

An Improved Approach for Interactive Ebooks

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ABSTRACT

Motivated by widespread changes to how technology is used in education, perceived high costs of traditional textbooks, and a desire to incorporate interactivity into materials, the fundamental nature of the textbook is changing. We present our ebook approach in the form of an interactive Java resource that can fully replace a course textbook or be used as a supplementary resource. We will demonstrate a platform and approach to the interactive textbook that improves on the significant and ongoing efforts by others in this area and that uses higher degrees of interactivity to increase student engagement while maintaining the pedagogical value of a textbook as both a learning tool and a trusted reference.

CCS Concepts

• Applied Computing → Education → Interactive learning environments • Applied Computing → Education → E-learning.

Keywords

Electronic textbook; interactive pedagogy; textbook replacement; online exercises; multimedia content; animations.

1. INTRODUCTION

For many years, our students and colleagues have expressed frustration with the cost and short shelf-life of traditional textbooks for our discipline, particularly those involving concepts that include the latest techniques for learning to program. As a result, we have developed our own ebook approach and platform. We surveyed the literature related to interactive approaches to computer science education and assessed current online tutorials and electronic textbooks before starting our work. The result is a highly flexible and interactive ebook platform and approach.

2. PRESENTATION ELEMENTS

The proposed aspects of the presentation of our interactive, electronic textbook approach and results are as follows:

2.1 Motivation and Validity

Significant work in the area of interactive, online learning material has been done for this project and by others. There appears to be long-standing consensus that the learning benefits are considerable for the use of dynamic content, such as:

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animations of algorithms, tools for exploring various CS concepts, online code learning tutorials, and even some interactive textbooks [1]. In the past, students expressed a preference for traditional textbooks over ebooks [4], though this result pre-dates fully interactive ebooks and recent studies indicate a trend toward ebook preference when interactivity is well-realized [2]. Such interactivity engages students, leading them to more deeply engage with the material, thus learning at a higher level in Bloom's Taxonomy [3]. In our presentation, we plan to very briefly summarize supporting research results and recent similar resources in this area to inform comparison with our current work.

2.2 Demonstration of Interactive Elements

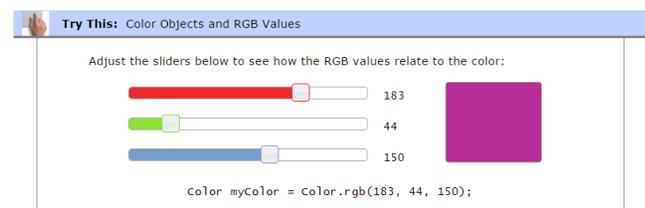
To support our approach, we will demonstrate the following innovative and interactive elements that comprise our ebook:

Hypertext Topic Content

We applied accepted good practices of graphic design and layout for the textual content of our ebook, which is managed in a custom, content-management system. The existing content is flexibly organized as approximately 150 "topics" (with more planned) with each topic representing a chapter section or subsection of a traditional, paper-based textbook. The content uses a hypertext approach to appropriately link coordinating content, font faces and sizes chosen for readability, and use of color, whitespace, embedded graphics, and callouts for things like common programmer errors to helping coding tips. The quantity of content provided supports both effective and efficient learning and use as a future and thorough reference on the subject matter.

Interactive "Try This" Elements

Also embedded within the content of a topic are "Try This" elements that enable students to directly interact with code in a variety of unique ways. For example, a "Try This" element in the "Representing Color" topic enables a student to explore RGB color spaces while instantly visualizing the corresponding Java code that represents the selected color.



Flipped Classroom Videos

Most topics contain videos that present each topic's content in an engaging and supporting way. We have used these videos in our own teaching as part of a flipped classroom approach, though they easily can serve as complementary learning material for a standard lecturer-driven approach.

Use of Humor and Context

The writing style used, including primary content and examples, incorporates a light touch of humor when it fits. This use of humor is a side-effect of the primary author's prior experience in Hollywood as a comedy writer for television and film, with the use of humor widely accepted as a way to facilitate communication of all forms. Quotations from famous and infamous people from history initiate each topic and are used to lend context beyond the technical content being explored.

He that would perfect his work must first sharpen his tools.
- Confucius

Computer Science is no more about computers than Astronomy is about telescopes.
- Edsger Dijkstra

Animations

Topics also may contain animations of algorithms or other concepts that benefit from a step-by-step demonstration.

Watch This: Binary Search

Binary Search

Search for 38 Search for 88 Search for 69

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19

12 17 22 26 27 30 33 38 41 48 55 59 64 70 75 77 81 88 93 97

Feedback

An important aspect of our ebook approach is that of feedback and our response to it. We have had success with quickly responding to feedback, including updates to content that can happen within minutes of receiving feedback. Using this approach, the ebook can be continually updated and improved.

Quick Checks

Each topic concludes with three to five interactive true/false, multiple choice and matching exercises that test the students understanding of the material. While these Quick Checks are tracked for right and wrong answers, including attempts, our goal for them is not as part of calculating a grade but as motivation for students to complete the assigned reading. We have used them to verify student completion of reading, in as much as successful completion of a topic's Quick Checks provides some level of assurance that the material was understood by the student.

Quick Check 0/6

True or False The Java Development Kit (JDK) is an example of an integrated development environment (IDE).

True or False The Java Virtual Machine is software.

True or False Java source code cannot be executed directly by a computer.

A typical Java compiler produces which type of output?

- JDK code
- Java source code
- Unicode
- Java bytecode

Toolkits for Instructors and Students

Tools are provided for instructors to learn more about features, create and manage courses, and create and manage syllabi. For both students and instructors tools are available to measure progress, update passwords and provide feedback.

Syllabus Design Interface

The most noteworthy tool in the instructor toolkit is the syllabus design interface. Because the content is organized by topic, an instructor using the ebook has the flexibility to create a unique syllabus, organized by week, to provide a topic flow that guides student reading and learning. In contrast to a chapter-oriented approach, this provides an instructor with the ability to completely customize the organization of content to match his or her specific course. The instructor and students still have access to the complete topic content, as with a traditional textbook, with the syllabus serving as an organized view of the course-specific content.

Your Syllabus

CSC 8000 - Fall 2015
Foundations of Algorithms and Data Structures

Save Changes

Open All | Close All

▼ Week 1 - Aug 24

- Welcome to CSC 8000!
- The Java Programming Language
- Hello, World
- The print and println Methods
- Comments and Programming Style
- Let's get programming!
- Compiling and Executing
- The Command-Line JDK
- Programming Errors
- The Java API

► Week 2 - Aug 31

► Week 3 - Sep 07

Source Material

New Week

New Note

Open All | Close All

- A Introductions
- B Background
- ▼ C Data and Expressions
 - Variables
 - Primitive Data Types
 - Constants
 - Numeric Expressions
 - The Math Class
 - Random Numbers
 - Big Numbers
 - Strings
 - Escape Sequences
 - The Unicode Character Set
 - Boolean Expressions
 - Boolean Operators
 - Object Equality
 - The compareTo Method

Interactive "Run & Revise" Code Examples

Embedded within the content of a topic can be runnable example code that a student can review, compile, run and edit and run again. These examples provide immediate learning support to topics as they are explored in the form of a concrete example.

```
public class HelloWorld {
    public static void main(String[] args) {
        System.out.println("Hello, World!");
    }
}
```

Run & Revise

2.3 Providing Access

We plan to provide access to attendees to our ebook, and hope to encourage feedback that could help us improve the approach

3. ACKNOWLEDGMENTS

Thanks go to my students and faculty colleagues who encouraged my work on this project and provided invaluable feedback that has made it much better than it otherwise would be.

4. REFERENCES

- [1] Edgcomb, Alex, and Frank Vahid. "Effectiveness of online textbooks vs. interactive web-native content." 2014 ASEE Annual Conference. 2014.
- [2] Gu, Xiaoqing, Bian Wu, and Xiaojuan Xu. "Design, development, and learning in e-Textbooks: What we learned and where we are going." *Journal of Computers in Education* 2.1 (2015): 25-41.
- [3] Shaffer, Clifford A., Thomas L. Naps, and Eric Fouh. "Truly interactive textbooks for computer science education." Proceedings of the Sixth Program Visualization Workshop. 2011.
- [4] Woody, William Douglas, David B. Daniel, and Crystal A. Baker. "E-books or textbooks: Students prefer textbooks." *Computers & Education* 55.3 (2010): 945-948.