focus on the situational interest to quickly focus our students, but it is the individual interest that makes the learning applicable to the student that is most needed by secondary students. Authentic learning bridges these two interests. It is the purpose of this chapter to present ideas of project-based learning in the authors’ secondary school that addresses the “need to know” through cross-curricular instruction and authentic learning.

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INTRODUCTION

Before beginning this chapter, allow us, the authors, to ask a question of you, the reader, “Why did you pick up this book?” It is a simple question, but the answers may be varied in response. Are you an academic looking for research material? Are you an administrator looking for ideas to build better learning in your school district? Or perhaps are you an educator looking for ideas to improve your own toolbox of ideas? Whatever the motivation, you are exhibiting the “need to know.” You were drawn to this book based on a problem, “How do we as educators work across the curriculum platform?”

In like manner, if students are to take ownership of their own learning, they must understand why they need to learn what we are teaching. In the thesis, “The Effects of Performance of Secondary Art Students Participating in an Interdisciplinary Chemistry-Art Program with Those Taught in an Art Only Program” (Hopkins, 2010), the author introduces the idea of teaching across the disciplines:

> Interdisciplinary teaching is not a new concept, but instead one that was first established by Dewey and Parker in the 1890’s progressive movement as a vital part of effective pedagogy (Hinde, 2005). Over the years, courses of instruction on all levels have become narrowed in focus and specialization. Unfortunately, the pace that information is added on a daily basis has prompted educators to return to the ideas of Dewey and re-learn the value of shared disciplines as they seek to find ways to help students connect with the fundamentals and make application to their world.

The concept of “needing to know,” was as valid in the 1890s as it is now in the 21st century. Since the writing of the aforementioned thesis, the introduction of Common Core State Standards (CCSS) for literacy and math, as well as finalization of the Next Generation Science Standards (NGSS) has at its core the charge to teach across the disciplines. Today’s teaching plans must not only include the immediate subject standards, but must also reference cross-curricular connections.

Science literacy is focused on how that data is communicated via graphs and charts or formal lab reports. However, literacy need not be limited to just these areas and, for the most part, a wide and diverse world of literary works, from poems to novels, has been widely overlooked as source material. English Language Arts (ELA) teachers focusing on the nuances of prose construction, often overlook the connections they are able to make to the importance of the science and math behind the main subject. Likewise, science teachers overlook related content outside of the textbook, such as the writings of David O’Hara and Matthew Dickerson (2014) in their book, “Downstream.” In this collection of short essays by the authors, a great deal of science related to the water quality of streams, as well as the general environmental changes required for stable ecosystems, are addressed in the context of fly fishing. Mathematic teachers are also benefited by increasing the presentation of science literacy as their own foundation was created based on observations of the natural world (Archimedes and Newton) in addition to the “how” of doing a mathematical procedure.

It is important to remember that the resistance of working across the disciplines is in large part due to the pressures of high stakes testing, forcing many to feel that they must “stick to the script” in order for students to be successful. It is the intent of this chapter to not give teachers “one more thing to do,” but instead to encourage teachers that working together strengthens all areas of learning and student motivation.

Project Based Learning (PBL) is an effort to meet these goals using an interdisciplinary approach to learning. Leszczynski, Monahan, Munakata, and Vaidy (2017) wrote that even at the college level, the need
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