
Blocks to Robots: learning with technology in the early childhood classroom

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Principles for successful use of technology in early childhood education do not easily fit with some of the more popular notions in the field of educational technology; a careful look at technology in the education of young children can be illuminating for a variety of audiences. Bers' *Blocks to Robots: learning with technology in the early childhood classroom* offers instructions on the specific technology of robotics in early childhood education as well as insights into the context, reflection, and deep thinking that would make this a fascinating read for anyone interested in educational technology or the education of young children.

This book is important because the sensitive role that technology can play in early childhood education can get lost in larger trends within the field of educational technology. It is common practice to directly associate educational technology with progressive education and learner-centred pedagogy (e.g. Sandholtz et al, 1997; Boss & Krauss, 2008). This connection falters, however, with regard to educating young children, for whom many popularly available pieces of technology do not easily facilitate developmentally appropriate practice. At the same time, concerns about digital technology use in the early years can seem counter-intuitive in a bifurcated world-view that splits up the young and old in terms of their digital proficiency; this is most overt in the popular metaphors used to distinguish between 'digital natives' and 'digital immigrants' (cf. Prensky 2001; Richardson, 2006; Palfrey & Gasser, 2008). Both of these trends – a strong assumption of the inevitable benefits of technology for learner-centred pedagogy and differentiating between digital 'natives' and 'immigrants' – are helpful frameworks for thinking about technology practices in classrooms, but they do not specifically address the unique social, emotional, cognitive, and physical needs pertaining to the development of young children.

A major concern for early childhood educators has long been the potentially detrimental effects of computer technology. One of the leading organizations for the education of young children within the USA, the National Association for the Education of Young Children (NAEYC), cautions educators and parents alike in its most recent position paper on technology. The Association argues that, based on the methods of implementation *in practice*, computer-based media is an unfavorable substitute for more traditional activities such as block play and water tables

(NAEYC, 1996). Indeed, more than 10 years after this position paper was released, there remains a network of prominent leaders in the fields of young children's health and education which strongly discourages current trends towards technology integration in early years education (cf. Alliance for Childhood, 2008). Indeed, since 2000 onwards, the Alliance for Childhood has called for a moratorium on the introduction of technology in early childhood and elementary education.

The bulk of these concerns about digital technology and child development relate to the perceived difficulties associated with adequately integrating digital technologies into developmentally appropriate practice within formal early learning contexts. Developmentally appropriate practice in this sense typically refers to educative practices that foster the social, emotional and cognitive growth of children aged 3-8 years (NAEYC, 1996; Alliance for Childhood, 2008). Despite such vocal opposition to young children engaging with digital technologies, however, both the NAEYC (1996) and the Alliance for Childhood network (2004) do temper their warnings and acknowledge the possibility of including digital technology in early childhood education provided such use is preceded by critical and holistic examination of intended applications and likely effects. Bers' book provides – and models – this type of critical and holistic examination within the context of early childhood education and unquestionably can help teachers to cultivate a 'special place' for technology in their early years teaching contexts.

In short, Bers' *Blocks to Robots* provides a compelling rationale and detailed road map for including robotics in the early childhood curriculum. The robotics kits on which Bers focuses comprise a variety of interchangeable mechanical pieces (wheels, arms, axles, gears, motors, etc.) that are assembled to create a seemingly limitless variety of robots. These kits include an operating program that interfaces between the assembled robot and a computer and which can be used to program the robot to complete a range of simple tasks (e.g. move, pick up small objects).

The appeal and success of this book, however, goes well beyond children and robotics. What impresses me about it is how, while making a strong case for robotics in early childhood classrooms, Bers clearly and thoughtfully reviews and critiques fundamental issues concerning early childhood development, educational technology, and constructivist learning theory.

Bers' primary focus in her take on the inclusion of robotics within early childhood education is the potential of robotics to enhance the socio-emotional development of children. A secondary focus is her commitment to using robotics to enhance young children's mathematics and science skills. Bers' foundational idea for her approach is that 'a genuine concern for socioemotional growth is mandatory in developmentally appropriate practice. Thus, technology needs to be integrating with the purpose as well' (p. 33). She promotes a systemic approach to technology integration – where technology is a catalyst and incubator of educational innovation – over simply focusing on the potential of a certain technology to improve the delivery of an existing skill or knowledge set. Indeed, Bers emphasizes the use of robotics as a catalyst and incubator for fostering student interests, creativity, and collaboration. Bers also notes that in 'early schooling experiences, we teach them about polar bears and cacti, which are probably further from their everyday experiences than smart faucets and cell phones' (p. 33). This observation fuels her push for introducing robotics to children as a gateway to knowledge, skills and mindsets used in mathematics, science, technology, and engineering, in addition to being a catalyst for children's socio-emotional development.

Bers is a protégé of Seymour Papert, and it is to the work of Papert that Bers owes her greatest debt. In a field where books can run the risk of being outdated by the time they are published, Papert's work reminds us that there *are* seminal works in the field of educational technology. Papert began developing a programming language for children during the early 1960s while he was a professor at the Massachusetts Institute of Technology (MIT) in the USA. Indeed, Papert developed LOGO for children to use well before the advent of the personal computer, and it was the subsequent rise of the PC and Papert's pioneering book, *Mindstorms: children, computers and powerful ideas* (1980) that made Papert and his conception and practice of 'constructionism' internationally popular. Another interesting dimension of Bers' book is her interplay between Piaget's constructivism and Papert's constructionism. Constructivism is a learning theory attributed principally to Jean Piaget's developmental psychology research. Constructivism in this sense focuses on the subjective and internal development of knowledge. Constructionism is an advancement of Piaget's work by Papert, and focuses on how interactions with technologies can advance social and cognitive development.

In discussing the developmentally appropriate use of robots as *constructionist* tools in early childhood environments, Bers addresses such issues as curriculum integration, learning styles, and matching students' imaginations and ambitions with the limitations to and potential technical frustrations associated with using digital technology. Bers offers informative and practical advice based on experience, theory and research for working with a variety of students in a range of classrooms.

The book provides a richly described context for Bers' extended work in robotics. This includes an overview of the history, antecedents, and related issues concerning robotics and early childhood education. This account runs from the establishment of kindergartens by Froebel in 1837, to the work of Seymour Papert to create programmable 'floor turtles' in the late 1960s, to the current state of play that includes computer-programmable Lego robotic kits. Bers uses lessons from literacy education to examine various approaches to parental involvement in robotics projects, especially when parents themselves might be uncomfortable with such technology. While she does describe alternatives, Bers focuses primarily on Lego kits throughout her book. This emphasis is reasonable given that these kits are the most popular product in the field. Moreover, Bers does an excellent job of explaining the parts and processes of hardware, software, and programming in the kits, and educators new to robotics will find these descriptions and explanations extremely useful.

The book is organized as a compelling tour through the major issues concerning developmentally appropriate use of robots in early years education. This tour is replete with results from Bers' own research, engaging vignettes, and compelling interviews. Whether by intuition or design, the book's organization reminds me of models of communities of practice. Bers begins by detailing larger, binding themes, and by the second half of the book the reader is accessing insider information about and practical guides for using Lego Mindstorms robot kits in the classroom, including everything from designing the learning environment to engaging parents in robot projects.

In an interesting move, and after making a persuasive and informed case for the use of robotics in the education of young children, Bers hands over the book to several contributors. The first is Chris Rogers, a Professor of Engineering at Tufts University, who has been working with schools and robotics for some time now. Rogers' experiences with and focus on robotics in early childhood education enables him to identify and discuss several recurring problems and solutions within this still relatively new field of endeavour. He tackles larger issues such as the need to focus on system-wide reform, through to more practical, on-the-ground advice on getting children to clean up the classroom at the end of a robotics session (he suggests, for example, to 'combine all of the little parts into bins in the center of the classroom' (p. 49), and then have one bin for axles, one bin for gears, and so on). It is this type of detail that not only helps a potential robotics teacher, but also adds credibility to his advice. Rogers also suggests initiating young children into robotics by providing time for 'free building' play, as opposed to building from instructions, even though the former typically requires paying more individual attention to students on the teacher's part.

Rogers addresses large issues with an eye on practice. One issue has both technical and epistemological implications: the ambiguity of problems and solutions in the field of engineering. This ambiguity can be uncomfortable for teachers and students who are habituated to arriving at 'correct' and tidy answers to design and construction problems. Another issue addressed by Rogers is gender differences he himself has observed between the way in which girls and boys engage with robotics. Boys, according to Rogers, tend to enjoy simply building, while girls work more effectively when they have a purpose, such as building a hospital or city.

There are more vignettes within the book written by a variety of robotics practitioners working in early childhood education, and each offers a different, yet engaging, perspective. There is a vignette from Megina Baker, a graduate student who introduced robotics within the context of her part-time job as a teaching assistant in a kindergarten class. She provides a close look at the step-by-step implementation of a robotic unit of study. There is a vignette about the collaboration between a teacher, Rebecca Merino, and an engineer, Kevin Staszowski, who together create a robotic simulation of historic sites of the Boston area with a kindergarten class. There are some interesting insights to be had from this particular vignette, especially the use of non-robotic material such as cereal boxes and egg cartons to keep children engaged and creative when teacher help or needed Lego resources are not readily available.

Another vignette – this one by Merredith Portsmore – offers some fascinating advice for teaching engineering principles to young children by means of developmentally appropriate practice using Lego robots. Her advice begins with teaching children how to distinguish and name all of the pieces in the kit in an engaging and collaborative way. Portsmore suggests beginning with straightforward activities such as having children design a chair that can support a stuffed bear. Her work with children focuses on scaffolded ways to introduce the design, test, and redesigning model of engineering.

Bers' book also includes two interviews that afford added insights into debates concerning robotics and developmentally appropriate instruction. First, Bers interviews Rebecca S. New, an expert in child development. New provides a cross-cultural perspective on play, development and education, and connects her larger, sociocultural views on these three dimensions of child education to technology use. Second, Sia Haralampus, an undergraduate student in Child Development, interviews Terry Green, a science teacher who is deeply involved in the use of robotics. Haralampus interviews Green after observing Green teach using Lego robotics kits. This interview involves Green in reviewing and explaining her choices, innovations, and implementation strategies through the dual lenses of early childhood development and science education in the discussion of classroom practice, and is an excellent capstone for Bers book.

Overall, Bers does a marvellous job of establishing practical and theoretical frameworks for using robotics in early childhood education in a thoughtful, varied, and accessible way. *Blocks to Robots* is excellent in its focus on robotics in early childhood education as well its perspective on educational technology and as a model for scholarship. Pre-service and in-service teachers alike will find this book to be an accessible read, and a book that can be used as both a reference guide and springboard to including robotics in their own classrooms. One strength of this book is that its implications for classroom practice are relevant across all grades, and educators working in elementary grades right through to university teacher education classrooms will find much of use.

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