

A Bloom's Taxonomy with Digital Additions

Category of Learning	Existing Verbs	Digital Verbs
Remembering Recalling Information	Cite, Find, Group, List, Locate, Name, Recall, Reproduce, Retrieve, Select	Bullet point, Bookmark, Highlight, Search, Social bookmark, Social network
Understanding Explaining ideas or concepts	Attribute, Classify, Describe, Explain, Identify, Interpret, Outline, Recognize	Advanced/Boolean search, Annotate, Blog journal, Comment, Subscribe
Applying Using information in another familiar situation	Carry out, Execute, Construct, Implement, Manipulate, Perform, Sequence	Download, Operate, Play, Run, Share, Upload
Analyzing (Critical Thinking) Breaking information into parts to explore understandings and relationships	Arrange, Compare, Contrast, Deconstruct, Distinguish, Examine, Experiment, Infer, Order, Organize, Sequence, Structure, Summarize	Categorize, Hack, Link, Mash, Reverse engineer, Tag
Evaluating (Critical Thinking) Justifying a decision or course of action	Assess, Check, Critique, Detect, Determine, Differentiate, Judge, Measure, Monitor, Paraphrase, Prioritize, Test, Validate	Blog, Collaborate, Edit, Moderate, Network, Post, Test, Validate
Creating (Critical Thinking) Generating new ideas, products, or ways of viewing things	Construct, Design, Devise, Formulate, Hypothesize, Integrate, Invent, Make, Originate, Plan, Produce, Set Up, Synthesize,	Animate, Direct, Mix, Produce, Program, Publish

Introduction and Background

In the 1950's Benjamin Bloom developed his taxonomy of cognitive objectives, Bloom's Taxonomy. This categorized and ordered thinking skills and objectives. His taxonomy follows the thinking process. You cannot understand a concept if you do not first remember it, similarly you cannot apply knowledge and concepts if you do not understand them. It is a continuum from Lower Order Thinking Skills (LOTS) to Higher Order Thinking Skills (HOTS). Bloom labels each category with a gerund.

In the 1990's, a former student of Bloom, Lorin Anderson, revised Bloom's Taxonomy and published the Bloom's Revised Taxonomy in 2001. Key to this is the use of verbs rather than nouns for each of the categories and a rearrangement of the sequence within the taxonomy. They are arranged below in increasing order, from low to high.

Bloom's Revised Taxonomy Sub Categories

Each of the categories or taxonomic elements has a number of key verbs associated with it.

Lower Order Thinking Skills (LOTS)

- Remembering - listing, retrieving, naming, locating, finding
- Understanding - describing, identifying, recognizing, classifying, explaining, outlining, attributing, interpreting,
- Applying - implementing, carrying out, executing, constructing, performing

Higher Order Thinking Skills (HOTS) AKA Critical Thinking

- Analyzing - comparing, organizing, deconstructing, structuring, inferring, summarizing, experimenting,
- Evaluating - checking, critiquing, judging, testing, detecting, monitoring, paraphrasing,
- Creating - designing, constructing, planning, producing, inventing, devising, making, integrating, hypothesizing,

These elements cover many academic activities and objectives but they do not directly address the new student learning outcomes and objectives presented by the emergence and integration of Information and Communication Technologies into the classroom and the lives of contemporary students. Thus, this creation of a Bloom's for digital skills within an educational context.

Remembering

The digital additions and their explanations are as follows:

- Bullet pointing – This is analogous to listing but in a digital format.
- Highlighting – This is a key element of most productivity suites; encouraging students to pick out and highlight key words and phrases is a technique for recall.
- Bookmarking or favorite-ing – This is where the students mark, for later use, web sites, resources and files. Students can then organize these.
- Social networking – This is where the students develop networks of peers and associates. It forges and creates links and communication between different individuals. Like social bookmarks (see below) a social network can form a key element of collaborating and networking.
- Social bookmarking – This is an online version of local bookmarking or favorites. It is more advanced because you can draw on others' bookmarks and tags. While higher order thinking skills like collaborating and sharing can, and do, make use of these skills, this is its simplest form - a simple list of sites saved to an online format rather than locally to the machine.
- Searching or "Googling" - Search engines are now key elements of students' research. At its simplest the student is just entering a key word or phrase into the basic entry pane of the search engine. This skill does not refine the search beyond the key word or term.

Understanding

The digital additions and their explanations are as follows:

- Advanced and Boolean Searching – This is a progression from the previous category. Students require a greater depth of understanding to be able to create, modify and refine searches to suit their search needs.
- Blog Journaling – This is the simplest of the uses for a blog, where a student simply "talks", "writes", or "types" a daily, or task-specific journal. This demonstrates a basic understanding of the activity reported upon. The blog can be used to develop higher level thinking when used for discussion and collaboration.
- Twittering – The Twitter site's fundamental question is "what are you doing?" This can be, in its most simplistic form, a one or two word answer, but when developed this is a tool that lends itself to developing understanding and potentially starting collaboration.
- Commenting and annotating – A variety of tools exist that allow the user to comment and annotate on web pages, pdf files and other documents. The student is developing an understanding by simply commenting on the pages. This is analogous with writing notes on handouts, but is potentially more powerful as students can link and index these.

- Subscribing – Subscription takes bookmarking in its various forms and simplistic reading one level further. The act of subscription by itself does not show or develop understanding but often the process of reading and revisiting the subscribed-to feeds leads to greater understanding.

Applying

The digital additions and their justifications are as follows:

- Running and operating – This is the action of initiating a program or operating and manipulating hardware and applications to obtain a basic goal or objective.
- Playing – The increasing emergence of games as a mode of education leads to the inclusion of this term in the list. Students who successfully play or operate a game are showing understanding of process and task and application of skills.
- Uploading and Sharing - Uploading materials to websites and the sharing of materials is a simple form of collaboration, a higher order thinking skill.
- Downloading – This procedure is when a student electronically transfers a file from a website for his/her own use.

Analyzing

The digital additions and their explanations are as follows:

- Mashing – Mash ups are the integration of several data sources into a single resource. Mashing data currently is a complex process but as more options and sites evolve this will become an increasingly easy and accessible means of analysis.
- Categorizing – This is digital classification, that is, having students organize and classify files, web sites and materials using folders, etc.
- Linking – This is establishing and building links within and outside of documents and web pages.
- Reverse engineering – This is analogous with deconstruction of a program. It is also related to hacking often without the negative implications associated with this.
- Hacking – Hacking requires the analysis of how computer, phone, or other electronic systems work. The student must understand and operate the application or system and analyze its strengths and weaknesses for enhanced knowledge.
- Tagging – This is organizing, structuring and attributing online data, meta-tagging web pages, etc. Students need to be able understand and analyze the content of the pages to be able to tag it.

Evaluating

The digital additions and their explanations are as follows:

- Blog/vlog commenting and reflecting – Constructive criticism and reflective practice are often facilitated by the use of blogs and video blogs. Students commenting and replying to postings have to evaluate the material in context and reply.
- Editing – With most media, editing is a process or a procedure that the student employs to adjust and enhance materials based on a standard or set of rules.
- Posting – Posting comments to blogs, discussion boards, threaded discussions are increasingly common elements of students' daily practice. Good postings like good comments, are not simple one-line answers but rather are structured and constructed to evaluate the topic or concept.
- Moderating – This is high-level evaluation; the moderator must be able to evaluate a posting or comment from a variety of perspectives, assessing its worth, value and appropriateness.
- Collaborating and networking – Collaboration is an increasing feature of education. In a world increasingly focused on communication, collaboration leading to collective intelligence is a key aspect. Effective collaboration involves evaluating the strengths and abilities of the participants and evaluating the contribution they make. Networking is a feature of collaboration, contacting and communicating with relevant individual via a network of associates.
- Validating – With the wealth of information available to students combined with the lack of authentication of data, students of today and tomorrow must be able to validate the veracity of their information sources. To do this they must be able to analyze the data sources and make judgments based on these.
- Testing (Alpha and Beta) – Testing of applications, processes and procedures is a key element in the development of any tool. To be an effective tester the student must have the ability to analyze the purpose of the tool or process, what its correct function should be and what its current function is.

Creating

The digital additions and their explanations are as follows:

- Programming – Whether it is creating their own applications, programming macros or developing games or multimedia applications within structured environments, students are routinely creating their own programs to suit their needs and goals.
- Filming, animating, videocasting, podcasting, mixing and remixing – These relate to the increasing availability of multimedia and multimedia editing tools. Students frequently capture, create, mix and remix content to produce unique products.

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- Directing and producing – Directing or producing a product, performance or production is a highly creative process. It requires the student to have vision, understand the components and meld these into a coherent product.
- Publishing – Whether via the web or from home computers, publishing in text, media or digital formats is increasing. Again this requires a huge overview of not only the content being published, but also the process and product. Related to this concept are also Video blogging – the production of video blogs, blogging--and also wiki-ing - creating, adding to and modify content in wikis. Creating or building mash ups would also fit here.

Bibliography

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