

Focusing questions for the panel

1. What are digital curriculum materials?
2. What are the characteristics that distinguishes them from print materials and other resources? What are the critical ways that these materials/resource vary in design?
3. What are the research foundations and traditions used to design digital curriculum materials? What research foundations are not typically be consulted but should be?
4. What research is needed to understand the impact and/or effective and improve future design of digital curriculum materials.



A Typology for Analyzing Digital Curriculum Programs

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Rationale for Digital Typology

- Digital content is increasingly present in U.S. K-12 classrooms, with a current push by federal officials to increase the rate at which digital textbooks are adopted.
- Textbook and educational software companies have begun to develop comprehensive programs that can supplement if not replace traditional paper textbooks.
- Wanted to gain an understanding of the current state of digital curriculum programs in the US.



Overview of Study

- We analyzed eight programs, including:
 - individualized learning programs,
 - digitized versions of traditional textbooks,
 - collections of digital lessons and
 - digital programs designed to accompany whole class discussions.
- We looked at :
 - How students might interact with content in the programs,
 - how teachers could adapt or use (re-source) content, and
 - built-in assessment systems.



Reported features of digital materials

- Use of multi-media
- Interactivity
- Socialization
- Customizing the learning experience
- Ongoing assessment and reporting of student progress



Use of multimedia

- Forms include:
 - high-definition graphics, video clips, animations, simulations, interactive lessons, and virtual labs
- It is not simply the presence of multimedia, but the ways in which they are coordinated to convey content that determine their impact on learning (Mayer, 2003)



Interactivity

Control over the nature and sequencing of content and feedback provided back to the user

Forms of interaction include:

- *Non-linear media* such as hyperlinked text that allow the user to:
 - move around a text in whatever sequence they choose or
 - to virtually interact with others as they engage with text
- Gathering materials from the web to research ideas or create presentations, designing new content, and posting content to the web
- Manipulating controls in models or using tools to pose and answer conjectures
- Tactile interface



Socialization

- Digital materials have the potential to engage students in collaborative or social learning by including components such as discussion boards, wikis, web blogs, and shared electronic documents
- These components have the potential to provide social resources to students and to connect students to communities beyond the physical proximity of their classrooms, including experts or tutors besides their teacher



Customizing the learning experience

- Digital materials can customize learning experiences to fit the needs and style of individual students
- This customization can include different levels of support and embedded assessment tools



Ongoing assessment and reporting

- Online assessment systems can incorporate features in which students' scores are automatically transmitted to the teacher
- Digital assessments can be adaptive, which means that students have customized content depending on their level of performance
- Web-based formative assessments can provide immediate feedback, linking feedback to learning resources, and creating interactive features into the assessments that can enhance student learning



Analysis

Theme 1: Students' Interactions with the Programs

In this section, we analyzed three categories that describe students' potential interactions with the programs:

1. Learning Experiences
2. Differentiation/Individualization
3. Social/Collective Features



Analysis

Theme 2: Curriculum Use and Adaptation

We analyzed the flexibility each program provided to teachers in terms of providing tools and resources to sequence and design lessons, including the ability to:

1. Map and sequence lessons;
2. Design content of lessons;
3. Locate and use multi-media presentation materials;
and



Analysis

Theme 3: Analysis of Assessment Systems

The analysis of the assessment systems built into the programs focused on the program's ability to:

1. Create assessments;
2. Record and store results of assessments;
3. Generate dashboard or other summaries of data



Individualized Learning Programs

- ALEKS
 - is a web-based adaptive program that provides explanations and practice of skills and procedures
- Dreambox
 - an adaptive program that provides individualized mathematics instruction through interesting contexts and interactive manipulatives
- Khan Academy
 - is a web-based program designed to have students work at their own pace through videos of narrated presentations on concepts and procedures, online practice problems, and online assessments



Collections of digital lessons

- LearnZillion
 - a collection of recorded presentations developed by a team of over 100 hundred teachers
- Your Teacher (MathHelp.com)
 - a collection of video narrations of problems and worked out solutions. Each lesson consists of sample problems with a video or narration of a teacher explaining and working out a problem. The program tracks scores on self-tests and provides individualized grade reporting and progress tracking as well as program usage.



Digitized versions of traditional textbooks

- ConnectED (Glencoe Math)
 - offers digital access to the full range of grade-level content and resources to students and teachers for certain McGraw Hill textbook series, such as *Glencoe Math Courses 1, 2, and 3*
- CINCH
 - *CINCH* is a version of a traditional textbook program designed to be used strictly in a digital environment and is not accompanied by a paper textbook, though most of its content can be downloaded as PDFs.



Digital programs designed to accompany whole class discussions

- Algebra in Action
 - digital textbook written for the iPad that weaves together an Algebra curriculum and a narrative



Features that Affect Students' Interactions with the Programs

Learning Experiences	Differentiation/ individualization	Social / Collective Features
<ul style="list-style-type: none">• View recorded presentations (Khan Academy, LearnZillion, ConnectED, CINCH, YourTeacher)• Practicing procedures after procedures are modeled (ConnectED, ALEKS)• Interactive scenarios in which students manipulate representations (Algebra in Action, Dreambox)	<ul style="list-style-type: none">• Built-in adaptive features (ALEKS, Dreambox)• Program suggests content to students (Khan, YourTeacher)• Teachers suggest content to students based on assessments (LearnZillion, ConnectED, CINCH)	<ul style="list-style-type: none">• Messaging or mailbox system (ALEKS, ConnectED, CINCH)• Teachers can comment on student work in program (Algebra in Action)• Students can communicate with coaches (Khan Academy)

Features for Curriculum Use and Adaptation

Ability to map and sequence lessons	Ability to revise or design lessons	Ability to locate and use multi-media materials
<ul style="list-style-type: none">• Teachers control the sequencing of content (ConnectED, CINCH, LearnZillion)• Teachers can set up pacing guides (ALEKS, Khan Academy, YourTeacher)• Program determines content (ALEKS, Dreambox)	<ul style="list-style-type: none">• Teachers select from a variety of resources to design offline lessons (ConnectED, CINCH)• Teachers can edit PowerPoint presentations (LearnZillion)• No ability to revise or design content (ALEKS, Algebra in Action, Khan Academy, Dreambox, YourTeacher)	<ul style="list-style-type: none">• Searchable databases of materials (ConnectED, CINCH)• Built-in recorded presentations (ALEKS, Khan, LearnZillion, YourTeacher)• Built-in interactive scenarios (Algebra in Action, Dreambox)

Features of Assessment Systems

Ability to create online assessments	Ability to record and evaluate results of assessments	Ability to generate dashboard or other summaries of data
<ul style="list-style-type: none">• Can create or revise assessments (ConnectED, CINCH)• Can select timing of assessment (ALEKS)	<ul style="list-style-type: none">• Adaptive (ALEKS, Dreambox)• Store, evaluate, and display assessment results (ConnectED, CINCH LearnZillion YourTeacher)• Stores data on program usage (Khan Academy)	<ul style="list-style-type: none">• Dashboards display assessment results (ALEKS, ConnectED, CINCH, Dreambox, Khan Academy, LearnZillion, YourTeacher)

Incorporation of multimedia

- Two programs, *Algebra in Action* and *Dreambox*, used multimedia (e.g., applets with representations that could be manipulated) and interactive features, such as games and scenarios that allow students to manipulate representations or models to solve problems
- The use of multimedia in the other programs was more limited, and typically involved videotaped presentations or narrated PowerPoint files. These programs provided opportunities to explore mathematics in ways similar to what is found in traditional textbook series



Social/collective features

- There were limited opportunities for students to link to virtual communities, to communicate with each other, or to communicate with the teacher within the programs.
- The lack of these features constrains opportunities for the kinds of collaborative or social features of learning envisioned by proponents of digital curricula and by learning theorists' exploration of distributed cognition



Customization

- The differentiation and individualizing of content was possible in most programs, with two programs (ALEKS and Dreambox) automatically providing differentiation by responding to evaluations of student performance in online assessment.
- Other programs allowed the teacher to select content, while yet other programs offered no means in the program to indicate what content students should study.
- The most sophisticated differentiation included responding to the speed and productiveness of students' actions with virtual manipulatives (Dreambox) as well as the accuracy of their performance on tasks.
- In all other cases, the differentiation was in response to students' performance on short-item or multiple choice assessments.



Curriculum Use and Adaptation

- Some programs offered options for teachers to revise, select, and sequence content.
- Most of the revising of content or ability to design lessons involved selecting multimedia files that presented or explained the content.
- There were few choices with respect to interactive tools or activities. Most interactive tools or activities were built directly into the student text materials.
- One of the most robust features involved the teacher's ability to indicate sequencing of content, so that students would be notified within the program about the progression of activities or content.
- In most of the individualized learning programs, teachers had few opportunities to revise the content or tools made available to students.



Assessment Systems

- The assessment systems generally provided opportunities for rapid reporting of student performance. All of the programs included some form of online assessment or reporting of student performance
- *Dreambox* offered the most sophisticated assessment tools, measuring students' facility with the use of manipulatives and the nature of students' strategies.
- Other programs offered blunter measures, including scores on multiple-choice or short free-response items, number of videos viewed, content accessed, and time spent logged into the program.
- The most robust features of these programs was their ability to generate snapshots of individual and aggregated scores according to specific content and to display those snapshots in a variety of visual representations.



Looking forward

- Enhanced and more sophisticated interactivity, including the presence of ubiquitous and constrained sets of tools (such as the Korean textbook and visualmath)
- Focus on solving problems that are:
 - accessible,
 - yield heterogeneous approaches, and
 - afford connections between representations and different mathematical topics
- Digital programs designed to provoke rich whole-class discussions
- More sophisticated assessments beyond multiple-choice or short-answer responses designed to evaluate procedural mastery



Role of Market-driven Programs

- Contrast market-driven with design driven programs
- Market driven design appeals to the contingencies of the job (i.e., make the job easier)
- Little sense of authorship (interchangeable or anonymous authors)
- Emphasis on features rather than learning principles
- Focus on diagnosis, remediation, individualization



Research on digital materials

- Getting access to materials is going to get harder, making research on curriculum development and design more difficult

