Chapter 71
Integrating Educational Robotics to Enhance Learning for Gifted and Talented Students

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ABSTRACT

Using educational robotics as a learning tool fosters gifted and talented students' learning, helping to instill the qualities necessary for them to be successful 21st century citizens and innovators who can profoundly affect the future US economy. Educational robotics provides a stimulating hands-on learning environment in which students constantly encounter problems that trigger inquiries, inspiring them to develop new solutions, test them out using the physical robots, and reiterate the process until they successfully solve the problems. Although educational robotics is considered "the most perfect instructional approach currently available" (Gura, 2013, para. 2), just bringing the tool into a classroom does not necessarily create the learning transformation that we wish to witness. The chapter presents the theories behind ideal Robotics in Education (RiE) approaches, introducing tips to ensure effective student learning and to maximize the potential of able students to display giftedness.

INTRODUCTION

In recent years, efforts to encourage innovation through expanding STEM fields in education have been discussed as critical for strengthening the economy in the US. Wagner (2012) urges that there is a general agreement that the new economy has to be based on innovation:

> *We have to become the country that produces more ideas to solve more different kinds of problems. We have to become the country that leads the way in developing the new technologies for sustainable planet and affordable health care. We have to become the country that creates the new and better products, processes, and services that other countries want and need. … We must out innovate our economic competitors. (p.3)*

Wagner (2012) introduces the Seven Survival Skills in his book, *the Global Achievement Gap,* which includes:

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1. Critical thinking and problem solving
2. Collaboration across networks and leading by influence
3. Agility and adaptability
4. Initiative and entrepreneurship
5. Accessing and analyzing information
6. Effective oral and written communication
7. Curiosity and imagination (p.12)

Wagner continues to argue that the Seven Survival Skills are not enough for becoming successful innovators. Through his interviews with innovators, Wagner's research suggests that the qualities of innovators also include perseverance, in particular a willingness to experiment, take calculated risks, and tolerate failure. Although those are not the kinds of qualities that are emphasized in schools because of the extensive focus on standardized testing, these qualities are included in the core of 21st century skills that have become the focus of education in recent years. Moreover, those are the qualities that can be well-fostered through Robotics in Education (RiE). Gura (2013) explains what educational robotics can bring into classroom:

I feel that robotics just may be the most perfect instructional approach currently available. It offers classroom activities that teach high-value STEM content as well as opportunities to powerfully address ELA Common Core Standards. In fact, there are connections to robotics across the full spectrum of the curriculum. Robotics is also a highly effective way to foster essential work skills like collaboration, problem solving and project management. It does all this while keeping kids so motivated and engaged that getting them to stop working and move on to the rest of the school day can be a challenge -- a good problem to have! (para 2)

This chapter introduces educational robotics as a learning tool used to enable student mastery (especially for the gifted and talented students) of the qualities and skills necessary to be the driving force for rebuilding the US economy in the future. In this chapter, 21st century skills, gifted- and talented-ness, and educational robotics as a learning tool, are introduced and discussed, as well as how robotics in education can foster the mastery of qualities necessary for students to be innovators and what educators need to do to ensure the success of their learning.

TWENTY FIRST CENTURY SKILLS

21st Century Skills have been the focus of educational reform in several countries including the U.S., Australia, Finland and Singapore. Especially in U.S., the focus on the 21st Century Skills has been highlighted as the core of the educational reform. The Partnership for 21st Century Skills, a national organization (http://www.p21.org/) advocating for 21st century readiness for every student, states:

In an economy driven by innovation and knowledge... in marketplaces engaged in intense competition and constant renewal... in a world of tremendous opportunities and risks... in a society facing complex business, political, scientific, technological, health and environmental challenges... and in diverse workplaces and communities that hinge on collaborative relationships and social networking... the ingenuity, agility and skills of the American people are crucial to U.S. competitiveness. (Partnership for 21st Century Skills, 2008, p. 1)

The Partnership for 21st Century Skills focuses on the 21st Century Skill Framework, which identifies 21st Century student outcomes and skills:

- **Core Subjects and 21st Century Themes:**
  - **Core Subjects:** English, World languages, Arts, Mathematics,