BOOK REVIEW

STEM Student Research Handbook. Darci J. Harland. NSTA Press. Arlington, Virginia. 2011. 218 p.

Dr. Harland writes directly to high school students who are involved in the process of conducting scientific research projects. Frequent text references to "your teacher" ensure that students continually check with their teacher or mentor to meet required criteria. The author addresses each stage of the scientific inquiry process in detail, guiding students from choosing a topic and planning their experiment, through the collection of data, analyzing, and then communicating their results. The detail and language in this concise handbook supports teachers and students at all experience levels. The handbook offers students the instructions to actually "do" their own scientific research, while encouraging the essential practices of maintaining a laboratory notebook, documenting references and data, and writing effectively.

Most chapters begin with Learning Objectives, and Key Terms that are addressed, and conclude with Chapter Questions and Applications that summarize ideas taught, as well as serve as discussion points. Chapters 7, 8, and 9 focus on organizing and analyzing the data. Chapter 7 "Descriptive Statistics", Chapter 8 "Graphical Representations" and Chapter 9 "Inferential Statistics and Data Interpretation" introduce students to several procedures from which they can choose to describe their data. The book also discusses analyzing the data and showing relationships and significance between the variables. The importance of instructing students to write "everything" in their laboratory notebook is emphasized on page 93 "...your laboratory notebook will be full of charts, graphs, tables, calculations, and computer printouts that may never make it into your paper or presentation." The text provides numerous tables and figures that enable students actually to view correct samples of note taking cards, reference cards, and graphical representations for both qualitative and quantitative data. The Appendices include: A. Research Project Due Dates Checklist; B. Research Presentations Observation Sheet; C. Research Paper Grade Sheet; D. Research Paper Grading Rubric; E. Oral Presentation Rubric, and F. Judge's Score Sheet for STEM Research Projects. Some chapters provide Student Handouts to further support the text guidelines.

The Introduction to *STEM Student Research Handbook* is essential for all readers, because it not only presents an overview of each chapter, but also discusses options for topics such as mentors, time limits, group work, documentation style, and computer and information technology tools. Checking requirements of specific science fairs/symposia in which students may participate is extremely important *before* the experiment begins. Harland suggests that students use the International Science and Engineering Fair (ISEF) guidelines as a model to follow for ethics and safety. This reviewer sees a need to more strongly encourage both students and teachers to read and acquaint themselves with all of the guidelines presented by ISEF www.societyforscience.org/isef/rulesandguidelines (Society for Science and the Public. 2012) . The ISEF site addresses requirements for use of human subjects, vertebrate animals, chemicals, equipment, etc. as well as the expectations regarding the writing of an abstract and specific display and poster guidelines. The website provides links to valuable science resources, checklists, and advice. Students need to be aware of the requirements and paperwork regarding many aspects of the design or plan for their experiment and research *before* the final parameters of their project are selected.

Strengths

The numerous visuals, and references cited throughout the text are strengths of this book; students and teachers alike will find them helpful. Dr. Harland presents alternative methods and procedures for teachers and students to consider regarding note taking, type of laboratory notebook, and documentation style. Dr. Harland discusses plagiarism and offers students suggestions on how to avoid it when taking notes, as well as when writing papers. On page 48 she remarks "electronically copying-and-pasting any author's work, including text, photos, images, or graphs, is plagiarism, unless that work is given proper documentation."

Weakness

Dr. Harland does not include discussion of technological design projects as a research design alternative in Chapter 2 "Research Design;" the text focuses only on scientific inquiry project design. Today's STEM students have the option of pursuing a technological design project in which the student defines a problem or need, gathers background information, establishes criteria, prepares designs and a prototype, analyzes their results and then communicates their findings (Douce 2010). Technological or engineering design projects are important to include as they demonstrate further the *interdependent* relationship between science, technology, engineering and mathematics. Appendix F lacks research design alternatives. The use of STEM in the title of this book suggested, at least to this reader, that technology and engineering would be included with the discussion of mathematics and science. Defining their connections, and how they work together to solve problems, (OAS 2010) is STEM. Science, alone, is not STEM. Also, acknowledging the similarities and differences in scientific and engineering practices (Framework 2011) that will be a part of the new science education standards was a missed opportunity.

Audience

The audience for this text includes science educators interested in guiding students through a science research project, as well as students doing their own scientific research project. Although Dr. Harland writes directly to students of grades nine through 12, many middle school students also would benefit.

References

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