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IESD FOUNDATIONS PAPER

How Edgenuity Courses Align with Research on Effective Instruction

February 2013

A Summary of Independent Research

Prepared by Interactive Educational Systems Design, Inc. for Edgenuity

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Introduction

The Challenge

Students today are preparing for a work world that will be more challenging than ever before. Global competition and technological advancements are putting an increased premium on advanced critical thinking, problem solving, and writing skills (Levy & Murnane, 2004, pp. 6–7). Economists estimate that 65 percent of U.S. jobs in 2025 will require education beyond high school (Carnevale & Rose, 2011, p. 10).

K–12 schools throughout the U.S. are committed to preparing students for college, careers, and beyond. Forty-seven states and the District of Columbia have adopted the Common Core State Standards, agreeing to focus on depth of knowledge in order to develop students' abilities to engage with complex texts across the curriculum and to apply mathematical concepts and procedures to solving problems.

In many cases, however, schools and districts are finding that their students have needs that can't be addressed in traditional classes. Increasingly, they are turning to online and blended instructional models to meet the needs of a broad population of students. For example, online learning can increase student access to a wide variety of quality courses taught by certified teachers in schools that would not otherwise have been able to provide those courses (Alliance for Excellent Education, 2012, p. 12). Flexible scheduling enables students who are accelerated, have health issues, or may be at risk to drop out to take classes at times that fit their own unique circumstances. Online and/or blended learning can increase accessibility of content for a variety of learners—including students with disabilities and English language learners (Lacina, 2004/2005, p. 113; Meyer & Rose, 2005). Online instruction also provides an alternative setting for students who do not thrive in traditional classrooms.

Increasingly [schools] are turning to online and blended instructional models to meet the need of a broad population of students.

Research supports the conclusion that students can learn just as well from online instruction as from traditional classes (Cavanaugh, 2013, p. 172). However, simply putting students in front of a computer is not enough to prepare them for the demands of college and careers. In order to achieve the best possible learning for students, online instruction needs to be research-based and practice-tested.

Edgenuity is committed to developing innovative courses that are grounded in research and best instructional practices. Edgenuity courses are based on four well-established, evidence-based principles:

- Instruction is systematic and explicit, designed to help students acquire, practice, and apply skills and knowledge.
- Courses promote deep learning and metacognition.
- Courses incorporate multimedia and graphic organizers in ways that reduce cognitive load and help students learn more effectively.
- Courses implement principles of Universal Design for Learning, incorporating multiple means of representation, expression, and engagement to meet students' individual needs.

This report provides an overview of the Edgenuity approach to instruction—and then goes on to describe in detail how Edgenuity translates the best research in online learning, neuroscience, educational psychology, and instructional design into its courses.

Edgenuity Overview

Since 1998, Edgenuity (formerly e2020) has been providing digital and online courses to propel student achievement. Edgenuity now offers over 100 courses for grades 6–12 in English language arts, social studies, math, science, world languages, and general electives. Edgenuity also offers a full suite of career pathways and electives, test preparation solutions for national and state exams, and credit recovery courses. Edgenuity courses can easily be implemented in alternative education settings that require flexible scheduling.

Edgenuity courses are designed to meet a range of district needs in flexible implementation models. For example, some schools and districts implement a blended learning model for Edgenuity courses. In this model, students spend part of their time completing Edgenuity online coursework. The rest of their time is spent in workshops, projects, or small-group instruction led by local teachers. These teachers provide tutoring, review quizzes, assign grades, and confirm that students are actively engaged in courses—in order to ensure that students achieve concept mastery and can apply what they've learned.

Aligned to common core and other state standards, Edgenuity's courses include challenging content, relevent activities, adaptable formative and summative assessments, and real-time feedback.

In other models, students complete the Edgenuity coursework online, and also receive guidance from a highly qualified live online teacher from Edgenuity. The live online teacher assesses student work, provides feedback, and offers additional support, instruction, and tutoring as needed via chat, email, and phone calls.

Course Design Process

Edgenuity courses are created by cross-functional teams of experienced educators and instructional designers with expertise in curriculum development, instructional technology, and content-area education. To create a new course, the team begins with a careful analysis of state and national standards, as well as syllabi and curriculum maps of existing courses from exemplary, high-performing districts. The scope and sequence is then created and reviewed by domain experts and education practitioners.

Using the principles of backward design, the team outlines each unit of instruction to capture big ideas and essential questions, refine learning objectives and lesson questions, and document anchor assessments and tasks. Prototype lessons are drafted and team-reviewed against research-based best practices, the iNACOL National Standards for Quality Online Courses, and Edgenuity's own development rubrics and guidelines before the remainder of the lessons are created.

Instructional Model

Edgenuity courses reflect research-based instructional practices to meet the needs of all students. Courses feature rigorous, explicit instruction led by certified on-screen teachers. Motivating media-rich content keeps students engaged, and powerful interactive instructional tools help them build content knowledge and essential skills. Aligned to Common Core and other state standards, Edgenuity's courses include challenging content, relevant activities, adaptable formative and summative assessments, and real-time feedback.

On-screen teachers present learning objectives, explain concepts, model strategies, and provide relevant examples that help students transfer knowledge and make real-world connections. Meaningful assignments ensure students master key concepts and develop analytical and critical thinking skills. Students complete a range of tasks—including independent reading, practice, and guided online exploration, as well as projects and performance tasks. Simulations and virtual labs help students make and test predictions, while graphics, images, and animations bring content to life. Targeted writing instruction and practice prepares students for narrative, argumentative, and analytical writing.

Each lesson includes assessments to determine whether students have mastered the lesson objectives. Cumulative practice and assessment is included at the end of each unit or topic, as well as at the end of each semester.

Interactive Tools and Supports

A full suite of digital tools helps students access content, complete assignments, and build essential skills. For example, animations and simulations provide explanation and modeling of key concepts and processes. The CloseReader™ supports in-depth reading of complex texts. A digital notebook known as eNotes provides spaces for students to record and organize their thinking. The eWriting tool scaffolds the writing process for all students—from pre-writing to the final draft. Numerous graphic organizers help students complete assignments, organize information, and more.

A full suite of digital tools helps students access content, complete assignments, and build essential skills.

Learning Management System Features

Edgenuity's learning management system offers a number of tools and features to support effective implementation. These include:

- Customizable assessment settings for time allotted for test completion, grade weights, number of retakes, and passing thresholds
- Clear graphical representations of student progress to help students stay on pace
- A customizable assignment calendar to help students track the coursework they should be completing each day
- Diagnostic and prescriptive capability to individualize student learning paths based on existing levels of mastery
- Robust reporting to allow educators to monitor student engagement, progress, and achievement
- Administrator tools to set teacher permissions, review teacher actions, and monitor student data
- A web-based Family Portal to allow parents and guardians to monitor student learning from their computer, tablet, or smartphone

Explicit Instruction

Explicit instruction represents a research-verified approach to teaching that is direct, structured, systematic, and unambiguous (Archer & Hughes, 2011, p. 1).[1] Based on decades of experimental and correlational studies about the practices of effective teachers, this approach to teaching also aligns with findings on the cognitive processing conditions that help students "develop a well-connected body of accessible knowledge" (Rosenshine, 1995, p. 262; see also Rosenshine & Stevens, 1986). This section focuses on Edgenuity's application of seven well-established principles of effective explicit instruction that contribute to student achievement:

- Activating students' prior knowledge
- Establishing a clear lesson purpose, goals, and expectations
- Presenting instruction in small, manageable segments
- Providing clear instruction, including examples and modeling
- Providing opportunities for practice with varying levels of scaffolded support
- Conducting frequent checks for understanding with appropriate feedback
- Incorporating reviews spread out over time

These principles apply not only in teaching well-structured academic knowledge that can be broken down into a fixed sequence of subtasks and components—such as arithmetic skills and facts of history and science—but also in less-structured cognitive domains such as reading comprehension and writing, where students must be taught how to apply strategies flexibly in a variety of circumstances (Rosenshine, 1995, pp. 265–267; Fisher et al., 2011, pp. 359–360).

"[Novices are] often unable to marshal what is known to solve the unknown. Therefore, it is important to activate useful background knowledge when figuring out how to do something less familiar."
Fischer et al. (2011)

Explicit instruction is a cornerstone of Edgenuity lessons. This section addresses how Edgenuity translates the research behind explicit instruction into instructional practice.

Prior Knowledge Activation

In order to learn effectively, students must connect new information and skills with pre-existing experience and knowledge (National Research Council [NRC], 2012, p. 4–12). However, as Fisher et al. (2011) point out, novices "[are] often unable to marshal what is known to solve the unknown. Therefore, it is important to activate useful background knowledge when figuring out how to do something less familiar" (p. 370). In order to help students activate their prior knowledge, effective teachers typically begin lessons with "a short review of previous, prerequisite learning" to provide a context for what they will be learning (Rosenshine & Stevens, 1986, p. 377; see also Rosenshine, 1995, p. 266; Archer & Hughes, 2011, p. 2).

[1]"No single, common term to describe this teaching has emerged as yet. Rather, a variety of terms are being used including direct instruction, systematic teaching, explicit instruction, active teaching, and effective teaching." (Rosenshine & Stevens, 1986, p. 378). For the purposes of this white paper, "explicit instruction" is the term that is used.

How Edgenuity Courses Support Prior Knowledge Activation

Edgenuity lessons begin by reviewing skills and knowledge students will need in order to understand the lesson and complete the activities. Edgenuity lessons also connect what students are learning with relevant prior knowledge, typically by using a warm-up activity that introduces students to the lesson's topic and engages students in a task that connects new knowledge to known knowledge. This task may help students recall and verify prior learning, prompt thinking about a subject, connect a topic to students' own lives, challenge students to reflect on a new idea, or pose a compelling problem. For example:

- A mathematics lesson on functions and relations uses the relationship between states and capitals to introduce the concept of ordered pairs. Students' prior understanding that each state has only one capital helps them understand one-to-one functions in which each element in the domain is related to one specific element in the range.
- An English language arts lesson defines *civil disobedience* and asks students to identify situations that might justify breaking a law. Students then read Thoreau's seminal essay, "Civil Disobedience," and learn that civil disobedience is a central theme of Thoreau's work and other work by transcendentalist writers. Students are thus prompted to connect what they already know to new subject matter and gain a better understanding of the text's historical significance and universal themes.

Clear Lesson Purpose, Goals, and Expectations

Education researchers consistently identify clearly spelled out lesson purposes, goals, and expectations as an element of effective instruction (Archer & Hughes, 2011, p. 2; Fisher et al., 2011, p. 360; NRC, 2012, p. 6-1; Rosenshine, 1995, p. 266; Rosenshine & Stevens, 1986, p. 379). In the context of online learning, Swan (2003) reported that a study of 73 different online courses "found significant correlations between the clarity, consistency, and simplicity of course designs and students' perceived learning. Such findings support the . . . prescription for clear goals and expectations for learners" (p. 19, citing Swan et al., 2000).

How Edgenuity Courses Support Clear Lesson Purpose, Goals, and Expectations

All Edgenuity lessons begin by presenting the instructional goals of the lesson and what students will be expected to learn and do as part of the lesson. Lesson goals are written in student-friendly language and are directly connected to assignments and tasks. They are often presented in a graphic organizer or table to make relationships between concepts and skills apparent to students.

Small, Manageable Instructional Segments

Research indicates that because of the limited size of human working memory, instruction is most effective when new information and new procedures are taught in small chunks (Archer & Hughes, 2011, p. 2; Rosenshine, 1995, p. 264; Rosenshine & Stevens, 1986, p. 377). This is true not only when teaching well-structured information but also in teaching cognitive strategies in less-structured areas of knowledge. Furthermore, research supports having students practice each new step in a skill after it is initially taught, and then practice the entire skill after all the component steps have been taught (Archer & Hughes, 2011, p. 2; Rosenshine, 1995, p. 264).

How Edgenuity Courses Support Instruction in Small, Manageable Segments

In Edgenuity lessons, skills and concepts are introduced to students in small, manageable segments. When students learn a complex skill, they practice key steps separately, then practice all the steps together as part of a unified sequence.

In Edgenuity lessons, skills and concepts are introduced to students in small, manageable segments. When students learn a complex skill, they practice key steps separately, then practice all the steps together as part of a unified sequence. For example:

- In a mathematics lesson on solving quadratic equations by factoring, students first learn to write the equation in standard form, so that one side is equal to zero. They then learn how to factor the expression. Next, they practice using the zero product property to write and solve linear equations. Finally, they practice checking their work and solutions. Eventually, students practice the complete process without being prompted step-by-step.
- In a biology lesson, the concept of photosynthesis is broken down into component ideas, each of which is presented separately before the onscreen teacher helps students synthesize the entire process. The teacher presents the following ideas in sequence:
    - Definition of photosynthesis as the process by which plants make carbohydrates from carbon dioxide and water, using energy captured from sunlight.
    - Explanation that inside the plant's cells are structures called chloroplasts. Chloroplasts contain a compound called chlorophyll that helps plants capture sunlight.
    - Portrayal of how photosynthesis takes place in two parts.
        - The first part, called the light reaction, happens in the thylakoid membrane and converts light energy to chemical energy. The energy harvested via the light reaction is stored by forming a chemical called ATP, a compound used by cells for energy storage.
        - The second part, called the dark reaction, takes place in the stroma within the chloroplasts and uses the products of the light reaction (ATP and another chemical called NADPH) to convert CO2 into sugar and organic compounds, which are the main food plants use to live and grow. This occurs in the dark.

At the end of the lesson, students are challenged to put this information together and apply what they have learned to determine how deforestation and global warming might impact photosynthesis.

Clarity of Instruction

For instruction to be effective, it must be clear. This is true both for well-structured types of knowledge, such as clear-cut procedures and factual information, and for teaching problem-solving, cognitive, and metacognitive strategies within less-structured knowledge domains (Archer & Hughes, 2011, p. 2; Rosenshine, 1995, pp. 266–267; Rosenshine & Stevens, 1986, pp. 377, 379, 381).

Research-based recommendations for clear teaching of *well-structured knowledge* include the following:

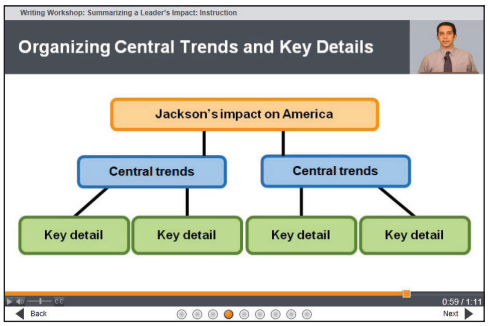
- Clear, detailed, and explicit teaching of concepts, information, and rules (Archer & Hughes, 2011, pp. 92, 108; Rosenshine & Stevens, 1986, p. 377)
- Calling attention to main points and to the structure of information (Rosenshine & Stevens, 1986, p. 379)
- Clear step-by-step directions (Rosenshine & Stevens, 1986, pp. 377, 381)
- Extensive use of appropriate examples and non-examples (Archer & Hughes, 2011, p. 2; Rosenshine, 1995, p. 266; Rosenshine & Stevens, 1986, p. 379)

Research and expert opinion on clear teaching of *less-structured knowledge* call for explanation of the strategies students will use, coupled with modeling and/or demonstrations (Archer & Hughes, 2011, p. 2; Fisher et al., 2011, p. 361; NRC, 2012, pp. Sum-8, 6–18, 6–22; Rosenshine, 1995, pp. 266, 267; Rosenshine & Stevens, 1986, p. 379).

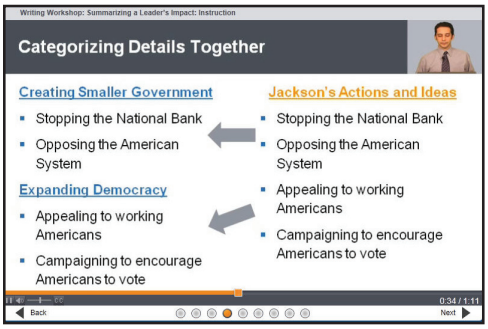
- Such modeling should incorporate the thought processes that underlie use of specific strategies (Fisher et al., 2011, p. 11; Rosenshine, 1995, p. 267). One effective method for doing this is through think-alouds, in which teachers verbalize their thought processes as they review text or solve problems (Archer & Hughes, 2011, p. 30).
- Worked examples represent another effective form of modeling when teaching problem-solving strategies (Clark, 2005, p. 596; Sweller, 2008, pp. 374–375). As student expertise increases, fully worked examples should be replaced by partially worked examples, and eventually by problems students complete without support (Sweller, 2008, p. 378).
- Students may also be taught "procedural prompts"—a specific set of steps or elements—in order to help them learn, remember, and apply cognitive strategies (Rosenshine, 1995, pp. 266–267). For example, in learning how to generate questions about material they are reading, students may be taught to ask "who," "what," "why," and "when" questions. Specific types of graphic organizers may also function as procedural prompts if students are taught to use those formats to organize their thinking and problem-solving.

How Edgenuity Courses Support Clear Explanations and Directions

Edgenuity recognizes the importance of clear explanations and directions. Within Edgenuity courses:

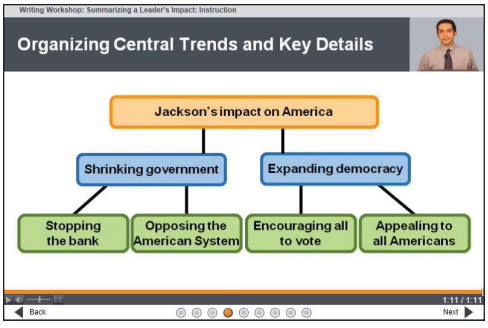


- Clear, detailed explanations are provided for the concepts, information, and rules students are expected to learn.
- In presenting information, on-screen teachers provide an overview of the content, highlight main points, and draw students' attention to the structure of the information. A summary section in each lesson reviews the main ideas.
- Students are given clear, step-by-step directions for procedures they are expected to complete.
- Concepts and rules are explained with examples and non-examples. For instance:
  - In a mathematics lesson about linear equations, students learn that the standard form is one way to express an equation of a line ($Ax + By = C$). Together with the definition, examples and non-examples of the standard form are provided. For example, the equation $3x + 5y = 3$ is in standard form, but the equation $2y = 4x + 2$ is not in standard form.
  - In a middle-school English language arts lesson, students are taught the definition of an independent clause. Students are then provided with examples of independent clauses ("she returned home," "the students play outside," "life is beautiful") and non-examples or fragments ("before we left for school," "because the weather was good," "when the sun is shining").



How Edgenuity Courses Support Modeling/Demonstrations

Edgenuity makes extensive use of models and demonstrations. Models provided in Edgenuity courses include worked examples of problem-solving strategies and procedures. On-screen teachers explain procedures that students are expected to learn and apply, and then they model those procedures via think-alouds.

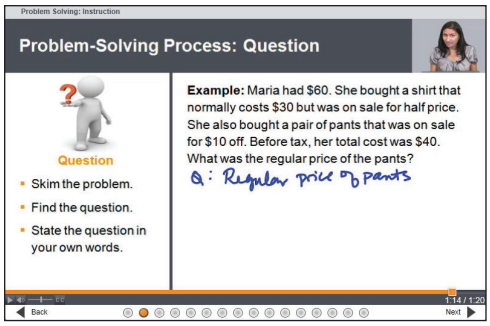


For example, in a history lesson about Andrew Jackson's presidency, the on-screen teacher models how to analyze historical events objectively by classifying and summarizing trends.

First, the teacher provides a general model and process for identifying key details and central trends. The instructor then applies the model using the Jackson presidency. After viewing the model, the student completes a similar assignment using the processes and procedures that were just modeled. This type of modeling also occurs in science, English language arts, and math lessons.

On-screen teachers also model problem-solving, cognitive, and metacognitive strategies. For example, the on-screen teacher in an Algebra II course thinks aloud while modeling a sequence of steps in the problem-solving process.

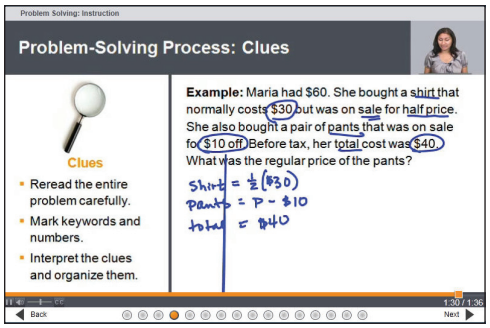
Additionally, the on-screen teachers in Edgenuity courses regularly model thought processes that underlie application of specific skills, procedures, and strategies. For example, a think-aloud in a high-school English language arts lesson models how to evaluate narration and tone by studying an excerpt from Jonathan Safran Foer's book, *Extremely Loud and Incredibly Close.* In Algebra I, a think-aloud models the mental process of determining whether a graph is a function—with the on-screen teacher reminding himself that "in order for a graph to be a function, there needs to be one x for every unique y," and then checking to see whether this is true. Think-aloud models for students in Edgenuity courses are clear, consistent, and concise, focusing on the critical aspects of the procedure.



How Edgenuity Courses Teach Procedural Prompts in Support of Cognitive Strategies Instruction

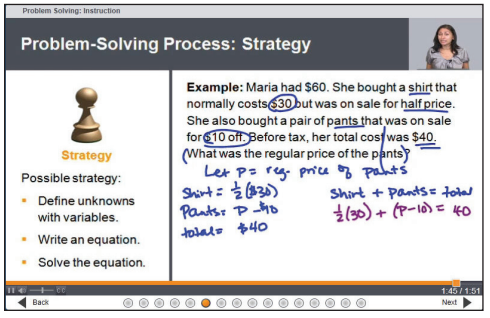
Students are provided with procedural prompts to support instruction in cognitive strategies. For example:

- In an English language arts lesson, students are taught a three-part structure for writing essays that present an argument.
- In a biology lesson, students are taught step-by-step procedures to identify variables.
- In a social studies lesson that emphasizes writing, the on-screen teacher uses procedural prompts to explain how to summarize historical events.



Scaffolded Practice

Studies of effective teacher practices and findings from cognitive research both support the importance of extensive student practice as a component of learning (Archer & Hughes, 2011, p. 201; NRC, 2012, pp. 4–9 to 4–12, 6–23 to 6–24; Rosenshine, 1995, p. 267; Rosenshine & Stevens, 1986, p. 377). Practice plays a key role in helping students move their knowledge from short-term to long-term memory—an essential part of remembering information and skills some time after first being introduced to them and being able to apply what they have learned. Practice also helps students develop fluency in applying key knowledge and skills. According to the authors of *Education for Life and Work,* "with each repetition of a cognitive skill . . . some additional knowledge strengthening occurs that produces continual small improvements" (NRC, 2012, p. 4-11).



An important element in effective practice is "explanatory feedback that helps learners correct errors and practice correct procedures" (NRC, 2012, p. 4-12). Multimedia learning environments of the type presented in online courses are well suited to providing this kind of practice with specific, immediate feedback (NRC, 2012, p. 4-12; Swan, 2003, p. 35).

Research evidence and expert opinion further substantiate that practice activities should be presented in a sequence in which students initially receive extensive support in order to successfully carry out practice activities, for example, in the form of prompts and worked examples (often referred to as guided practice) (Archer & Hughes, 2011, pp. 2, 32–34; Fisher et al., 2011, p. 368; Rosenshine, 1995, pp. 264–266; Rosenshine & Stevens, 1986, pp. 377, 382–383). Over time, these supports should be reduced, as students become more capable of carrying out tasks on their own.

The term *scaffolding* is often used to describe the use of temporary supports to help students carry out tasks until they are able to do so independently. Research and expert opinion strongly support the use of scaffolding, transitioning over time to student independent practice (Archer & Hughes, 2011, pp. 2, 37; Fisher et al., 2011, pp. 366, 371–373; Lajoie, 2005, pp. 542–544, 551; NRC, 2012, pp. 6–18, 6–22; Rosenshine, 1995, p. 267; Rosenshine & Stevens, 1986, p. 380; Sweller, 2008, pp. 377–378).

How Edgenuity Courses Support Scaffolded Practice

Throughout Edgenuity courses, students are consistently provided with extensive opportunities to practice new skills, starting with a high level of support and transitioning to less support as they become more experienced and demonstrate increased competence.

- Students are provided with cognitive, metacognitive, and comprehension prompts to help them carry out their tasks. Visual and verbal cues are designed to focus students' attention and to help them check their own understanding.
- As noted above in the subsection on Clarity of Instruction, students are provided with extensive modeling that shows them how to complete tasks, including worked examples. For example, on-screen teachers show students how an expert would think through or solve a similar problem using visual cues (e.g., highlighting or underlining text, furnishing a model of a molecule) and verbal cues to alert students to important information (e.g., "Listen to how the author describes the old house").
- During their practice activities, students receive immediate, corrective feedback that reinforces correct performance and helps them make adjustments as needed—after every question during early supported practice, and after a question set is completed for later, more independent practice.
- As students progress through a lesson, Edgenuity increases the complexity of tasks and decreases the level of support. For example, students may see partially worked examples instead of fully worked examples. Prompts fade as students master skills. Edgenuity also withdraws explanatory feedback as students demonstrate success.
- Even after students have advanced to the level of independent practice, they continue to have access to resources such as the "Show Me" videos to reteach content as needed.

Checks for Understanding

Research-supported explicit instruction includes frequent assessment to check for student understanding, coupled with systematic and corrective feedback (Archer & Hughes, 2011, pp. 3, 174–180; Fisher et al., 2011, p. 368; NRC, 2012, pp. 4–11 to 4–12; Rosenshine, 1995, p. 266; Rosenshine & Stevens, 1986, pp. 377, 379, 381, 385–386; Swan, 2003, pp. 7, 24, 25). In many cases, these assessments are carried out in the context of guided and independent practice.

When coupled with appropriate feedback, such checks for understanding not only inform teacher instruction and verify student learning, but can also improve the rate of student learning: "Individuals acquire a skill much more rapidly if they receive feedback about the correctness of what they have done" (NRC, 2012, p. 4-11).

How Edgenuity Courses Support Checks for Understanding

Edgenuity lessons are structured so that students typically answer a question every 5–7 minutes while they are engaged in online instruction. After each instructional sequence, students answer questions and complete tasks to check what they learned and to apply new skills.

Students receive immediate, appropriate feedback each time they respond to a question within an Edgenuity lesson.

- Feedback is provided with a human voice and is friendly, supportive, and explanatory.
- Feedback messages not only inform students whether their responses are correct or incorrect, but are also consistently designed to refine students' understanding of concepts and to correct misconceptions.
- As noted above, feedback is provided after student practice—after every question during early supported practice and after a question set is completed for cumulative practice and review. Edgenuity withdraws explanatory feedback as students demonstrate success.

"Research and theory to date...suggest that instructors...should focus on prolonged, deliberate practice and application rather than one-shot deals."

National Research Council (2012)

Review over Time

According to the *Education for Life and Work* report, "Research and theory to date. . . . suggest that instructors . . . should focus on prolonged, deliberate practice and application rather than one-shot deals" (p. 6-24). More specifically, Archer & Hughes (2011) specify that explicit instruction should provide both "distributed" practice (multiple opportunities to practice skills over time) and "cumulative" practice (opportunities to practice old skills and new skills together) (p. 3; see also Rosenshine, 1995, p. 266; Rosenshine & Stevens, 1986, p. 379).

How Edgenuity Courses Support Review over Time

Edgenuity courses are designed to provide periodic practice by reviewing skills and content at the end of every topic/unit, as well as at the end of each semester.

Edgenuity test and exam reviews represent opportunities for cumulative practice that integrates previously learned skills in a meaningful context. Because review activities are generated dynamically based on the course content students actually completed, they are automatically designed to provide cumulative practice of only the skills each student actually covered in instruction.

Deep Thinking for Transferable Knowledge

Increasingly, life and work in the 21st century require that students transfer knowledge that was learned in one situation by applying it in other situations (NRC, 2012, pp. 4–1 to 4–2). In other words, they need to possess both content knowledge and "knowledge of how, why, and when to apply this knowledge to answer questions and solve problems" (NRC, 2012, pp. Sum-4 to Sum-5). This includes the ability to engage in higher-order thinking processes such as understanding, application, analysis, evaluation, and creation (Mayer, 2002, p. 228; Krathwohl, 2002, p. 215).

This section shows how Edgenuity courses incorporate the following educational practices, which research has shown promote "deeper thinking"—which in turn leads to transferable knowledge (NRC, 2012, p. Sum-4):

- Highlighting processes of thinking
- Providing multiple representations
- Encouraging students to engage with texts and concepts (e.g., through elaboration, questioning, and explanation)
- Teaching application conditions
- Involving students in generating and testing hypotheses

Teaching For Understanding Of General Underlying Principles And Concepts

Research indicates that deep thinking for transferable knowledge results when students understand the general principles underlying specific facts, concepts, and examples (NRC, 2012, p. Sum-7; NRC, 2000, pp. 16–17, 260).

Research indicates that deep thinking for transferable knowledge results when students understand the general principles underlying specific facts, concepts, and examples.

How Edgenuity Courses Support Student Understanding of General Underlying Principles and Concepts

Lessons in Edgenuity courses are designed to build student understanding of core ideas and principles in the subject areas. As part of the initial lead-in portion of each lesson, students are frequently reminded of "big picture" connections to major themes and ideas they have been learning about in the course. As new concepts are explained, specific information and problem-solving procedures are connected to core ideas and principles that run across lessons. For example:

- In Algebra I, students learn that the goal of solving linear equations is to figure out an unknown. In order to isolate a variable, students are taught to use the multiplication property of equality, the addition property of equality,

the subtraction property of equality, the division property of equality, and order of operations. In doing so, students learn the underlying principle of balance and equality—that whatever operations are done on one side of the equation must be done on the other side as well.

- In English Language Arts 11, students learn that authors often use words and phrases designed to appeal to one or more of the senses (sight, taste, touch, hearing, and smell). In studying poets such as James Lowell, Henry David Thoreau, Langston Hughes, and Ezra Pound, students learn about the specific times and themes that impacted their writing, but also come to understand that all these poets employed imagery as a literary device to create a vivid mental image for the reader.
- In a U.S. History lesson, students examine how the demands of African Americans helped produce a stimulus for civil rights in the U.S. military, major league baseball, and the U.S. education system. Students learn how nonviolent protests helped to pave the way for the quests of American Indians, Asian Americans, and Hispanic Americans seeking equal opportunities. Several core themes of history are stressed in studying the civil rights movement: cause and effect of events, change and continuity over time, major turning points, and how the past provides insight into present circumstances—themes that are revisited throughout the course.
- Students learn that an underlying theme in organic chemistry is that carbon is the skeleton in and upon which a complex structure can be built. This theme is developed through individual lessons that address specific chemicals and chemical reactions.

Edgenuity courses provide clear instruction and modeling related to problem-solving, cognitive, and metacognitive thinking processes.

Highlighting Processes of Thinking

Research suggests that deeper thinking leading to transfer occurs when instruction focuses on the processes of thinking and not just on the results of student thinking (NRC, 2012, p. Sum-8). Experts recommend that instruction should include modeling of thought processes that underlie specific strategies (Fisher et al., 2011, p. 11; Rosenshine, 1995, p. 267; NRC, 2012, p. Sum-8) and regular feedback that highlights the processes of thinking (NRC, 2012, p. Sum-8).

How Edgenuity Highlights Processes of Thinking

Edgenuity courses provide clear instruction and modeling related to problem-solving, cognitive, and metacognitive thinking processes. Feedback to students draws their attention to elements of these processes, not just whether their understanding is correct or incorrect.

Multiple Representations

In order for students to be able to apply their knowledge, research calls for presenting concepts and tasks in "multiple and varied" ways, "such as diagrams, numerical and mathematical representations, and simulations, combined with activities and guidance that support mapping across the varied representations" (NRC, 2012, p. Sum-7; see also Archer & Hughes, 2011, p. 31).

How Edgenuity Courses Support Multiple Representations

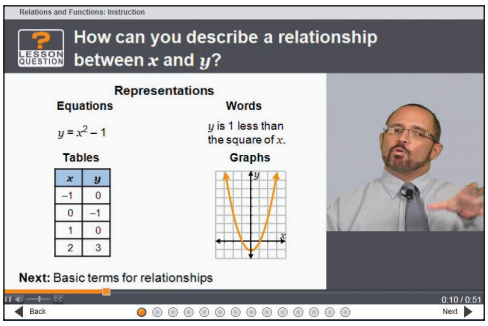
Key concepts and tasks in Edgenuity courses are explained using multiple representations—verbal, concrete manipulative, numerical, graphical, and symbolic—and students are guided in mapping meaning among the varied representations.

For example, students in an Algebra II course are taught to describe the relationship between two variables through equations, words, tables, and graphs.

Similarly, students in a chemistry course learn the characteristics of chemical equilibrium through verbal modeling, pictures, symbols, videos, dynamic representations and graphs, and molecular-level animations of reactions.

Encouraging Student Engagement with Content

Research has found that encouraging students to engage with content in active ways promotes transfer (NRC, 2012, p. Sum-7). Specific ways of engaging with content include "elaboration, questioning, and explanation—for example, prompting students who are reading a history text to think about the author's intent and/or to explain specific information and arguments as they read" (NRC, 2012, p. Sum-7). This kind of active engagement also improves student retention of information (Rosenshine, 1995, p. 263).



How Edgenuity Courses Support Student Engagement with Content

Edgenuity courses require students to interact with texts and ideas in order to summarize, clarify understanding, explain concepts, elaborate, and/or synthesize information. For example:

- In an English language arts lesson, students are asked to describe how Sojourner Truth uses personal experiences to make a logical and emotional case for women's rights.
- In a U.S. history lesson, students are asked whether Franklin Delano Roosevelt's Fireside Chats helped to move the country forward in 1933 and are prompted to justify their answers.
- In another U.S. history lesson, students are prompted to explain what pictures of Hoovervilles show about the mood of the country during the Great Depression.
- While reading a selection from Chief Joseph, students are prompted to paraphrase in their own words the central idea(s) of each paragraph, using the Edgenuity sticky notes feature. This feature provides many opportunities for students to interact with texts in a variety of ways in Edgenuity courses.
- In a biology course, after reviewing findings from an experiment, students

are asked to go into detail about five problems that could have caused inconsistent results.

- In a U.S. history lesson, students create multimedia presentations comparing significant technology advances of the Second Industrial Revolution and construct arguments to explain which they think is most important—synthesizing what they have learned in the unit.

Teaching Application Conditions

As noted previously, transferable knowledge includes knowing not only *how* but also *when*—under what circumstances and conditions—to apply specific knowledge, strategies, and procedures. Students can do this more effectively if instruction explicitly "emphasizes the conditions for applying a body of factual or procedural knowledge" (NRC, 2012, p. Sum-7; see also NRC, 2000, p. 236).

How Edgenuity Courses Teach Application Conditions

As part of their learning in Edgenuity courses, students are taught when to use specific procedures and how and when to apply facts and information.

As part of their learning in Edgenuity courses, students are taught when to use specific procedures and how and when to apply facts and information. This is done in different ways for different courses, as appropriate to the specific subject area and course. For example:

- In an English language arts lesson, students learn about active and passive voice and are taught to prioritize active voice in their writing. However, they are also taught that the passive voice can be used when a writer wants to emphasize the object of a sentence or doesn't know who is taking the action.

- In an Algebra II lesson, students learn to use graphing and elimination methods for solving systems of equations. The online instructor coaches students to use the elimination method when there are decimals that are hard to graph.

- In an organic chemistry lesson, students learn that each of the five different models to visually represent organic compounds should be used at different times.
  - Chemical formulas are best for showing chemical composition.
  - Structural formulas are helpful for illustrating chemical connectivity.
  - Lewis structures are beneficial for demonstrating chemical connectivity and valence structures.
  - Space-filling models are effective in illustrating three-dimensional representations of molecules.
  - Ball-and-stick models are valuable for demonstrating bonds and the general shape clearly.

- In a middle-school math lesson on dividing fractions, the on-screen teacher teaches a number of alternatives to "flip and multiply." Students learn mental

math strategies for dividing a fraction by a whole number both when the numerator of the dividend is the same as the divisor and when it is different.

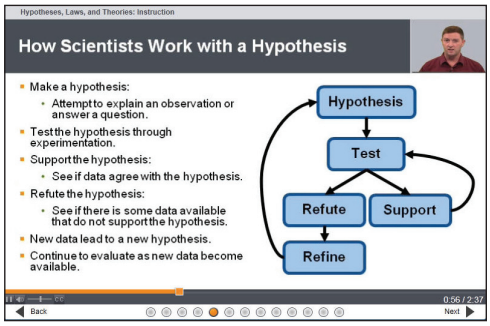
Hypothesis Generation and Testing

Researchers have described hypothesis generation and testing as a research-based strategy for increasing student achievement that "requires students to apply previous or developing knowledge to novel situations" (Allen, 2010, p. 114, citing Marzano et al., 2001). This practice applies particularly to instruction in science and history.

How Edgenuity Courses Employ Hypothesis Generation and Testing

Edgenuity courses provide students with appropriate and extended opportunities to generate and test hypotheses.

- For example, in a lesson on heredity, students study and test Mendel's laws of inheritance by conducting virtual pea plant experiments. Next, students generate hypotheses related to Mendel's Principle of Segregation and Principle of Independence and then conduct experiments with virtual mice in an online simulation.



  - Students are coached on how to make predictions and generate hypotheses about what the effect of changing the alleles of parental mice would be on the fur color of their offspring.

  - Students predict, breed, and confirm: (1) the offspring of two mice homozygous for black fur; (2) the offspring of a mouse homozygous with white fur and a mouse homozygous for black fur; (3) the inheritance pattern of a cross of two hybrid mice; and (4) the offspring of a female with white fur and a male with black fur.

  - After generating new hypotheses, collecting data, and analyzing data, students compare their predicted values to simulated values and draw conclusions. Then they apply findings from the mice experiments to a hypothetical situation where they advise couples about their risk of passing down sickle cell anemia to their children.

Promoting Metacognition

Researchers stress the importance of students monitoring and regulating their thinking processes while learning—a set of skills that researchers refer to as *metacognition* (Mayer, 2011, pp. 42–43; National Research Council [NRC], 2000, p. 12).

Incorporating metacognitive practices into instruction helps to support transfer of knowledge (NRC, 2000, p. 67) and has been shown to have "a particularly large impact on students who are lower-achieving" (NRC, 2005, p. 577). Perhaps most important, development of metacognitive skills allows students to become self-regulated learners—an increasingly important qualification for life and work in today's world (Mayer, 2011, p. 43; NRC, 2000, p. 18).

This section describes how Edgenuity courses integrate the following research-based practices that have been shown to promote student metacognition:

- Teaching a diverse range of metacognitive strategies, including self-monitoring strategies and self-explanation
- Using instructional approaches that incorporate modeling, coaching, scaffolding, and group discussion and problem solving in teaching metacognitive skills

"The ability to monitor one's understanding is closely tied to domain-specific knowledge and expertise."
National Research Council (2012)

Teaching a Diverse Range of Metacognitive Strategies

Research confirms that students can be taught to incorporate metacognition into their learning (NRC, 2012, p. 4–19; NRC, 2000, p. 18). Ideally, students should be introduced to a diverse range of metacognitive strategies, so they can adapt their learning in response to the particular situation (NRC, 2000, p. 100). Experts also recommend that metacognitive strategies should be incorporated as part of subject-area instruction, since "the ability to monitor one's understanding is closely tied to domain-specific knowledge and expertise" (NRC, 2012, p. 4-19).

Recommended metacognitive strategies for incorporating into instruction include:

- "[M]ental devices that help them stay on task, monitor their own progress, reflect on their strengths and weaknesses, and self-correct errors" (NRC, 2012, p. 4-19)
- "[T]he ability to predict outcomes, explain to oneself in order to improve understanding, note failures to comprehend, activate background knowledge, plan ahead, and apportion time and memory" (NRC, 2000, p. 18)
- Self-monitoring of a student's own learning processes and understanding of what is being learned, which represents an important part of the knowledge that experts have in their subject (NRC, 2000, p. 18)

- Comprehension monitoring, which includes "awareness of how well you understand what you are reading" (Mayer, 2011, p. 43) but applies to other learning media as well
- Self-explanation, in which learners explain instructional content to themselves—allowing them to repair their own misunderstandings (Roy & Chi, 2005, p. 276)

How Edgenuity Courses Teach a Diverse Range of Metacognitive Strategies

Edgenuity courses provide extensive instruction and practice with a diverse range of metacognitive strategies, as appropriate to the content of the specific course. Below are examples of metacognitive instruction and practice that are promoted in the Edgenuity courses.

Goal-Setting

The on-screen instructors in Edgenuity courses teach self-regulation strategies related to goal-setting. For example, in an English language arts lesson, an on-screen teacher suggests that students set goals related to how long they can read before losing concentration, use a timer to measure their reading stamina, and keep track of how their performance improves over time.

Determining Importance of Information

The on-screen instructors in Edgenuity courses prompt students to highlight, underline, and take notes in order to determine importance. The instructors use think-aloud demonstrations to model their thinking and provide guidance on what students should be alert for as they annotate. For example, in an Algebra II course, an on-screen instructor highlights the important words needed to translate a word problem on alkalinity into a logarithmic equation.

The on-screen instructors in Edgenuity courses prompt students to highlight, underline, and take notes in order to determine importance.

Planning Ahead and Strategic Thinking

Students in Edgenuity courses are taught to plan ahead and think strategically during their problem-solving in mathematics, science, and social studies by asking themselves questions such as the following:

- What is the question at hand?
- What words or ideas cue information that is needed to solve the problem?
- What strategies and data are needed to solve the problem?
- How do my prior experiences relate to the problem?
- What can I draw or write down to solve the problem? Table? Chart? List? Diagram?
- What do I think the outcome will be?

Self-Monitoring

Throughout Edgenuity courses, students are taught that it is important to monitor themselves in order to make sure they understand what they are reading or doing. On-screen instructors model this process of monitoring comprehension. For example, when they are reading a text or trying to solve a problem, instructors ask themselves, "Does this make sense?" If the text or task makes sense, they keep reading and return to the task. If they don't understand, they ask themselves, "When did I lose track?"

Students in Edgenuity math courses are taught to monitor their understanding of word problems by asking themselves questions such as the following:

- Are there words I don't know that I must understand to solve the problem?
- Am I using the proper strategy to solve the problem?
- Am I learning anything important as I solve the problem?
- Am I making mistakes?
- Do I need to revise my strategy?

Students in Edgenuity courses are explicitly taught to explain to themselves what they are learning and they are provided with prompts to employ this strategy on a regular basis.

Self-Explanation

Students in Edgenuity courses are explicitly taught to explain to themselves what they are learning and they are provided with prompts to employ this strategy on a regular basis. For example:

- In a math lesson on two-variable linear inequalities, students are prompted to explain to themselves whether certain data sets could be potential solutions to a word problem about saving money for a computer.
- As students read an article in a biology lesson, they are prompted to self-explain how changes in new technologies and experimental methods lead to changes in theories.

Self-Evaluation

Students in Edgenuity courses are taught to evaluate their performance by asking themselves questions such as the following:

- Did I check my answer?
- How do I know the answer to the question is correct?
- If my answer isn't correct, what could I do differently?

Additionally, at critical points in instruction, students are asked to respond to open-ended prompts. Once students have constructed their responses, they are given a model answer and asked to compare their own writing to the model, using a checklist to evaluate the elements of the model that they included in their own answer. By comparing their response to a model and completing the checklist, they critically assess their own work and identify strengths and weaknesses in their thinking and communication.

Using Research-Based Instructional Approaches for Teaching Metacognition

The authors of *How People Learn* described instructional approaches that had been successful in teaching metacognition and identified common elements of those strategies. These included "modeling, coaching, and scaffolding, [and] collective problem solving and whole-class and small group discussions" (NRC, 2000, p. 68; see also NRC, 2012, p. Sum-8).

How Edgenuity Courses Utilize the Research-Based Instructional Approach for Teaching Metacognition

As described in the section on Explicit Instruction, Edgenuity courses make extensive use of modeling, coaching, and scaffolding in teaching strategies of all kinds—including metacognitive strategies. This includes processes of generating alternative approaches, evaluating the merits of each approach, and monitoring progress toward the goal. Teachers in Edgenuity courses are also encouraged to post weekly discussion board questions that prompt students to share different perspectives about what they have been learning or how to solve problems.

Edgenuity courses teach metacognitive strategies such as generating alternative approaches, evaluating the merits of each approach, and monitoring progress toward the goal.

Reducing Cognitive Load

Research indicates that human working memory—the cognitive structure in which we consciously process information—is limited in the amount of information it can hold at one time. However, a much larger body of interrelated information and knowledge can be stored in long-term memory. Once information has been organized and stored in long-term memory, it can be accessed again as needed without placing a large burden on working memory (Sweller, 2008, p. 373).

Students learn more effectively if cognitive load—the burden that is placed on working memory—is reduced, so that working memory can be devoted to important learning tasks. This section describes how Edgenuity courses utilize several research-supported approaches to improving student learning in ways related to reducing cognitive load:

- Adhering to principles of effective multimedia instruction
- Using graphic organizers to present information to students
- Having students use graphic organizers to organize their knowledge

Experimental studies conducted by researchers such as Richard Mayer and his colleagues have established principles of design for effective multimedia instruction.

Effective Multimedia Instruction

A large body of research evidence supports the idea that our brain processes what we see (visual processing) and what we hear (auditory processing) along two separate "channels," each with its own separate capacity within working memory (Clark, 2005, p. 598; Mayer & Moreno, 2003, p. 44). Multimedia instruction capitalizes on this dual-channel system to make instruction more effective (Mayer & Moreno, 2003, p. 44).

Experimental studies conducted by researchers such as Richard Mayer and his colleagues have established principles of design for effective multimedia instruction. Principles arising out of this research that are particularly relevant for Edgenuity courses are described below.

Use Two Modalities for Complex Content

Complex content can be communicated more effectively if instruction uses both the visual and the auditory modalities to communicate different (but complementary) information (Clark, 2005, p. 598; Sweller, 2008, p. 376). More specifically, audio narration should not duplicate text that appears on the screen, since this unnecessarily splits the learner's attention (Mayer & Moreno, 2003, pp. 45–46).

Provide Synchronized Audio Narration to Accompany Visuals

Synchronized audio narration can help clarify animation and complex static graphics that aren't self-explanatory. However, Clark (2005) cautions:

> If either the words or the visuals can stand on their own, adding audio becomes an extraneous input for working memory and both slows down the learning process and depresses the outcomes. (p. 599; see also Mayer & Moreno, 2003, p. 46)

Avoid Split Attention

When possible, essential information should be integrated so that the learner's attention is not split between multiple competing sources (Sweller, 2008, p. 375; Mayer & Moreno, 2003, p. 49). For example, text labels for a diagram should appear next to the items they name, not elsewhere on the screen.

Break Narrated Animation into Small Segments

Describing how learners process narrated animation, Mayer and Moreno (2003) cautioned that "if the information content is rich and the pace of presentation is fast, learners may not have enough time to engage in the deeper processes of organizing the words into a verbal model, organizing the images into a visual model, and integrating the models" (p. 47). To counter this, research supports breaking the animation into "bite-size" segments and letting learners choose when they are ready to go on to the next segment (Mayer & Moreno, 2003, pp. 46–47; Clark, 2005, pp. 603–604).

Research supports breaking the animation into "bite-size" segments and letting learners choose when they are ready to go on to the next segment.

Eliminate Extraneous and Redundant Information

The more information is included in a multimedia presentation, the greater the learner's cognitive load—and the harder it is, therefore, for students to learn new content. Research confirms that providing the same information in multiple ways and including unnecessary details can hinder student learning (Sweller, 2008, pp. 376–377; Mayer & Moreno, 2003, p. 48).

This includes details that may be "interesting but extraneous" or that may be included in simulations for the sake of realism but aren't critical to the content being taught (Mayer & Moreno, 2003, p. 48; Sweller, 2008, p. 377). It also includes extraneous audio, such as "environmental sounds with narration [and] the addition of music to narration" in cases where the audio does not add "cues that [are] relevant to the instructional goal" (Clark, 2005, pp. 599–600). Such extraneous and redundant information should be eliminated whenever possible.

Use Signaling to Reduce Cognitive Load

In cases such as narrated animations where it may be necessary for instructional reasons to present a great deal of content in a relatively short time and/or limited space, designers can reduce cognitive load by "providing cues to the learner about how to select and organize the material—a technique called signaling" (Mayer & Moreno, 2003, p. 48). Examples of signaling include providing an outline of content prior to a lesson, stressing key words in supporting audio, using arrows or colored circles to highlight critical parts of a visual, using headings in text, and using "pointer" words such as "first . . . second . . . third" and "therefore" (Clark, 2005, p. 604; Mayer, 2011, p. 78; Mayer & Moreno, 2003, p. 48).

Use Simulations to Teach Complex Content

According to Clark (2005), one of the benefits of simulations is the "capability to accelerate expertise in domains of high cognitive complexity" (p. 606). Similarly, "[s]ituations that allow learners to engage with tasks that cannot be practiced in real-world settings recommend the use of well-designed simulations" (Clark, 2005, p. 610). Such simulations should be simplified to focus on elements that are appropriate to the instructional goal in order to avoid excessive cognitive load (Clark, 2006, pp. 608–609).

Information presentation in Edgenuity courses takes advantage of the learning benefits offered by multimedia resources while conforming to principles of effective multimedia instruction.

How Edgenuity Courses Use Principles of Effective Multimedia Instruction

Information presentation in Edgenuity courses takes advantage of the learning benefits offered by multimedia resources while conforming to principles of effective multimedia instruction, as described below.

Use Two Modalities for Complex Content

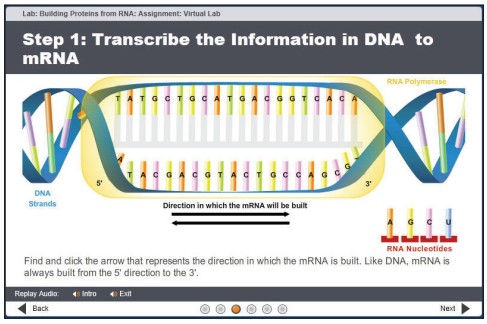
Edgenuity courses are strongly positioned to take advantage of the visual and auditory modalities because they combine audio explanations by the on-screen teachers with robust graphic illustrations of concepts and modeling/demonstration of skills. In Edgenuity courses, presentation of complex content is designed in a way that utilizes both the audio and visual modalities in complementary ways. On-screen instructors use still graphics, animations, and videos as appropriate to explain concepts and skills during lesson warm-ups, instruction, assignments, tasks, and summaries. Careful attention is taken to ensure that teachers are not simply reading the text that appears on the screen, and that audio provided in the CloseReader™ and hints does not duplicate information that can already be understood from the text or graphic.

Provide Synchronized Audio Narration to Accompany Visuals

Edgenuity courses consistently employ synchronized audio narration to explain visual content in complex animations and static graphics where the content is not self-explanatory. In addition, the CloseReader provides audio prompts to guide the close and active reading of complex text and help make the content accessible to all students, particularly English language learners and those with special needs.

Avoid Split Attention

Information presentations within Edgenuity courses are carefully designed, reviewed, and edited to avoid splitting the learner's attention. For example, whenever feasible, labels are incorporated next to the items they are labeling in visual diagrams, animations, and assignments. Additionally, within Edgenuity courses, related information is positioned together and images are usually accompanied by audio.

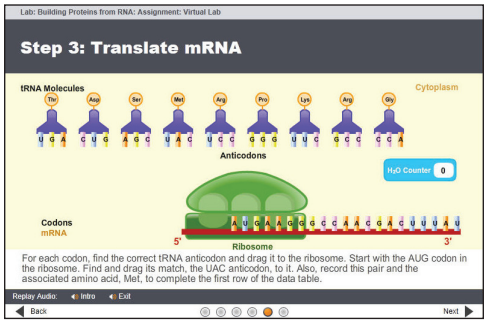


Break Narrated Animation into Small Segments

Animated and video presentations of content within Edgenuity courses are broken up into segments of a few minutes each. Between segments, interactive tasks prompt students to check for understanding, make predictions, and/or check their work before choosing to go on. Students can also choose to pause animations and videos at any point.

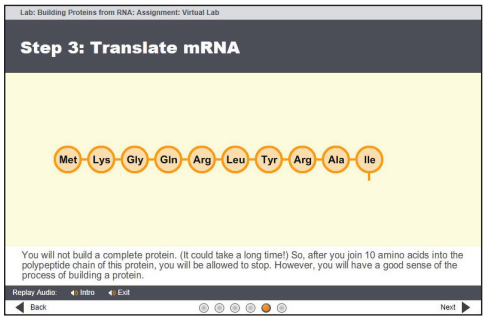
Eliminate Extraneous and Redundant Information

Information presentations within Edgenuity courses are carefully designed, reviewed, and edited to eliminate redundant and extraneous information as defined in the research literature on cognitive processing. Details contribute to student understanding, rather than detracting from it. For example, students might read a quote from Benjamin Franklin along with an explanation of how the quote illustrates his beliefs about American independence—rather than simply reading an esoteric "Did you know?" factoid about Franklin's life. While providing instructionally valuable audio support, Edgenuity courses also avoid use of extraneous audio that does not contribute to the instructional goal.



Use Signaling to Reduce Cognitive Load

Edgenuity courses use signaling in appropriate cases to help reduce cognitive load in complex multimedia presentations. Video in Edgenuity courses always includes a title, graphical icons, and headings that are designed to clearly show the most relevant information to the student. As noted in the section on Explicit Instruction, each lesson begins with a section that previews the overall content students will see in that lesson. Graphic organizers, strategic highlighting, and color coding help describe the relationships between textual and pictorial information and clarify text and ideas. Within information presentations, visual prompts are included to direct the eye to the most important information.

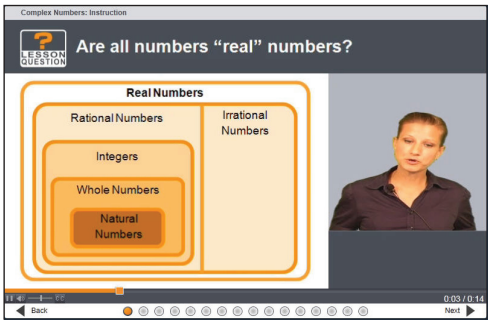


Use Simulations to Teach Complex Content

Simulations are used strategically in Edgenuity courses to help teach complex domain-specific principles, processes, and/or problem-solving heuristics. For example:

- In an Algebra II lesson, a simple simulation is used to help students understand the difference between linear and exponential growth. To help make this abstract idea more concrete, students play two games with different scoring systems to see how their scores change over time with linear and exponential growth.

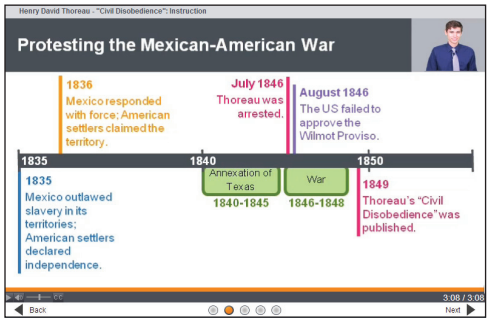
- In a biology lesson, students explore the process of building proteins from the information carried by RNA. Complex information is broken down into component parts so that students can see and apply the problem-solving process. In a virtual lab, students first review what RNA nucleotides are and how to make base pairs in a DNA antisense strand. Then they practice transcribing information in DNA to mRNA, as shown below in the screen for Step 1. Finally, they put the information together in a protein structure chart, as shown below in the screens for Step 3.



Presenting Information in Graphic Organizer Format

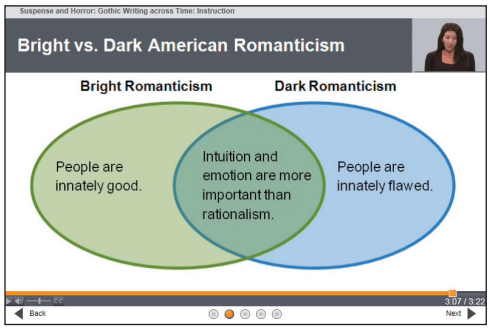
Research supports the finding that students often learn more effectively when information is presented via a graphic organizer than when it is presented via text alone (Nesbit & Adesope, 2006, p. 434). Such benefits extend not only to students in general but to learning disabled students in particular (Kim et al., 2004, p. 113).

Researchers have speculated that students may benefit from presentation of information in graphic organizer formats because graphic organizers help students organize new information. This helps the learner develop his/her own information structure or schema in long-term memory (Mayer, 2011, p. 79; Sweller, 2008, p. 374). Researchers have also speculated that presenting information in graphic organizers may reduce students' cognitive load by drawing attention to key elements of content and lowering the processing demands in the brain necessary to associate new concepts with already familiar concepts (Mayer, 2011, p. 133; Nesbit & Adesope, 2006, p. 418, citing Larkin & Simon, 1987).



How Edgenuity Courses Present Information in Graphic Organizer Format

Edgenuity courses use a wide range of graphic organizers to present information to students. For example, web structures, hierarchical diagrams (tree structures), matrixes, think-around structures, and concept maps (fishbone and spider maps) are used to present conceptual information. T-charts, Venn diagrams, and concept tables are used to compare and contrast concepts, events, and ideas by exploring similarities and differences. Timelines, flow charts, and sequence graphics are used to illustrate procedures, demonstrate cause and effect, and explore how events developed over time.



Graphic organizers are incorporated in every stage of instruction. Before instruction, advance organizers preview content that students will learn later in the lesson and relate information to prior knowledge. For example, at the beginning of an Algebra II lesson on complex numbers, a concept table is used to show relationships among different categories of numbers.

Within lessons, graphic organizers are used to show processes; highlight important ideas; help students see connections and patterns in concepts, ideas, and information; and guide students in their tasks.

At the end of instruction, Edgenuity courses use graphic organizers to summarize key instructional terms and concepts.

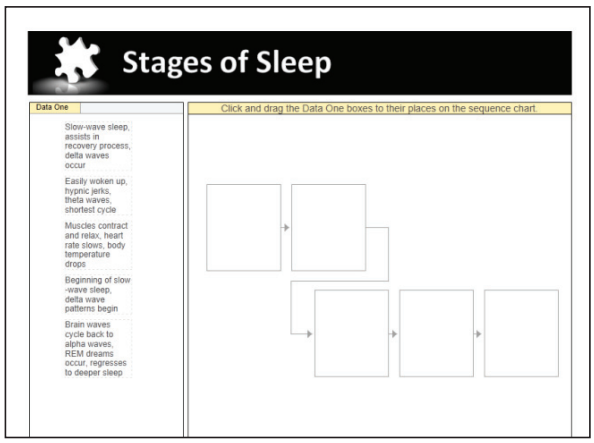
Student Use of Graphic Organizers

Research evidence also strongly favors having students use graphic organizers to actively structure their knowledge (Kim et al., 2004, p. 113; National Reading Panel, 2000, p. 4-45; Nesbit & Adesope, 2006, p. 427). This instructional method involves the same advantages as presenting information in graphic organizer format, in terms of helping students construct their own schema and/or reducing their cognitive load for processing new information—with the added advantage of actively involving students in processing concepts and/or texts.

How Edgenuity Courses Incorporate Student Use of Graphic Organizers

Student activities in Edgenuity courses include student use of graphic organizers as appropriate to structure what they have learned. For example, in ELA courses:

- After reading Shakespeare's Sonnet 130, students drag lines from the poem in a three-column chart to identify imagery, metaphors, and similes.
- After studying wartime literature, students manipulate an interactive T-Chart to compare the beliefs of Anne Frank and Zlata Filipovic.
- Students are asked to manipulate an interactive plot diagram to document the defining moments of Sophocles' *Antigone*.
- After reading Ishmael Beah's memoir, students manipulate an interactive flow diagram to track the sequence of events in *A Long Way Gone.*



In a Psychology elective course:

- Students are asked to compare and contrast descriptive and experimental research by manipulating elements in an interactive T-Chart.
- Student are asked to manipulate an interactive sequence chart to identify the stages of sleep.

Universal Design for Learning

Universal Design for Learning (UDL) is a framework of research-based recommendations for designing curriculum that that is flexible and adaptable to the varying needs of individual learners (Center for Applied Special Technology [CAST], 2011, p. 4). More specifically, as defined in the Higher Education Opportunity Act of 2008, UDL makes instruction more flexible and "reduces barriers . . . for all students, including students with disabilities" and English language learners (as quoted in CAST, 2011, p. 5).

Modern digital technologies provide powerful tools for "practical, cost-effective" customization of instruction to meet individual student needs in ways called for by UDL (CAST, 2011, p. 9). This section provides a top-level summary description of how Edgenuity online courses align with three basic principles of UDL:

- Multiple means of representation
- Multiple means of action and expression
- Multiple means of engagement

Multiple Means of Representation

Because "[l]earners differ in the ways that they perceive and comprehend information that is presented to them," it is important to provide multiple options for how information is presented to students—including options for language, mathematical expressions, and symbols—and options to support students in comprehending information (CAST, 2011, p. 14).

How Edgenuity Courses Support UDL by Providing Multiple Means of Representation

To accommodate students of all learning styles and diverse abilities, Edgenuity courses use a variety of instructional formats, including video lectures, graphic displays, simulations, closed captioning, and text (with optional read-aloud support). Key information and concepts are explained using multiple representations (verbal, concrete manipulative, graphical, and symbolic). This is especially important in mathematics instruction, where students need to understand the interrelationship among symbolic expressions, graphic representations, and text and spoken language expressions.

Graphic organizers (web diagrams, hierarchical diagrams, flow charts, timelines, and sequence graphic) are included in instruction, tasks, and assignments. Definitions are available for newly introduced vocabulary. Edgenuity lessons further support comprehension by activating and supplying background knowledge, focusing on important concepts, prompting active engagement with information, and promoting transfer of knowledge.

Multiple Means of Action and Expression

Differing student capabilities require that students be provided with options in

areas related to physical action and to expression and communication. UDL researchers also recommend scaffolding skills and strategies related to students managing their conditions of learning (e.g., setting goals, planning to meet these goals, monitoring progress, and revising strategies as necessary), known as "executive functions" (CAST, 2011, p. 25).

How Edgenuity Courses Support UDL by Providing Multiple Means of Action and Expression

The student interface for Edgenuity courses features customization options to accommodate various learners. Edgenuity courses offer a variety of ways for students to develop and express their knowledge, including use of contemporary tools and media such as interactive discussion forums, multimedia composition software, virtual manipulatives, and graphing calculators. Graduated levels of support are provided for practice and performance. Tools and activities for strengthening students' metacognitive skills help students develop executive functions.

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Multiple Means of Engagement

Different students are motivated to learn in different ways. Effective engagement builds student interest through strategies such as optimizing choice and autonomy, optimizing value and relevance, providing an appropriate level of challenge, and minimizing threats and distractions. Effective engagement also involves developing traits related to sustained student effort and persistence and helping students learn to self-regulate (CAST, 2011, pp. 28–34).

How Edgenuity Courses Support UDL by Providing Multiple Means of Engagement

Customizing tools within the Edgenuity courses provide opportunities for students to manipulate their learning environment. For example, students can learn at their own pace, pause and rewind videos, mark up text, and take electronic notes. Relevance is optimized through contemporary topics, thematic units, and application to real-world problems, while the use of headphones in Edgenuity courses helps reduce distractions. Adjustments to student instruction based on assessment data help to ensure an appropriate degree of challenge, with scaffolding support to help students persist in their efforts. Teachers also have options to customize the course settings (e.g., adjust the time allotted for assessments; change the grade weights for quizzes and exams) in order to make the level of challenge more appropriate for individual students. Tools and activities for strengthening students' metacognitive skills in areas such as goal setting, self-monitoring, and self-evaluation help students learn to self-regulate.

Conclusion

Edgenuity's online and blended courses reflect the best research-based practices in effective instruction. Explicit teaching guides students to develop key content area knowledge and skills by activating students' prior knowledge, establishing a clear purpose and goals for lessons, presenting information in small segments, providing clear instruction with examples and modeling, incorporating practice with scaffolded support, conducting frequent checks for understanding with appropriate feedback, and incorporating reviews spread out over time. Instruction is designed to promote deep thinking that leads to the kind of knowledge that can be applied flexibly across a broad range of conditions—and to help students develop metacognitive skills for monitoring and regulating their thinking processes while learning. Edgenuity courses enhance instruction while reducing cognitive load for students by adhering to principles of effective multimedia instruction and by using graphic organizers to present information and engage students in developing their own knowledge. The courses also implement principles of Universal Design for Learning to meet the needs of students in their individual circumstances.

With over 500,000 enrollments each year, Edgenuity provides the tools and resources to help students achieve their potential. For case studies and success stories describing how Edgenuity has met the diverse needs of students across a range of circumstances, please visit www.edgenuity.com.

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References

Allen, J. (2010, November). Generating and testing hypotheses. In Beesley & Apthorp (2010), pp. 114–129.

Alliance for Excellent Education. (2012, June). *The digital learning imperative: How technology and teaching meet today's education challenges.* Washington, DC: Author. Retrieved February 26, 2013 from http://www.all4ed.org/files/DigitalLearningImperative.pdf.

Archer, A., & Hughes, C. (2011). *Explicit instruction: Effective and efficient teaching*. NY: Guilford Publications.

Beesley, A. D., & Apthorp, H. S. (Eds.). (2010, November). *Classroom instruction that works, second edition: Research report*. McREL. Retrieved October 17, 2012 from http://www.mcrel.org/~/media/Files/McREL/Homepage/Products/01_99/prod21_CITW_report.ashx.

Carnevale, A. P., & Rose, S. J. (2011). *The undereducated American*. Washington, D.C.: Georgetown University Center on Education and the Workforce. Retrieved February 26, 2013 from http://cew.georgetown.edu/undereducated

Cavanaugh, C. (2013). Student achievement in elementary and high school. In M. G. Moore (Ed.), *Handbook of distance education (3rd. ed.)* (pp. 170–184). New York: Routledge.

Center for Applied Special Technology (CAST). (2011). *Universal Design for Learning Guidelines version 2.0*. Wakefield, MA: Author.

Clark, R. C. (2005). Multimedia learning in e-courses. In R. E. Mayer (ed.), *The Cambridge handbook of multimedia learning* (pp. 589–616). New York: Cambridge UP.

Fisher, D., Frey, N., & Lapp, D. (2011). What the research says about intentional instruction. In S. J. Samuels & A. E. Farstrup (Eds.), *What research has to say about reading instructio*n (4th ed.). Newark, DE: International Reading Association, 359–378.

International Association for K-12 Online Learning (iNACOL). (2011, October). *National standards for quality online courses, version 2*. Vienna, VA: Author. Available February 26, 2013 from https://www.inacol.org/research/nationalstandards/iNACOL_CourseStandards_2011.pdf.

Kim, A., Vaughn, S., Wanzek, J., & Wei, S. (2004). Graphic organizers and their effects on the reading comprehension of students with LD: A synthesis of research. *Journal of Learning Disabilities*, *37(2)*, 105–118.

Krathwohl, D. R. (2002, Autumn). A revision of Bloom's taxonomy: An overview. *Theory into Practice*, *41(4)*, 212–218.

Lacina, J. (2004/2005, Winter). Technology in the classroom: Promoting language acquisitions: Technology and English language learners. *Childhood Education, 81(2)*, 113–115

Lajoie, S. P. (2005). Extending the scaffolding metaphor. *Instructional Science, 33*, 541–557.

Larkin, J. H., & Simon, H. A. (1987). Why a diagram is (sometimes) worth ten thousand words. *Cognitive Science,* 11, 65–99.

Levy, F., & Murnane, R. J. (2004). *The new division of labor: How computers are creating the next job market*. Princeton, NJ: Princeton University Press.

Marzano, R., Pickering, D., & Pollock, J. (2001). *Classroom instruction that works: Research-based strategies for increasing student achievement.* Alexandria, VA: Association for Supervision & Curriculum Development.

Mayer, R. E. (2002, Autumn). Rote versus mearningful learning. *Theory into Practice, 41(4)*, 226–232.

Mayer, R. E. (2011). *Applying the science of learning.* Upper Saddle River, NJ: Pearson.

Mayer, R. E., & Moreno, R. (2003). Nine ways to reduce cognitive load in multimedia learning. *Educational Psychologist*, *38, 43–52*.

Meyer, A., & Rose, D. H. (2005). *The future is in the margins: The role of technology and disability in educational reform.* In D. H. Rose, A. Meyer, & C. Hitchcock (Eds.), T*he universally designed classroom: Accessible curriculum and digital technologies* (pp. 13–35). Cambridge, MA: Harvard Education Press.

National Reading Panel. (2000). *Report of the National Reading Panel: Reports of the subgroups*. Washington, D. C.: National Institutes of Health (NIH).

National Research Council (NRC). (2000). *How people learn: Brain, mind,experience, and school (expanded ed.)*. Committee on Developments in the Science of Learning and Committee on Learning Research and Educational Practice. J. D. Bransford, A. Brown, & R. R. Cocking (Eds.). Commission on Behavioral and Social Sciences and Education. Washington, D.C.: National Academy Press.

National Research Council (NRC). (2005). *How students learn: Science in the classroom. Committee on How people learn, A Targeted Report for Teachers*, M. S. Donovan & J. D. Bransford (Eds.). Division of Behavioral and Social Science and Education. Washington, D.C.: The National Academies Press.

National Research Council. (2012). *Education for life and work: Developing transferable knowledge and skills in the 21st century*. Committee on Defining Deeper Learning and 21st Century Skills, James W. Pellegrino and Margaret L. Hilton, Editors. Board on Testing and Assessment and Board on Science Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

Nesbit, J. C., & Adesope, O. O. (2006). Learning with concept and knowledge maps: A meta-analysis. *Review of Educational Research*, *76(3)*, 413–448.

Rose, D. H., & A. Meyer. 2000. The future is in the margins: The role of technology and disability in educational reform. A report prepared for the U.S. Department of Education Office of Special Education Technology. Washington, DC: USDOE. Available February 26, 2013 from http://www.udlcenter.org/sites/udlcenter.org/files/Meyer-Rose_FutureisintheMargins.pdf.

Rosenshine, B. (1995). Advances in research on instruction. *Journal of Educational Research*, *88(5)*, 262–268.

Rosenshine, B., & Stevens, R. (1986). *Teaching functions*. In M.C. Wittrock (Ed.), Handbook of research on teaching (3rd ed.) (pp. 376–391). New York: Macmillan. Roy, M. & Chi, M.T.H. (2005). *The self-explanation principle in multimedia learning*. In R.E. Mayer (Ed.), The Cambridge handbook of multimedia learning (pp. 271–286). New York: Cambridge University Press.

Swan, K. (2003). Learning effectiveness online: What the research tells us. In J. Bourne & J. C. Moore (Eds.), *Elements of quality online education: Practice and direction*. Sloan-C series, vol. 4. Needham, MA: Sloan Center for Online Education, 13–45.

Swan, K., Shea, P., Fredericksen, E., Pickett, A., Pelz, W., & Maher, G.(2000). Building knowledge building communities: Consistency, contact and communication in the virtual classroom. *Journal of Educational Computing Research*, 23(4), 389–413.

Sweller, J. (2008). *Human cognitive architecture*. In J. M. Spector, M. D. Merrill, J. van Merriënboer, & M. P. Driscoll (Eds.), Handbook of research on educational communications and technology (3rd ed.) (pp. 369–381). New York: Lawrence Erlbaum Associates.

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