Integrating Open Educational Resources in Mathematics Courses

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In this presentation

- Publisher textbook problems
- What are OERs?
- How CCBC made the move
- Advice
- Our resources and your resources
Costs of Higher Education

The Student Perspective
Surveys

- Textbook prices have increased 82% from 2003-2013 (U.S. Public Interest Research Group)

- Textbook prices have increased 1041% from 1977-2015 (NBC's review of Bureau of Labor Statistics)

- 65% of students don’t purchase a textbook during their college career because of affordability, and 94% of those felt it hurt their grade (U.S. Public Interest Research Group)
Annual Textbook Costs of a Full-Time Student

(2015-2016 College Board’s Annual Survey of Colleges)
A Little Math…

- $1,364 borrowed first two years at CCBC: $2,728
- Direct subsidized loans (undergraduates): 4.29%, compounded daily
- Standard loan repayment period: 10 years
- Interest: $631.59 (23% of original loan)
- Monthly Payment: $28.00
The Textbook Competition and Affordability Act of 2009: Resources

- Full Text of HB 85 / SB 183
- Summary by Maryland Association of Community Colleges
- Memorandum issued by V.P. Mark McColloch
- Commitment to Affordability for Students, CCBC Bookstore
The Textbook Competition and Affordability Act of 2009: Responsibilities of the Publisher

- Provide, in writing, a list of changes made in a textbook from one edition to the next
- Disclose all available formats of a textbook
- Provide pricing and all textbook information to bookstore (ISBN, copyright, edition, author, title)
The Textbook Competition and Affordability Act of 2009: Responsibilities of the Institution

- Used books and previous editions
- Majority of materials are used in the course
- Lower cost formats (loose-leaf and electronic)
- Multiple semester adoption
- Awareness of price
Loophole: Purchasing Options and Buyback

- Barnes & Noble $27.87
- Amazon $32.27
- Textbooks.com $55.77
- CCBC $132.10

Custom Looseleaf Textbook
A Textbook Problem

10.6 Radical Equations

Objectives
1. Solve radical equations.
2. Use radicals in functions to solve problems.

Critical Thinking Exercises
State how - In Exercises 131-136, determine whether or not the given condition makes sense and explain your reasoning.

131. \( \sqrt{x+2} = x \) and \( \frac{x}{x+2} = \frac{1}{2} \)

132. \( \sqrt[3]{x+1} = x^2 \) and \( \frac{x}{x+1} = \frac{1}{3} \)

133. \( \sqrt{x-3} = x \) and \( \frac{x}{x-3} = \frac{1}{4} \)

134. \( \sqrt[3]{x+2} = x^3 \) and \( \frac{x}{x+2} = \frac{1}{2} \)

SECTION 10.6 Radical Equations

Solving Radical Equations
Consider the following radical equation:

\[ \sqrt{x} + 3 = 9 \]

We solve the equation by squaring both sides:

\[ \left( \sqrt{x} + 3 \right)^2 = 9 \]

\[ \sqrt{x} + 3 = \pm 3 \]

The proposed solutions, \( x = 0 \) and \( x = 36 \), can be checked in the original equation, \( \sqrt{x} + 3 = 9 \). Because \( \sqrt{x} = 6 \), the solution is 36 and the solution set is 36.

In general, we solve radical equations with square roots by squaring both sides of the equation. We solve radical equations with nth roots by raising both sides of the equation to the nth power. (Unfortunately, it occurs, at the solutions of the equation are not the same number of solutions to the original equation. Consider, for example, the equation:

\[ x^2 = 4 \]

If we square both sides, we obtain:

\[ x = \pm 2 \]

The solution set of the original equation, \( x = \pm 2 \) has two solutions. By squaring, each of 4 is a solution of the original equation, \( x = 4 \). Furthermore, when raising both sides of an equation to an even power, always check proposed solutions in the original equation.

A general method for solving radical equation with nth roots:

1. Simplify any inner terms.
2. Isolate the radical function on one side of the equation.
3. Raise both sides of the equation to the nth power to eliminate the nth root.
4. Solve the resulting equation. If the equation still contains radicals, repeat steps 1 and 2.
EXAMPLE 1  Solving a Radical Equation

Solution
Step 1. Isolate the radical on one side. The radical \( \sqrt[3]{x + 5} \) is isolated on the left side of the equation, so we can stop here.

Step 2. Raise both sides to the nth power. Because \( n = 3 \), we square both sides.

\[
\sqrt[3]{x + 5} = 3
\]

Both sides have been raised to the same power, so the equation is balanced.

Step 3. Solve the resulting equation.

\[
x + 5 = 27
\]

Subtract 5 from both sides.

\[
x = 22
\]

The resulting equation is a linear equation, so we can solve for \( x \) by subtracting 5 from both sides.

EXAMPLE 2  Solving a Radical Equation

Solution
Step 1. Isolate the radical on one side. The radical \( \sqrt{x - 3} \) is isolated on the left side of the equation, so we can stop here.

Step 2. Raise both sides to the nth power. Because \( n = 2 \), we square both sides.

\[
\sqrt{x - 3} = 6
\]

Both sides have been raised to the same power, so the equation is balanced.

Step 3. Solve the resulting equation.

\[
x - 3 = 36
\]

Add 3 to both sides.

\[
x = 39
\]

The resulting equation is a linear equation, so we can solve for \( x \) by adding 3 to both sides.

EXAMPLE 3  Solving a Radical Equation

Solution
Step 1. Isolate the radical on one side. The radical \( \sqrt[3]{x + 11} \) is isolated on the left side of the equation, so we can stop here.

Step 2. Raise both sides to the nth power. Because \( n = 3 \), we cube both sides.

\[
\sqrt[3]{x + 11} = 4
\]

Both sides have been raised to the same power, so the equation is balanced.

Step 3. Solve the resulting equation.

\[
x + 11 = 64
\]

Subtract 11 from both sides.

\[
x = 53
\]

The resulting equation is a linear equation, so we can solve for \( x \) by subtracting 11 from both sides.
A Textbook Problem
A Textbook Problem

**EXAMPLE 1** Solving a Radical Equation

**Solution** Although we can rewrite the equation in radical form,

\[ \sqrt{x - 1} = 4 - 0, \]

it is not necessary to do so. Because the equation involves a single root, we isolate the radical term - like this, the terms with the rational exponents—see below both values.

\[ \sqrt{x - 1} = 4 - 0 \]

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\[ \sqrt{x - 1} = 4 - 0 \]

Because both sides are equal, we add the power, square both values to check the proposed solution. –2). However, checking a solution is good idea. Do the next and verify that –2 is the solution and the solution set is \(|{-2}|\).

Example 1 illustrates that a radical equation with rational exponents can be solved by:

1. Isolating the expression with the rational exponent, and
2. Making both sides of the equation to a power that is the reciprocal of the rational exponent.

Keep in mind that it essential to check proposed solutions when both side are raised to even powers. Thus, equations with rational expressions such as \(|{-2}|\) must be checked.

**CHECK POINT 1** Solve \( \sqrt{x - 1} + 3 = 0 \)

**Applications of Radical Equations**

Radical equations can be solved to answer questions about variables contained in radical expressions.

1. The long-term trend in the collar firms from the U.S.

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40. The long-term trend in the collar firms from the U.S.
What are OERs?
Open Educational Resources (OERs)

“Open Educational Resources (OERs) are teaching and learning materials that are freely available online for everyone to use, whether you are an instructor, student or self-learner.” (source)
Types of OERs
Copyrights

All rights reserved

Some rights reserved
Creative Commons

- Nonprofit organization that assists with free legal assistance for sharing content
## Creative Commons Licenses

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OER in the CCBC Mathematics Department
Phase 1:
MATH 081 (Pre-Algebra) Textbook

- Lumina Grant
- Develop an internal textbook
- Online homework
- Used in traditional and online courses
- Lessons learned
Phase 2: OERs and Acceleration

- Accelerated Mathematics Program (AMP)
  - Pre-Algebra and Introductory Algebra (081 & 082)
  - Intermediate Algebra and College Algebra (083 & 163)
  - Intermediate Algebra and Applied Algebra & Trigonometry (083 & 135)

- Blackboard course shells created with OERs
  - Pre-Algebra (in-house OER)
  - Intermediate Algebra
Phase 3: Regional Accreditation

- 2012: 10-year evaluation with self-report and site visit

- June 28, 2012 outcome: To reaffirm accreditation and commend the institution for the quality of the self-study process and the quality of the self-study report.

- One recommendation regarding outcomes of distance learning
Outcomes of Distance Learning Recommendation

- Institutional course model developed
- Online courses developed by small committees
- Faculty teach from pre-built shells
- External review- Quality Matters (QM) certification
Phase 4: OERs and Online Classes

- Pre-Algebra (MATH 081) – QM Certified 6/14/2014
- Intermediate Algebra (MATH 083) – QM Certified 2/11/2015
- Introductory Algebra (MATH 082) – QM Certified 8/14/2015
- Statistical Methods (MATH 153) – QM Certified 3/22/2016
- College Algebra (MATH 163) – QM Certification 11/01/2016
- Finite Math & Modeling (MATH 125) – QM Certification 12/31/2016
- Precalculus (MATH 165) – QM Certification 1/15/2017

*MyOpenMath*

- [http://www.mathispower4u.com/](http://www.mathispower4u.com/)
- [http://www.wallace.ccfaculty.org/videos.html](http://www.wallace.ccfaculty.org/videos.html)
Phase 5:
OERs and Traditional Classes

Original Texts

- Intermediate Algebra (MATH 083)

- Introductory Algebra (MATH 082)

- Finite Mathematics & Modeling (MATH 125)
  http://www.opentextbookstore.com/mathinsociety/index.html
Phase 5:
OERs and Traditional Classes

Edited Texts

- Intermediate Algebra (MATH 083)
- Introductory Algebra (MATH 082)
- Finite Mathematics & Modeling (MATH 125)

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<th>Spring 2016</th>
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<td>$31.00</td>
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<td>MATH 082: Introductory Algebra</td>
<td>$132.10</td>
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<td>MATH 083: Intermediate Algebra</td>
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<td>MATH 081: Pre-Algebra</td>
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<td>MATH 163: College Algebra</td>
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OER Resources
- Creative Commons Search: http://search.creativecommons.org/
- College Open Textbooks: www.collegeopentextbooks.org
- Curriki: http://www.curriki.org/
- CK-12 Foundation: http://www.ck12.org/
- Geogebra: www.geogebra.com
- Gooru: http://www.gooru.org/
- Khan Academy: https://www.khanacademy.org/
- MERLOT World Languages Portal: www.merlot.org/merlot/WorldLanguages.htm
- My Open Math: www.myopenmath.com
- Languages Open Resources Online (LORO): http://loro.open.ac.uk/
- Lumen Learning: www.lumenlearning.com
- OER Commons: https://www.oercommons.org/
- Online Stat Book: www.onlinestatbook.com
- OpenStax: https://openstax.org/
- Open Textbook Store: http://www.opentextbookstore.com/
- Study.com: http://study.com/
- TEDEd: http://ed.ted.com/
Advice & Best Practices
Survey Existing Materials

- What are current bookstore prices?
- What currently exists?
- What licenses are applied to these materials?
- Is substantial modification needed?
- Can we create a better product than what’s currently offered?
- Are we willing to develop our own materials, from scratch?
Assemble a Team of Cheerleaders

- Small teams
- OER experts
- Fight resistance
- Holistic approach
Prepare for the Publishers

- CCBC: Big account
- Lack of awareness
- Unexpected office visits with faculty members
- Meetings with administrators (support needed)
- Lowered pricing
- Pilot opportunities
- Bargaining chip
Do Not...

- Adopt OER for the sake of OER
- Underestimate the time commitment (editing documents and videos)
- Forget why you made the decision to adopt OER
- Forget about sustainability
- Use external links, if possible (save local copies)
Contact Us!

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