Ten Evaluative Standards

for Assessing the Cognitive Effectiveness

of Instructional Media

ED 7503

Instructional Media Tools

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Contents:

Abstract

This paper is a discussion of ten evaluative standards used to assess the cognitive

effectiveness (or educational value) of the learning managements systems, Blackboard and

WebCT and two software programs Dreamweaver and Flash. The ten standards used are:

1) the capability to assess expertise, 2) the capability to manage cognitive load, 3) the ability to

manage students' attention, 4) the ability to syntesize prior learning, 5) the correct use of

implicit and explicit models, 6) the effective use of enterprise tools, 7) the application of

accelerating transfer, 8) the effective use of empirical learning, 9) the capability to motivate

learners, and 10) the use of metacognition, instructional media tools, and learning theory.

Introduction

In developing the evaluative standards it is essential to know the models of learning and the four instructional architectures as described by Ruth Clark in *Building Expertise*.

Three models of learning are:

1. The *absorption model* which views the student as a container absorbing knowledge

2. The *behaviorist model* involves learning by observing and doing.

3. The *cognitive model* involves the active mental sensing, processing, retaining, and recalling of knowledge through cerebral processes.

The four instructional architectures are listed below:

1. *Receptive architecture* involves the student receiving and storing information.

2. *Directive architecture* is a sequential gathering by the student of structurally dispensed information .

3. *Guided discovery* occurs when instructional support walks the student through the information to be learned, explaining the information, and helping, coaching, and encouraging the student when needed.

4. *Exploratory architecture* is giving the student more free reign to explore and discover, often through trial and error, new material and many of the approaches and procedures involved in the learning process are constructed by the learner as he is learning.

Most learning is in fact a mixture in varying amounts of each of the above mentioned architectures. Experts tend to process information based on studied and reasoned information whereas novices often resort to trial and error or attempting a task using a hit or miss approach. The models of learning and instructional architectures using reading, writing, listening, interaction, experience, repetition, memorization, experimentation, and creativity are methods by which one travels on the road toward expertise. Instructional media is another tool, using computer and other advanced technologies, that can facilitate and accelerate the learning process by giving empirical training for both near and far transfer skills and in developing expertise.

Ruth Clark writes, "It turns out that there really is no one best method for teaching" (p. 11). I think this is true because there are so many differences to consider external to the teaching material and method. For example, there are cultural differences, socio-economic differences, availability of technology differences, age differences, level of knowledge differences, intelligence differences, ability differences, language differences, personality differences, and interest differences.

Bloom's Taxonomy

- Knowledge: (memory, data, information)

- Comprehension: (understanding, paraphrasing)

- Application: (using, applying information)

- Analysis: (categorizing, organizing)

- Synthesis: (creating new structures)

- Evaluation: (judging, critiquing)

Using Bloom's Taxonomy, one can progress through instructional media and arrive at evaluation standards some of which are listed in the paper below.

1. The Capability to Assess Expertise

An expert is a person with a high degree of skill in or knowledge of a certain subject or field (2001, *American Heritage Dictionary*).

Concerning an expert, or knowledge worker, Ruth Clark lists the characteristics that make an expert:

1. Expertise requires practice and involves time to nurture and develop.

2. Expertise is domain specific hence the importance for someone striving towards expertise to focus on a particular area of knowledge.

3. Some challenging problems can require diverse solutions and expertise from a consortium of experts.

2. The Capability to Manage Cognitive Load

Authoring tools can be effective in managing cognitive load since the learner can proceed with the learning regimen at his or her own pace. Also the learner can refer back to the information created by the authoring tools when needed in the manner of a reference manual. Authoring tools can create job aids (such as instructions or directions for use) and referenced-based training (as in software tutorials). Automaticity can be developed with regular use of the educational materials developed with authoring tools through the use of drills, practices, tests, and exercises. The learner can also learn by observing and studying worked examples and by studying educational materials that use visual and auditory modalities, redundancy, and absorbable amounts of information. There are times when too much information (more

than can be realistically absorbed in a given amount of time) presented to the learner is acceptable but this approach would be intended only to introduce the information to the learner who can then return at a future time to the information to delve more deeply into its content. All of these techniques, in addition to the correct use of visuals, sound, and text, can contribute to an effective learning experience. As I was teaching English as a second language, I realized how important visuals are in learning and I also witnessed the importance of repetition.

3. The Capability to Manage Students' Attention

In a learning situation a teacher should optimize the students' attention capacity by managing the learning environment (including the physical comfort level), avoiding student fatigue and boredom, and promoting participation by having learners complete interactive tasks, asking questions to individual students, maintaining eye contact, and using an energetic instructional pace to stimulate interest by the students.

Divided attention occurs when the student attends to more than one information source at a time whereas selective attention involves attention to one source at a time. Methods to affect selective attention include asking relevant questions before, during, and after reading (this is best when used with mature learners), establishing learning objectives, and utilizing signals within written and spoken information to guide the learner and reinforce learning.

Methods to use to avoid creating divided attention include using contiguity (such as placing labels and descriptive words close to the visuals that they are describing), making information readily available within the text or in pop-up screens, making feedback areas in e-learning close to the learner's response field, synthesizing information that should be placed on flip charts and screens, and minimizing distractions.

In maximizing attention capacity, factors to consider include the effectiveness of the instructional material used and the learning environment; the learner's knowledge, goals, and skills; and learning tasks for the students to use (Clark, 2003). Other factors to consider include sustaining the student's interest to avoid boredom, age (it is well known that the younger the student, the shorter the attention span), regional location, abilities and disabilities, talents, interests, aptitudes, concentration ability, intelligence, emotional maturity, health, use of senses (especially seeing and hearing), cultural and economic background, and personality. Also important to consider are the instructional techniques used while instructing the students in addition to the availability and level of technology and learning material.

4. The Ability to Synthesize Prior Learning

Prior knowledge should be presented sequentially; however, exercises can be utilized while learning where a task requires that non-sequential items are to be arranged to form the correct sequences. Prior knowledge can be addressed through discussions and showing previously learned material (and asking questions related to previously learned material) before, during, and after the learning presentation. Group discussions can be used to activate prior knowledge and to increase understanding of a learning topic. The correct use of visual, auditory, verbal information, and learning objects can also enhance the learning experience while utilizing previously learned material and all of these techniques combined can foster synthesis of prior knowledge which can then be applied to learning new concepts.

Learning objects are recyclable and reusable learning units or clumps, clusters, or illustrations of information which can have pictorial, verbal, auditory, animation, or interactive aspects to them.

Learning Objects consist of three main elements:

1. Instructionally sound content with a focused learning objective,

2. Learner-centered rich media environments that enable the learner to practice, learn, and receive assessment, and

3. Metadata or keywords that describe the learning objects' attributes, and mechanisms for communicating with management systems or other web applications." (Heins & Himes, 2002)

In short, learning objects can be thought of as a sort of a la carte approach to learning.

Flash can be used to create learning objects to improve the retrieval of knowledge and skills from long-term memory when interactivity is required or when animation, color, or illustrations enhance the learning experience as they almost always do when used correctly and appropriately. These activities can stimulate learning of new material as well as cause long term memories to be retrieved within the context of learning.

5. The Correct Use of Implicit and Explicit Models

The following adjectives can be applied to implicit learning: implied, hidden, symbolic, artful, approximate, imaginative, fiction, indirect.

To assist in building implicit learning models the following can be used:

- Illustrative, relevant graphics

- Examples and non-examples

- Analogies

- Processing knowledge

- Prior knowledge learners should have access to diverse material

These adjectives can be used when referring to explicit learning: utilitarian, obvious, real, actual, apparent, factual, nonfiction, direct.

To build explicit mental models the following can be used:

- Questions

- Practice assignments and exercises

- Train students to self-question

- Self-explanations to problem solutions

- Utilize collaborative learning

- Provide detailed lecture notes to the students

6. The Effective Use of Enterprise Tools

Concerning the efficacy of a browser-based, enterprise-wide tool for a team, especially if the team works in more than one location, one of the advantages of the Internet is that people can retrieve and send information instantaneously and over long distances, in fact, from one side of the world to the other. When developing web based material, team members can be spread across the globe and share and develop projects provided they share compatible technology and software. Files and information can be shared and sent to any of the team members as long as they have an Internet connection, and in today's world that is almost anywhere in the world, or anywhere that there are telephone lines. High speed cable connections would be available in any city or higher educational institution in the world. Likewise, contents from the reviewed software could be shared, developed, and sent worldwide.

The Internet has realized the vision of the creator of the World Wide Web, Tim Berners-Lee, who wanted the possibility of "anything being potentially connected to anything." Even though there is always room for creativity and individuality, there is also a need for standardization in many cases. For example, no one wants every light bulb screw mount to be different from all of the others. The computer world also realizes the importance of standardization, communication, and compatibility so that now most graphic and word processing software programs can be imported into other programs so that there can be an integration and interaction and communication amongst a variety of platforms.

7. The Application of Accelerating Transfer

Transfer is the ability to apply learned information and skills. Transfer not occurring can be the result of poor organizational support, lack of transferable skills to specific jobs, insufficient training for new situations or difficulty in transferring skills to different contexts. Transfer can occur in specific job situations or as generalized analytical skills and both can be applied to near (tasks that have a very similar context each time they are performed) and far (tasks that have a generalized application) tasks.

Near transfer can be instilled with the use of drill and practice exercises and how to training. Far transfer can be taught using contextual examples, inductive and deductive learning techniques, simulations for guided discovery, and the use of cognitive aids.

The use of these programs could facilitate transfer which could be strengthened using interactive approaches such as those that could especially be offered by Authorware.

8. The Effective Use of Empirical Learning

Problem-centered learning and instruction is focused, experiential learning organized around the investigation and resolution of real-world problems. A problem-centered curriculum offers authentic experiences that encourage active learning, support knowledge construction, and naturally integrate school learning with real life experiences.

With this approach students become actively engaged problem solvers, identifying the root problems and the conditions needed for a correct solution. By so doing they are pursuing meaning and understanding and become self-directed learners. In this method, teachers are problem-solving colleagues who model interest and enthusiasm for learning and are cognitive coaches who nurture an environment conducive to open inquiry.

Of the four architectures of learning (receptive, directive, guided discovery, exploratory), this approach is really the definition of guided discovery, as it is about solving a problem through experimentation and discovery. There are many examples such as solving mathematics or geometry word problems (such as: what is the area of a triangle with sides 13cm x 14cm x 15cm?) and imagining socially related problems such as having the students become part of a jury to determine the innocence or guilt of a hypothetical crime or to determine the truth or falsity of a theory or hypothesis. The scientific method which uses hypothesis, experimentation, observation, analysis, and conclusion also involves this concept. To have students listen to a patient's symptoms to arrive at a diagnosis of a disease or condition is one example of using the problem-centered approach to learning. Another example is to determine the best method of doing a particular task with given materials, resources and time. Another is a detective approach in determining a cause of a particular event given the information of the current circumstances of the event in question.

9. The Capability to Motivate Learners

Motivation is essential for learning and it can be intrinsic (internal rewards) or extrinsic (external rewards). Motivation involving the basic human needs includes drive theory (survival drive, etc.), arousal (attentiveness), Maslow's hierarchy of needs (physiological, safety, belonging, esteem, and self-actualization), competence and self-worth, and relatedness (feeling of social connectedness). Individuals have different needs for affiliation, approval, and achievement. Also, related to motivation is affect which includes the emotions of pleasure, anxiety, excitement, pride, depression, anger, guilt, etc. (Omrod, 2004).

Quality, useful information, and motivation are the most important factors in learning. Quality instruction is a plus but the learning is done by the student so, other than the material to be learned, the characteristics within the student are the most important factors in learning. Another characteristic of the student is intelligence — one can only fill a tank to the capacity that it can hold.

The teacher can make the material as interesting as possible as the teacher functions as a facilitator and mediator between the student and the body of knowledge to be learned and should provide the sort of knowledge, expertise, and training necessary for the students' intellectual and cultural growth. The teacher can only make the students aware of the immediate and future extrinsic rewards. A student's motivation is a combination of intrinsic and extrinsic factors. Motivation usually becomes more extrinsic as the child attempts to please its parents and others. I think as a person matures, in addition to the rewards that are intrinsic and information learned for personal satisfaction, the rewards from learning are external to the internalized knowledge and generally become increasingly more extrinsic in nature.

10. The Use of Metacognition, Instructional Media Tools, and Learning Theory

Instructional media tools (authoring and learning management tools) should incorporate every learning theory and instructional design principle that they can manage so that then the author can select the ones that suit the material's purpose.

When students are using metacognitive activities while learning the information is more likely to be recorded into the long term memory from the working (short term) memory. While teaching or using instructional media tools the following aspects of learning should be incorporated into the learning procedures:

- Engage learner motivation – give real world intrinsic and extrinsic reasons for learning the material and demonstrate how the knowledge can be applied to their lives.

- Gain and sustain attention – Find the students' interests and use them to foster student involvement and interest.

- Activate prior knowledge – get the students to use through exercises and problems their previously learned knowledge.

- Manage cognitive load in working memory – Give them realistically obtainable learning goals and do not overwhelm them with material that, rather than stimulates, only frustrates them.

- Build mental models in long-term memory – have them commit the information to long term memory through memorization, repetition, and empirically derived information (such as in scientific experimentation).

- Support transfer of learning to the job – give the students opportunities to learn by doing

- Support participants' metacognitive skills — Demonstrate metacognititve (Knowledge about one's own thinking) skills and cognitive concepts skills through games and examples.

Below is a list of some collaboration tools that should be available for use in instructional media:

Calendar	File sharing	Project management	Time sheets
Contacts	E-mail	Document management	Telegram
Notes	Chat rooms	Discussion forum	Evaluation
Tasks	Pinboard	Ideas & brainstorming	Scheduler

Collaboration tools (tools for creating learning environments, content building materials, asynchronous course rooms, discussions, mail, whiteboard, instructor-authored calendar, instructor's evaluations, connection to the Internet, text and graphics, html, html creator, spell check, search engine, announcements, breadcrumbs, profiles, expand/collapse capability, progress record, setting the number of records per page, draft box, compile feature, composing messages, use of several languages, synchronous learning, contents that can be shared and reused, chat areas, timed on-line quizzes and tests, user directory, address book, personal information, add/remove buttons, customize background colors, help menu, technical support) can be used to form an interactive learning environment.

Conclusion

Dreamweaver and Flash can both incorporate the above described evaluation standards are therefore both effective media tools for educational media projects although Flash can be more useful with the interactive applications of the above mentioned principles. Expertise, cognitive load management, managing students' attention, synthesizing prior knowledge, using implicit and explicit educational models, the use of enterprise tools, accelerating knowledge transfer, empirical learning, learner motivation, metacognition and learning theory can all be conveyed in collaboration with the learning media tools covered and reviewed during the progress of the course ED 7503: Instructional Media Tools.

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A Comparison of Two Learning Management Systems used as Cognitive Learning Tools

Capability	WebCT	Blackboard
Tools for creating learning environments	Yes	Yes
Content building materials	Yes	Yes
Asynchronous courseroom	Yes	Yes
Discussions, mail, whiteboard	Yes	Yes
Instructor-authored calendar	Yes	Yes
Instructor's evaluations	Yes	Yes
Connect to Internet	Yes	Yes
Can use text and graphics	Yes	Yes
Use Html function	Yes	Yes
HTML creator	Yes	
Spell check	Yes	
Search engine	Yes	
Announcements	Yes	
Breadcrumbs	Yes	
Profiles	Yes	
Expand/collapse capability	Yes	
Progress record	Yes	
Set number of records per page	Yes	
Draft box	Yes	
Compile feature	Yes	
Compose message	Yes	
Several languages		Yes
Can handle thousands of learners		Yes
Virtual classroom for synchronous learning		Yes
Contents can be shared and reused		Yes
Chat function		Yes
Timed on-line quizzes, tests		Yes
User directory		Yes
Address book		Yes
Personal information		Yes
Add/remove buttons		Yes
Customize background colors		Yes
Help menu		Yes
Technical support		Yes

The Effectiveness of Dreamweaver and Flash as

Cognitive Learning Tools Using

Ten Evaluative Standards

Evaluative Standard	Dreamweaver	Flash
1. The Capability to Assess Expertise	■	
2. The Capability to Manage Cognitive Load	■	
3. The Capability to Manage Students' Attention		■
4. The Ability to Synthesize Prior Learning	■	
5. The Correct Use of Implicit and Explicit Models		■
6. The Effective Use of Enterprise Tools	■	
7. The Application of Accelerating Transfer	■	
8. The Effective Use of Empirical Learning		■
9. The Capability to Motivate Learners		■
10. The Use of Metacognition, Instructional Media Tools and Learning Theory	■	

Though Dreamweaver and Flash can both implement all of the above mentioned

evaluative standards, the chart indicates which of the two learning tools is strongest

in each of the listed areas.

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