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THE INTERDISCIPLINARY JOURNAL OF PROBLEM-BASED LEARNING

BOOK REVIEW

Orchestrating Inquiry Learning

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Littleton, K., Scanlon, E., & Sharples, M., Eds. (2012). *Orchestrating inquiry learning*. Abingdon, NY: Routledge. 227 pp. ISBN 978-0-415-60113-9. \$180.00 (hardcover); \$59.95 (paperback).

This edited volume focuses on science inquiry learning and on the orchestration of learning within and beyond the classroom, in such locales as homes, school grounds, and outdoor spaces. Most of the authors of the volume concentrate on science inquiry learning in the formal educational settings of schools and colleges. As summarized by the editors, Littleton, Scanlon, and Sharples, the volume conceptualizes orchestration, on a general level, as “planning, management and guidance of learning” (p. 1). A starting point for the book is that inquiry learning is, in many ways, challenging for both teachers and students. Therefore, the book aims to provide practical help for resourcing and supporting the processes of inquiry learning. A central argument of the volume is that, as described by the editors, “technological support, when coupled with appropriate design of the activities and learning environment, can enable the orchestration of inquiry learning experiences that are engaging, authentic and personally relevant” (p. 1). The book comprises an editorial introduction and ten chapters written by 27 authors representing various disciplinary contexts and geographic locations (including the United Kingdom, the United States, Sweden, Finland, Norway, Greece, the Netherlands, and Germany).

Chapter Summaries

In Chapter 1, Scanlon, Anastopoulou, and Kerawalla present a review of the literature on inquiry learning, with a special emphasis on technology-supported inquiry learning in science subjects. Their working definition of inquiry-based learning is the following: “inquiry-based learning involves learners asking questions about the natural of material world, collecting data to answer those questions, making discoveries and testing those discoveries rigorously” (de Jong, 2006, p. 532). The authors concentrate particularly on discussing the various approaches to inquiry learning, the personalization of inquiry, and the different representations of the inquiry learning process. With the help of practical project examples,

the authors argue that it is through the technology-supported personalization and representation of processes that some of the challenges faced by practitioners can be addressed.

In Chapter 2, Littleton and Kerawalla focus on a central challenge of inquiry learning: “how connections are made between ideas and events over time” (p. 31). Specifically, the authors discuss how connections are made between known and new, and between everyday and scientific understanding, both among learners and between learners and teachers. They also consider how connection-building is mediated by representations and technologies. The authors present analytic extracts from their study on students aged 11 to 12 years, which involved the students in scientific learning activities concerning microclimates, both within the classroom and on school grounds. The authors argue that the use of a web-based application (*nQuire*) designed to facilitate the inquiries of secondary school students can support learners in developing trajectories of coherent connection-building.

In Chapter 3, McElhaney and Linn address yet another major challenge of inquiry instruction: “the need for students to take on the role of scientific investigator and (to some extent) let go of their role as a science student” (p. 66). The authors argue that, too often, experiments are treated as ends in themselves. Accordingly, inquiry learning may focus on the “recipe-like procedures” (p. 49) of controlling variables, rather than on the authentic nature of scientific investigation and experimentation. The authors draw on the knowledge integration perspective of learning to describe how the use of a knowledge integration pattern can strengthen inquiry instruction by helping students integrate ideas from experiments into existing educational and personal experiences. They illustrate how the use of a web-based platform (specifically, a web-based inquiry science environment, or *WISE*) designed for science inquiry activities can support the development of high school students’ integrated knowledge (in this case, with regard to factors leading to a high risk of injury to a driver from an airbag).

Chapter 4, written by Sharples and Anastopoulou, addresses taking learning beyond the classroom and back with the help of computer-based tools for orchestration. Drawing on their work in the *Personal Inquiry* project, the authors present design principles to support the orchestration of inquiry learning, which spans both formal and non-formal settings. The challenge put forward by the authors is to create an optimal balance between control and freedom: the “orchestration of inquiry learning must provide a framework that allows creativity within the constraints of accepted scientific process” (p. 76). A further challenge that the authors address is “improvisational orchestration” (p. 77) by the teacher; that is, the integration of externally conducted inquiry (e.g., inquiry conducted at home) and the improvisation of a discussion of unforeseen results during classroom lessons. In particular, the authors illustrate how the use of a computer-based toolkit (*nQuire*) can support the orchestration of learning activities across formal and informal settings.

Collins, Mulholland, and Gaved focus, in Chapter 5, on how scripting (i.e., describing a set of activities to encourage student interactions) can be applied to support personal inquiry learning and, especially, its five aspects: personal choice, collaboration, regulatory process support, transformative process support, and orchestration. The authors discuss personal inquiry learning, the role of technology in supporting inquiry projects, and the key approaches to scripting. They argue that scripts are a means for students and teachers to specify and undertake inquiries and that, in the case of collaboration, for example, they “engineer and exploit differences between students’ opinions and knowledge in order to motivate learning through discussions” (p. 91). The authors point out that one of the dangers of scripting is the creation of over-constraining scripts, which may stifle collaboration. The authors end their chapter with examples illustrating how these five aspects of personal inquiry learning can be supported by scripts authored and enacted in a web-based content management platform (*nQuire*).

In Chapter 6, Pea, Milrad, Maldonado, Vogel, Kurti, and Spikol take us back to the topic discussed in Chapter 4, that is, taking learning beyond the classroom and back with the help of technological supports. The authors discuss the aims of the inquiry science pedagogy and the need to incorporate contemporary technologies into classroom learning and fieldwork because contemporary technologies “provide persistent conversational resources for science learning discussions back in the classroom” (p. 106). The specific focus of the chapter is mobile science inquiry laboratories, which the authors define as “the technologies and services that enable distributed collaborative science inquiry” (p. 107). In particular, the chapter describes a collaborative international project (the *LET’S GO!* project) that aims to provide

educational activities and tools (e.g., geospatial data sensing, data visualization, and Web 2.0 tools) to secondary school students to facilitate their participation in collaborative scientific inquiry.

Chapter 7, written by Viilo, Seitamaa-Hakkarainen, and Hakkarainen, moves the discussion toward teachers’ guiding efforts. The authors argue that, though it has been shown that teachers play a crucial strategic role in supporting collaborative inquiry learning practices, “the significance of teacher guidance has often remained unexplained” (p. 128). The authors examine a teacher’s practices of supporting the collaborative inquiry of 10- to 11-year-old students. Specifically, the chapter describes how the teacher organized and promoted computer-supported collaborative inquiry in the classroom using a computer-based group work space (*Knowledge Forum*), reflected on her actions, and used these reflections to redesign and reorganize subsequent activities. The authors describe the salient pedagogical infrastructure framework and the pedagogical model of progressive inquiry that informed the teacher’s work and discuss implications for teacher guidance of inquiry practices.

In Chapter 8, the topic of assessment is brought to the fore. Drawing predominantly on the U.S. context, Hickey and Filsecker first consider a major challenge for inquiry-oriented instruction, namely, the “coupling of science education standards with test-driven accountability” (p. 148). They then summarize a comprehensive approach to instruction and assessment, drawing on situative theories of cognition, participatory views of learning, and design-based methods. According to the authors, this approach adopts a much broader view on assessment and testing than externally developed multiple-choice achievement tests. The chapter describes five of the most important assessment design principles that the authors originally developed for an inquiry-oriented immersive educational videogame (*Quest Atlantis*). The authors also present research results reporting increased learning outcomes as evidence of the usefulness of the principles developed.

In Chapter 9, Wasson, Vold, and de Jong continue with the topic of assessment. They discuss assessment “in learning by design environments where the creation of artifacts is both a vehicle for, and a result of, learning” (p. 175). With the help of a project example (*SCY—Science Created by You*), the authors illustrate how they intertwine the assessment mechanism with the learning process to support peer feedback and self-reflection, which are then supported by features of the learning environment (*SCY Mission*) and the assessment tools. The artifacts that learners produce during the project are labeled Emerging Learning Objects (ELOs). The authors describe how the formative assessment mechanisms are implemented in the project in the forms of peer

feedback (as the students provide feedback on each other's ELOs) and self-reflection (as the students add their ELOs to ePortfolios). In addition, the students create portfolios to be submitted for summative assessment.

In the final chapter, Chapter 10, Jones, Blake, and Petrou discuss how “personalized inquiry learning can be supported and guided across a semi-formal context (an after-school club) and in informal context (home)” (p. 194). For a case study, they examine an after-school club encouraging students to engage in personal inquiry learning and to focus on issues related to food sustainability. The authors describe supporting personal inquiry as “supporting learners to investigate issues that affect their lives and relate directly to their interests and curiosities” (p. 193). Specifically, they consider the nature of personalized inquiries in this context, examining how the inquiries were resourced and supported at home. The various roles of the computer-based toolkit (*nQuire*, also discussed in Chapters 2, 4, and 5) in supporting learning are also explored, as are students' learning outcomes and the implications for supporting inquiry learning in semi-formal contexts.

Review

This volume does an excellent job in addressing the challenges involved in orchestrating science inquiry learning, especially in school and college settings. The book deals with challenges such as connection-building between everyday and scientific understanding, and orchestration of learning activities across various locations as well as formal, informal, semi-formal and non-formal settings. It considers orchestration through the lens of its crucial processes: the planning, management, guidance, and assessment of learning. At the heart of the volume are the various roles that technology, especially mobile technology, can play in supporting (science) inquiry learning. Considering the increasingly technological worlds of students, experts, and other stakeholders, as well as the affordances of integrating technology in classrooms, this is a well-grounded emphasis.

The book is aimed primarily at researchers, postgraduate students, and advanced undergraduates in education, educational technology, and psychology; however, it is also designed for educational practitioners and policy makers. As a university lecturer and a learning researcher, I feel that the book resonates more with my lecturer role. The main aim of the volume is clearly to provide theoretically informed and research-based implications for the orchestration of inquiry learning in practice. Accordingly, several of the presented research designs, processes, and results are described less systematically, critically, and rigorously than I would expect, as a researcher. To compensate, the authors of, for example, Chapters 2, 4, and 9 direct interested readers to their more

detailed original research articles. Reading the volume as a learning researcher, mindful of the risks of overstating the roles of technology (see also Ravitz & Blazevski, 2014), I found myself wishing for more research evidence and greater critical consideration of the positive roles of technology.

I consider the research-based practical descriptions of the technology-supported orchestration processes, as well as the literature reviews on the topics of inquiry learning, orchestrating, scripting, and peer- and self-assessment, highly useful for all of the intended readers of this volume. In addition, throughout the volume, readers are provided with useful visuals (e.g., screencasts of the tools and environments used) to help them understand the technology-supported orchestration practices described. Integrating technology into problem-based, project-based, and inquiry-oriented classrooms presents challenges for preservice and practicing teachers (Brush & Saye, 2014; Liu et al., 2012; Ravitz & Blazevski, 2014), and I believe that this volume provides teacher education stakeholders with inspiring examples of how to integrate technology into learning.

The book is aimed at an international audience, and its authors represent several nationalities. However, it must be kept in mind that the specific project examples and case studies described come from technologically affluent Western countries with, for example, high Internet penetration rates. When reading this book, it should be weighed that presently only about 42% of the world population can access the Internet (Miniwatts Marketing Group, 2014), and that differences exist between various populations living in the technologically affluent countries in terms of Internet use, digital skills, and the meanings of technology (e.g., Baym, 2010). The book is based, in part, upon work conducted in the *Personal Inquiry* project, which explains why half of the chapters in the volume report or touch upon on the use of one particular web-based content management platform: *nQuire*. The volume succeeds in presenting encouraging case studies from its specific cultural contexts. However, as university teaching faculties should aim to educate graduates with global perspectives (Rasi, Hautakangas, & Väyrynen, 2014), we should be mindful of the cultural biases in this volume (as well as in other readings that we offer to our students).

Though this book is focused mainly on science inquiry learning in school contexts, I believe that it offers useful insights for problem-based or inquiry-oriented learning environments in other disciplines and at other educational levels. Throughout the book, the orchestration of learning experiences that are “engaging, authentic and personally relevant” (p. 1) is emphasized. For example, the authors of Chapter 3 discuss the need for students to take on the authentic role of scientific investigator, and the authors of Chapter 4 and 10 underline that students should carry out investigations

that relate directly to their everyday lives, interests, and curiosities. This emphasis has broad relevance for education, regardless of students' ages. Furthermore, the volume nicely demonstrates how the orchestration of inquiry learning is a highly collaborative process, whereby stakeholders (e.g., teachers, learners, experts, science educators, learning researchers, software developers, representatives of companies, and parents) work together to achieve goals. This is a very important message that is relevant for resourcing, planning, managing, guiding, and assessing learning in various contexts and at numerous educational levels.

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