

Chapter 6

Exploring the Co-Development of Mathematical and Technological Knowledge Among African American Students

Francis Nzuki

Richard Stockton College of New Jersey, USA

ABSTRACT

This study examines African American students' interactions with the graphing calculator as a tool to support their mathematical learning. Two participants, chosen through purposive sampling, were the focus of this study. The participants were presented with a task-based interview, and the strategies they employed in solving these tasks with the help of a graphing calculator were examined. The participants' strategies were analyzed using Goos, Galbraith, Renshaw, and Geiger's (2003) framework of the varying modes of sophistication with which students work and interact with technology and the ways in which technology can mediate learning. These modes include technology as master, technology as servant, technology as partner, and technology as an extension of self. In solving the mathematical tasks, the participants' modes of interacting with the graphing calculator technology were influenced by how and when they chose to use the graphing calculator. They were also influenced by their ability to reinforce their mathematical and technological knowledge mutually. It is this ability to develop an interactive relationship between mathematical and technological knowledge that shaped the participants' fluency in solving the mathematical tasks.

INTRODUCTION

Several reports have documented underachievement and limited persistence of African American¹ students in mathematics (Delpit, 1995; Ladson-Billings, 1995; Martin, 2000, 2003; Oakes, 1985;

Perry, Claude, & Hilliard, 2003; Stinson, 2006; Tate, 1997b). Further, studies reveal that at both high school and collegiate levels advanced mathematics classes have mainly White and Asian American students, while remedial mathematics classes contain disproportionate number of African American students (Martin, 2003; Moses & Cobb, 2001; Tate, 1997b). While there are disturbingly

DOI: 10.4018/978-1-4666-2017-9.ch006

low rates of mathematics achievement among students of color, data from the 2003 Mathematics Assessment of The National Assessment Educational Progress revealed that compared to other students of color—Hispanic, Asian/Pacific islanders, and American Indian/Alaska native students—African American students scored lower on average in both the fourth and eighth grade (Braswell, Daane, & Grigg, 2003).

Further, in discussing equity issues in mathematics, the use of technology in classrooms has been recommended as useful in helping engage low-SES² and students of color in learning that encourage them to use complex thinking skills in mathematics (Hennessy & Dunham, 2002). The National Council of Teachers of Mathematics (NCTM) (2000) argues that “technological tools and environments can give *all* [emphasis added] students opportunities to explore complex problems and mathematical ideas” (p. 13). In addition, NCTM posits that technology can attract students who disengage from non-technological approaches to mathematics and that all students should have opportunities to use technology in appropriate ways that will afford them access to interesting and important mathematical ideas. On the other hand, students need to have sufficient technological knowledge in order for them to use the technology appropriately. When technology produces ill-fitted or unsuitable results, students can use their mathematical knowledge to foster the development of their technological knowledge in order to correct or interpret the output of the technology. Thus, while the use of technology can augment students’ learning of mathematics, their mathematical knowledge can foster the acquisition of more knowledge of technological tools. As such, through the opportunities afforded to them to interact with technology when learning mathematics, it is worth examining the dialectic relationship between the technological knowledge that low-SES and students of color develop and their mathematical knowledge.

The study reported in this article is derived from previous work (Nzuki, 2008) and examines African American students’ development of an interactive relationship between their mathematical and technological knowledge when using graphing calculators to solve mathematical tasks. The study was guided by the following research question:

What interactive relationship between technological and mathematical knowledge do African American students at a low-SES school develop?

Theoretical Framework

A sociocultural perspective lays emphasis on the socially and culturally situated nature of mathematical activity, where the classroom, as a community of practice, supports a culture of sense-making where meanings are shared among students and the teacher. From this perspective, learning entails the collective process of enculturation into the practices of mathematical communities (Galbraith, Goos, Reinshaw, & Geiger, 1999) where students interact among themselves, with the teacher, the mathematics tasks, and classroom artifacts within the social context of the classroom. These interactions are patterned and governed by social expectations, conventions, norms, habits, and rituals (Galbraith et al., 1999; Goos, Galbraith, Reinshaw, & Geiger, 2000; Warschauer, Knobel, & Stone, 2004). An essential aspect of sociocultural theory is that learning is mediated by cultural tools and is fundamentally transformed in the process. The graphing calculator technology is an example of how such tools transform mathematical tasks. Learning, thus, is a process of appropriating the cultural tools recognized by a community of practice, and participation in such classroom communities requires learners to acquire new forms of reasoning and action that are beyond their established capabilities (Galbraith et al., 1999; Goos et al., 2000).

In order to describe the varying degrees of sophistication with which students and teachers

9 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage:

www.igi-global.com/chapter/exploring-development-mathematical-technological-knowledge/68575

Related Content

Exploring the Virtual Learning Environment

Teresa Torres-Coronas (2005). *Encyclopedia of Distance Learning* (pp. 906-911).

www.irma-international.org/chapter/exploring-virtual-learning-environment/12208

Continuing Science Education of the Global Public

Leo Tan Wee Hin (2009). *Encyclopedia of Distance Learning, Second Edition* (pp. 432-438).

www.irma-international.org/chapter/continuing-science-education-global-public/11792

Integrating XML Technologies and Open Source Software for Personalization in E-Learning

Hsun-Ming Lee, Robert A. Davis and Yu-Liang Chi (2011). *Dynamic Advancements in Teaching and Learning Based Technologies: New Concepts* (pp. 216-231).

www.irma-international.org/chapter/integrating-xml-technologies-open-source/49305

Identifying Student Usability Needs for Collaborative Learning Environment Design

Danuta Zakrzewska and Joanna Ochelska-Mierzejewska (2010). *Distance Learning Technology, Current Instruction, and the Future of Education: Applications of Today, Practices of Tomorrow* (pp. 196-215).

www.irma-international.org/chapter/identifying-student-usability-needs-collaborative/39457

Opportunities and Challenges of Cybersecurity for Undergraduate Information Systems Programs

Shouhong Wang and Hai Wang (2019). *International Journal of Information and Communication Technology Education* (pp. 49-68).

www.irma-international.org/article/opportunities-and-challenges-of-cybersecurity-for-undergraduate-information-systems-programs/223472