Chapter 5
Learning About Genetics in an Elementary Classroom Using a Web-Based Inquiry Science Environment (WISE) Unit

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ABSTRACT
Genetics is an increasingly important topic in today’s society, yet continues to be an ongoing challenge to the science education community and an important aspect of school student learning. This chapter examines how STEMGenetics, an inquiry-based technology-enhanced online unit, engages upper elementary students in building a better understanding of the concepts of inheritance of traits, variation of traits, and the life cycle of plants. Using pre/post measures, supplemented with qualitative analyses of students’ responses, the authors show how upper elementary students’ understanding of inheritance and variation of traits, as well as the life cycle of plants, resulted in greater learning gains. In addition, engaging in learning technologies, such as dynamic visualizations, provided the students opportunities to interact with the scientific phenomena and enhanced their reasoning about inheritance of traits and its relationship to the life cycle of plants.

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INTRODUCTION

In issues ranging from the consumption of genetically modified foods to getting tested for one’s personal risk of certain illnesses, understanding genetics plays a vital role in everyday health-related decision-making (Costa-Font, Gil, & Traill, 2008; Kesselheim, Cook-Deegan, Winickoff, & Mello, 2013; Stark & Pompei, 2010). Despite the demonstrated importance of understanding genetics and other heredity-related topics, numerous studies have shown that these ideas are difficult for students at all ages to grasp (e.g., Ayuso & Banet, 2002; Haga, 2006; Duncan & Reiser, 2007; Duncan, Rogat, & Yarden, 2009; Lewis & Wood-Robinson, 2000; Tsui & Treagust, 2007). Developing a full understanding of how genetics, the environment, and the interaction between these two factors can affect organisms’ traits is a key expectation for students in third grade and beyond. In the U.S., these expectations are reflected in the Framework for K-12 Science Education (2012) developed by the National Research Council (NRC) of the National Academy of Sciences and the Next Generation Science Standards (NGSS, 2013). The key ideas for the upper elementary students found in the grade band (3-5) under the NRC Framework are that offspring inherit genetic information, that variations in this information result in variation in traits, and that the environment also plays a role in influencing traits and thus enhancing observed variation (i.e., even identical twins are usually not entirely identical).

Given the complex nature of genetics and the extent of persistent non-normative ideas, technology-enhanced instruction has “tremendous” potential for promoting student learning around complex and abstract science topics such as genetics (Banet & Ayuso, 2000; Roseman, Linn, & Koppal, 2008; Shear, Bell, & Linn, 2004; Songer, 2007; Tsui & Treagust, 2007). Technology-enhanced inquiry curricula and instruction can lead to improvement in the K-12 students’ learning outcomes (Edelson, Gordin, & Pea, 1999; Kali, Linn, & Roseman, 2008; Krajcik, Blumenfeld, Marx, Bass, Fredericks, & Soloway, 1998; Linn, Davis, & Bell, 2004; Reiser, Tabak, Sandoval, Smith, Steinmuller, & Leone, 2001; Songer, Lee, & Kam, 2002). These inquiry-based materials help students develop deep understandings of complex science ideas that are standards-based (Lee, Linn, Varma, & Liu, 2010; Linn & Hsi, 2000; Roschelle, Pea, Hoadley, Gordin, & Means, 2000; Slotta & Linn, 2009;). For instance, computer-based environments such as Geniverse (https://concord.org/teaching-genetics/dragons) engage students in complex reasoning about genetics while experimenting with breeding different virtual dragons. This in turn provides students with a mode of instruction that is web-based and technology enhanced, allowing them to manipulate different dynamic representations while potentially deepening their understanding of concepts of genetics.
Local Lotto: Mathematics and Mobile Technology to Study the Lottery
www.igi-global.com/chapter/local-lotto/190111?camid=4v1a

Beyond Angry Birds™: Using Web-Based Tools to Engage Learners and Promote Inquiry in STEM Learning
www.igi-global.com/chapter/beyond-angry-birds/180864?camid=4v1a