

## I/ITSEC IEEE Learning Standards Special Event

**Discussion Topic:** Recommended Practices for the Evaluation of Adaptive Instructional Systems (AISs)  
Special Event: Evaluate and critique descriptors that are needed to inform AIS buyers about different AIS capabilities

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- **Background:** Adaptive Instructional Systems (AIS) are increasingly present in the commercial marketplace. However, “adaptive” being a very big umbrella term covering a wide variety of capabilities, it can be confusing to a consumer to evaluate the value presented by an AIS product. The buzz around AI and personalized systems is sometimes being parlayed into business opportunities with little concern for demonstrating evidence for touted benefits.
- **Discussion:**
- **Issue #1:** There is no clear understanding or definition of AIS, which can range from very simple to very complex adaptations.
  - **Recommendation 1.1:** There is an IEEE AIS standardization working group devoted to the task of developing a model of common AIS features. This model will play a key role in defining the standard descriptors for AISs to communicate to users. The AIS feature model may have to be described at different levels of abstractions for communication with different audiences.
  - **Recommendation 1.2:** Following a user-centered approach, the descriptors used AISs (i.e. features of an AIS) should be framed in language and theories that are familiar to educators. For example, the terms macro-adaptive or micro-adaptive may not be familiar to customers. It would be also be useful to identify the benefits and concerns that users associate with AISs. End users must be involved in this process of identifying key descriptors to provide insights into the features that speak to them and to provide formative feedback on the products of this process.

One example of framing a description of an elearning system is to map its features to learning science guidelines that are familiar to educators, as shown by the example in Figure 1.

Instructional Strategies ...		In GO Math! ...
<b>1</b>	<b>Establish mathematics goals to focus learning.</b> Effective teaching establishes clear goals, situates goals within learning progressions, and uses the goals to guide instructional decisions (NCTM, 2014, p. 12).	The goals are clearly labeled in <b>HMH GO Math!</b> More importantly, the scope and sequence have been built around learning progressions and the big ideas of mathematics.
<b>2</b>	<b>Implement tasks that promote reasoning and problem solving.</b> Effective teaching engages students in solving and discussing tasks that promote mathematical reasoning and problem solving and allow multiple entry points and varied solution strategies (NCTM, 2014, p. 17).	The 5E lesson framework in <b>HMH GO Math!</b> helps ensure that students explore worthwhile activities in every lesson to develop their understanding of mathematical concepts.
<b>3</b>	<b>Use and connect mathematical representations.</b> Effective teaching engages students in making connections to deepen understanding of concepts and procedures and as tools for problem solving (NCTM, 2014, p. 24).	Students interactively explore new concepts using pictorial representations, a variety of tools, and approaches in order to achieve proficiency with symbolic mathematics.
<b>4</b>	<b>Facilitate meaningful mathematical discourse.</b> Effective teaching facilitates discourse among students to build shared understanding by analyzing and comparing student approaches and arguments (NCTM, 2014, p. 29).	<b>Math Talk</b> is a central feature of <b>HMH GO Math!</b> Question prompts and sample dialogue in the Teacher Edition support you as you engage students to develop their conceptual understanding.
<b>5</b>	<b>Pose purposeful questions.</b> Effective teaching uses purposeful questions to assess and advance students' reasoning and sense making (NCTM, 2014, p. 35).	The Teacher Edition has many question prompts you can use to generate mathematical discourse and reflection, determine what students currently know, and advance their learning. These prompts allow you to transform your classroom into an interactive, student-centered learning environment.

Figure 1: Example of a product information material for GO Math! from Harcourt Mifflin Houghton (HMH). Note how the author is mapping the product features to guidelines established by a recognized body that is familiar to users (NCTM)<sup>1</sup>

Another approach is adapting frameworks such as that described in the book *A Framework for Teaching* for communicating the behavior and value of AISs. The Framework of Teaching identifies and organizes teacher responsibilities that has been have been theoretically or empirically shown to improve learning.<sup>2</sup> Figure 2 shows a section of the framework.

**FIGURE 4.16**

<b>DOMAIN 3: INSTRUCTION</b>				
<b>Component 3e: Demonstrating Flexibility and Responsiveness</b>				
<small>Elements: Lesson adjustment • Response to students • Persistence</small>				
ELEMENT	LEVEL OF PERFORMANCE			
	UNSATISFACTORY	BASIC	PROFICIENT	DISTINGUISHED
<b>Lesson adjustment</b>	Teacher adheres rigidly to an instructional plan, even when a change is clearly needed.	Teacher attempts to adjust a lesson when needed, with only partially successful results.	Teacher makes a minor adjustment to a lesson, and the adjustment occurs smoothly.	Teacher successfully makes a major adjustment to a lesson when needed.
<b>Response to students</b>	Teacher ignores or brushes aside students' questions or interests.	Teacher attempts to accommodate students' questions or interests, although the pacing of the lesson is disrupted.	Teacher successfully accommodates students' questions or interests.	Teacher seizes a major opportunity to enhance learning, building on student interests or a spontaneous event.
<b>Persistence</b>	When a student has difficulty learning, the teacher either gives up or blames the student or the student's home environment.	Teacher accepts responsibility for the success of all students but has only a limited repertoire of instructional strategies to draw on.	Teacher persists in seeking approaches for students who have difficulty learning, drawing on a broad repertoire of strategies.	Teacher persists in seeking effective approaches for students who need help, using an extensive repertoire of strategies and soliciting additional resources from the school.

Figure 2: Component from Framework for Teaching

<sup>1</sup> <https://www.hmhco.com/documents/go-math-and-the-principles-of-effective-mathematics-programs>.

<sup>2</sup> Danielson, C. (1996). *Enhancing professional practice: A framework for teaching*. Alexandria, Va: Association for Supervision and Curriculum Development.

- **Recommendation 1.3:** AISs are a type of educational technology and share many features with non-adaptive instructional technology tools (e.g. LMS interface, usability). It would be useful for the descriptors to reflect the spectrum from non-AIS to AIS systems and that there are many commonalities. Situating AIS in a context that is more familiar may reduce barriers to acceptance. It will also allow users to more easily identify the distinguishing characteristics of AISs.
- **Issue #2:** AIS systems are evaluated in narrow terms yet marketed very broadly. For example, a system may have demonstrated learning in students age 10-12, with a specific demographic profile, implemented in a particular fashion. Yet, the marketing claim may generalize to declare its effectiveness to the entire target market. Guidelines can help vendors present evidence with greater clarity and help users evaluate the evidence.
  - **Recommendation 2.1:** Look at how elearning products are currently being marketed to identify best practices that can be applied to AISs.
  - **Recommendation 2.2:** Similar to Recommendation 1.2, it would be beneficial to identify the benefits and concerns that are important to consumers. This can inform developers of AIS products on what they should evaluate/demonstrate.
  - **Recommendation 2.2:** Evidence-based evaluation criteria for AISs are likely to be similar those used on instructional technology products in general, i.e. non-adaptive systems need to be evaluated and validated too. Evaluation guidelines have been developed for such systems and should be the starting point for evaluation guidelines for AISs. Reference and incorporate guidance issued by other government/regulatory/standardization bodies on evidence-based evaluations of educational products.
    - What Works Clearinghouse<sup>3</sup>
    - ESEA<sup>4</sup> guidance: Using Evidence to Strengthen Education Investments<sup>5</sup>

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<sup>3</sup> <https://ies.ed.gov/ncee/wwc/>

<sup>4</sup> Elementary and Secondary Education Act

<sup>5</sup> <https://www2.ed.gov/policy/elsec/leg/essa/guidanceusesinvestment.pdf>

**Table 1. Summary of Recommended Study Criteria for Each Evidence Level**

	<b>Strong Evidence</b>	<b>Moderate Evidence</b>	<b>Promising Evidence</b>	<b>Demonstrates a Rationale</b>
<b>Study Design</b>	Experimental study	Quasi-experimental study	Correlational study with statistical controls for selection bias	Provides a well-specified logic model informed by research or evaluation
<b>WWC Standard</b>	Meets WWC Evidence Standards <u>without</u> reservations (or is the equivalent quality)	Meets WWC Evidence Standards <u>with</u> or <u>without</u> reservations (or is the equivalent quality)	N/A	N/A
<b>Favorable Effects</b>	Shows a statistically significant and positive (i.e., favorable) effect of the intervention on a student outcome or other relevant outcome	Shows a statistically significant and positive (i.e., favorable) effect of the intervention on a student outcome or other relevant outcome	Shows a statistically significant and positive (i.e., favorable) effect of the intervention on a student outcome or other relevant outcome	Relevant research or an evaluation that suggests that the intervention is likely to improve a student outcome or other relevant outcome
<b>Other Effects</b>	Is not overridden by statistically significant and negative (i.e., unfavorable) evidence from other findings in studies that meet WWC Evidence Standards with or without reservations (or are the equivalent quality)	Is not overridden by statistically significant and negative (i.e., unfavorable) evidence from other findings in studies that meet WWC Evidence Standards with or without reservations (or are the equivalent quality)	Is not overridden by statistically significant and negative (i.e., unfavorable) evidence from other findings in studies that meet WWC Evidence Standards with or without reservations (or are the equivalent quality)	An effort to study the effects of the intervention, ideally producing promising evidence or higher, will happen as part of the intervention or is underway elsewhere
<b>Sample Size and Overlap</b>	Includes a large sample and a multi-site sample, overlapping with populations <u>and</u> settings proposed to receive the intervention	Includes a large sample and a multi-site sample, overlapping with populations <u>or</u> settings proposed to receive the intervention	N/A	N/A

Figure 3: ESEA guidance for evaluating evidence on impact of educational interventions<sup>6</sup>

<sup>6</sup> <https://www2.ed.gov/policy/elsec/leg/essa/guidanceusesinvestment.pdf>

**PROGRAM OVERVIEW**

Houghton Mifflin Harcourt *GO Math!* K-5 integrates the Standards for Mathematical practices along with conceptual fluency, which fosters the development of 21<sup>st</sup>-century skills. The program provides rigor, depth of understanding through interactive lessons, research-based instructional approaches, best practices, English learner support, and differentiated instructional resources to ensure success for all students.



**STUDY LOCATION:** Nine schools across seven states:  
Arizona, Idaho, Illinois, Michigan, Ohio, Pennsylvania, Utah  
**STUDY YEAR:** 2012–2013 and 2013–2014  
**STUDY CONDUCTED BY:** Cobblestone Applied Research and Evaluation, Inc.

**EVIDENCE CRITERIA**

**STUDY EVIDENCE & HIGHLIGHTS**

Well-designed & well-implemented experimental study or Randomized Control Trial (RCT)

An experimental RCT study, where intervention teachers implemented *GO Math!* K-5 for two school years. Results were analyzed using multilevel modeling to compare student academic achievement after exposure to two years of the program.

Teachers at Grades 1-3 were randomly assigned to use either *GO Math!* K-5 (treatment group) or their existing curriculum (control group) for the span of two academic years. During those two years, a majority of treatment teachers at each grade level reported covering a majority of the *GO Math!* K-5 lessons. Teacher implementation logs indicated that treatment teachers utilized a majority of the program components with over 70% of teachers implementing the program with fidelity.

Large & multi-site sample

The sample consisted of nine different schools from both rural and suburban districts that were both economically and racially diverse.

**ANALYTIC SAMPLE:**

- Suburban and urban schools
- 9 schools
- Grades 1–3
- 898 participating students for two-year analyses
- 10% African American; 13% Hispanic; 66% Caucasian; 2% Asian; 8% Native American/Other
- 9% English learner
- 52% Free/reduced-price meals

Shows statistically significant & positive effects

HMH *GO Math!* K-5 students who were exposed to the curriculum for two consecutive years demonstrated significantly more growth in Iowa Tests of Basic Skills<sup>®</sup> Math scale scores across the two academic years when compared to students in the control group.

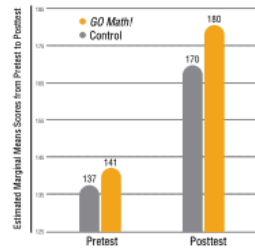


Figure 4: Example of the use of ESEA guidelines for product marketing<sup>7</sup>

- **Recommendation 2.4:** Require marketers to include fine print qualifications of their claims with evaluation data. For example, the claim is that the product leads to an average of one reading grade level important should include, in fine print, a very brief summary of the evaluations and results that led the claim (e.g. “based on a study performed with 60 high-school students using the product in daily one hour lab sessions for five weeks”). It would be important to establish guidelines for what goes in these fine print notes).

It seems common for educational products to include research results. However, just describing results from multiple research studies may leave a consumer confused about the bottom-line takeaway. Guidelines can be established to summarizing the results in a clearly digestible manner.

<sup>7</sup> <https://www.hmhco.com/documents/essa-evidence-criteria-4>

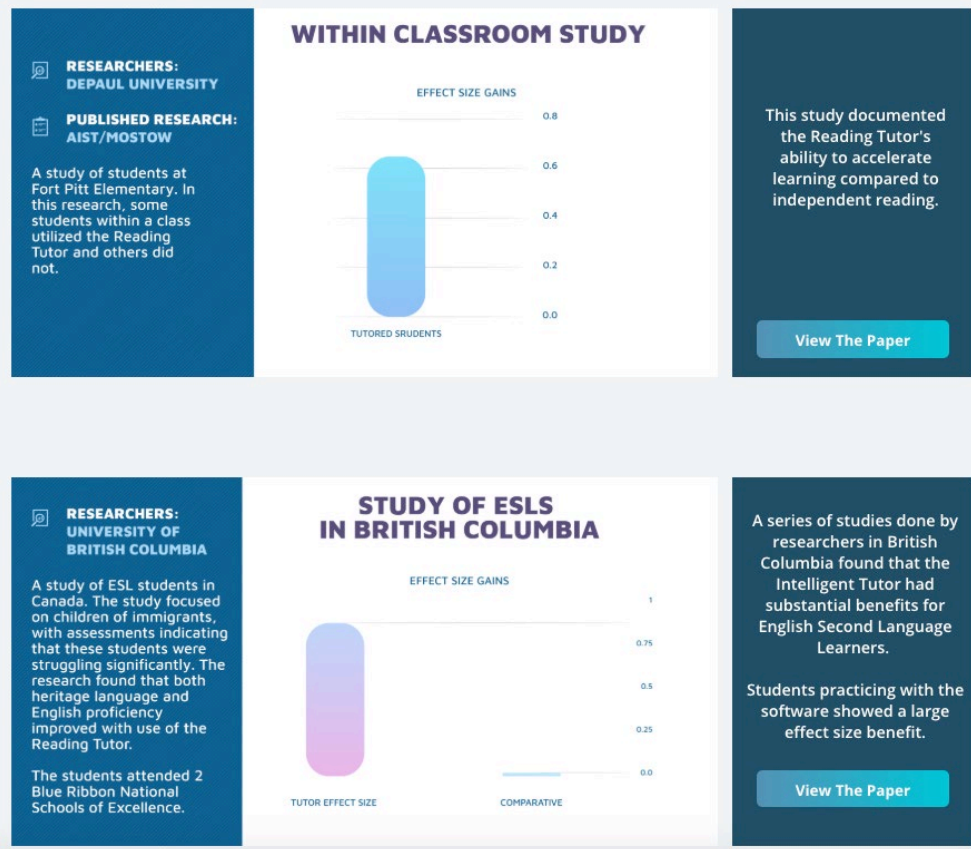


Figure 5: Reporting of effectiveness research for Amira, an AIS to teach reading skills. Multiple studies are presented. It would be helpful to summarize these results into a single takeaway message. For example, "Amira is demonstrated to improve reading skills for English Language Learners between grades 1-4".<sup>8</sup>

<sup>8</sup> <https://www.amiralearning.com/amira-research>