# The Technology Driven Student: How to Apply Bloom's Revised Taxonomy to the Digital Generations

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## Abstract

*A growing concern is being voiced on educating the modern digital student. As of now, the landscape of education can be considered that of a revolution with technology being the engine powering it. The proliferation of technology has given birth to the biggest generational gap since the induction of rock and roll music; however the field of education has yet to structure teaching and learning to match the millennial generation. This article does not propose an update to Bloom's Revised Taxonomy, but rather calls attention to the need of adapting the revised taxonomy to a new generation of students. This theoretical piece presents an overview of the evolution of Bloom's Original Taxonomy to Bloom's Revised Taxonomy to the start of what is termed Bloom's Digital Taxonomy. The authors argue that current restrictions on the use of technology in the classroom, although well intentioned, fail to build a connection between the classroom and reality. Education has been a cornerstone of human life and success, and if educators are to keep the interest of the youth, adaptation and modification may be necessary.*

**Keywords:** Millennials, Generation Y, Boomerang Generation, Peter Pan Generation, Generation Me, and Echo Boomers

## *1. Introduction*

*"The dogmas of the quiet past are inadequate to the stormy present. The occasion is piled high with difficulty. As our case is new, so we must think anew and act anew. We must disenthrall ourselves and then we shall save our country." Abraham Lincoln, Second Annual Message to Congress, December 1, 1862*

Since the time of Aristotle, Socrates and Plato, education has been viewed as a foundational pillar to better one's life. Through the Socratic method, Plato's *Republic,* and Aristotle's belief that societal quality is determined on the grounds of its education, these historical ideologies are still as relevant today as they were in the past (Johnson, Musial, Hall & Gollnick, 2013). However, the field of education and how students learn have changed drastically through the passage of time. It wasn't until the 1950's that educators understood how students learned and reasoned in a classroom setting thanks to Bloom's Taxonomy. This taxonomy was developed as a framework to classify statements of what educators expect their students to learn through the process of instruction (Krathwohl, 2002). The Taxonomy itself has had considerable impact on the field of education as Bloom, Englehart, Furst, Hill and Krathwohl (1956) asserted "the taxonomy must be accepted and used by workers in the field if it is to be regarded as a useful and effective tool" (p. 24). In addition, it includes properties that deal with both educational and psychological issues.

The educational issues categorized objectives "to facilitate communication" while psychological issues helped categorized objectives making them "consistent with relevant and accepted psychological principles and theories" (Bloom et al., 1956, p. 6).

## *2. The Problem*

Educators use Bloom's Taxonomy and Bloom's Revised Taxonomy as a necessary and vital hierarchical instructional set of cognitive processes designed to structure appropriate learning experiences with the hope of positive academic outcomes for their students. Granted, these approaches have worked in the past and still do, however the field of education has yet to structure teaching and learning to match the coming digital generations. It is no secret that many forms of technology (i.e. wikis, blogs, education games, apps, etc.) exist and are available to students at little or no cost. However, if educators were to use these forms of technology correctly or in conjunction with lesson planning, the bridge between education and technology would be lessened. The problem is that technological innovations need to be transformed from tools of obsession into tools of education. Instructional technology has altered the way students are learning making them 21st century learners, but have teachers become 21st century educators? Collaboration is not only a 21st skill but has been deemed essential to move forward (Churches, 2009). Collaboration, in this context, does not refer to people working together, but the fusion of traditional frameworks and theories with technology to enrich the learning experience and excite student curiosity.

## *3. The Purpose*

This expose does not propose an update to Bloom's Revised Taxonomy as practitioners consistently use it to create and align objectives, lessons, and assessments to achieve all cognitive levels within the classroom (Anderson & Krathworthl, 2001; Joyce & Weil, 1996). Rather the intent is to focus attention to the need of adapting this framework to a newer generation of technology driven students (i.e. Millennials). The call for an updated adaptation of Bloom to a new generation is validated by the Millennial Generation as they bring about new educational and social characteristics that are unprecedented (Taylor, 2005). Much credit is given to Andrew Churches' (2009) idea to conceptualize a platform to learn through the use of technology (i.e. Bloom's Digital Taxonomy) to where technological tools are used as learning objects. These objects are able to promote journal writing, collaboration, role-playing and real-life problem-based learning (Cheal, 2007). Cheal continues in that the theory behind this type of learning is termed constructivism, which according to Bloom produces the highest form of learning in which student evaluate and create knowledge.

## *4. 1st Generation: Bloom's Taxonomy*

Bloom's taxonomy is arguably one of the most influential works in field of education (Richard, 1985). Although research on the taxonomy is primarily focused on the cognitive domain because of its application in secondary and postsecondary settings (Chyung, 2003), Bloom et al. (1956) categorized learning into three behavioral domains: cognitive, affective, and psychomotor. To further these categories, the authors organized the domains into simple and complex classifications. Benjamin Bloom originated the idea for the taxonomy in hopes to reduce teacher preparation for comprehensive exams (Krathwohl, 2002). To do so, Bloom recruited a group of specialists that met twice a year beginning in 1949, with the finalized draft being under the title *Taxonomy of Educational Objectives: The Classification of Educational Goals. Handbook I: Cognitive Domain* (Bloom et al., 1956). According to Krathwohl (2002, p. 212), Bloom held that the Taxonomy could be used as a tool for the following:

- common language about learning goals to facilitate communication across persons, subject matter, and grade levels;
- basis for determining for a particular course or curriculum the specific meaning of broad educational goals, such as those found in the currently prevalent national, state, and local standards;
- means for determining the congruence of educational objectives, activities, and assessments in a unit, course, or curriculum; and
- Panorama of the range of educational possibilities against which the limited breadth and depth of any particular educational course or curriculum could be contrasted.

More specifically, the taxonomy was meant to be a philosophical scheme used to represent a multitude of goals in a neutral way (Bloom et al., 1956, p. 14). This *neutrality* was meant in respect to source such as philosophy of education and the relative worth of goals (Furst, 1981).

The creators of the original taxonomy made claims that its properties concerned educational and psychological issues alike (Seddon, 1978). Specifically, the educational issues were concerned with the categorization of the educational objectives "to facilitate communication" (Bloom et al., 1956, p. 10) while the psychological issues ordered the categories to stay "consistent with relevant and accepted psychological principles and theories" (Bloom et al., 1956, p. 6). However, educational objectives were not included as Bloom and his team ruled out specific goals that did not relate to student behaviors (Bloom et al., 1956).

The original taxonomy consisted of six levels: *knowledge, comprehension, application, analysis, synthesis and evaluation* (Bloom et al., 1956) with each having their own carefully developed definitions (Krathwohl, 2002). These categories were chosen to reflect the distinction that was believed that teachers were already making among student behaviors (Bloom et al., 1956). The structure of the original Taxonomy can be seen in Appendix A. The proposed categories were arranged from simple to complex as well and concrete to abstract. To further its structure, Krathwohl (2002) asserted that the Taxonomy represented a hierarchy, in that each category was seen as a prerequisite to the next.

## *5. 2nd Generation: Bloom's Revised Taxonomy*

A revised version of Blooms Taxonomy was developed 45 years later in the same manner as the original (Anderson, Krathwohl & Bloom, 2001), but there were a number of significant changes. The authors note that although the original number of categories (six) remained the same, three categories were renamed, two categories were re-ordered, and the three categories names that remained were changed to their verb tenses to match the way they were used in the objectives. This revision of the original Taxonomy moved the model towards a two-dimensional framework that addresses both knowledge and cognitive processes (Krathwohl, 2002). Roslin Growe (2011) agreed with the two-dimensional approach by affirming "this new era has brought about a dynamic, exciting, frustrating and complex assessment of how to best prepare students for the changing skills set needed to be successful" (p.1). That the reconfigured design in curriculum development tends to point to the connection between how traditional knowledge transmission is becoming obsolete and being retooled based on specific driving forces.

### 5.1. Knowledge Dimension

Similar to the original model, knowledge is categorized in the revised model cross subject matter lines (Krathwohl, 2002). The major change in this dimension is that it contains four main categories instead of the original three. The three original categories were restructured to use the appropriate terminology to make the distinctions of cognitive psychology, but the fourth (Metacognitive knowledge) includes knowledge about cognition as well as the mindfulness about one's own cognition (Krathwohl, 2002). The structure of the knowledge dimension can be seen in Appendix B.

### 5.2. Cognitive Dimension

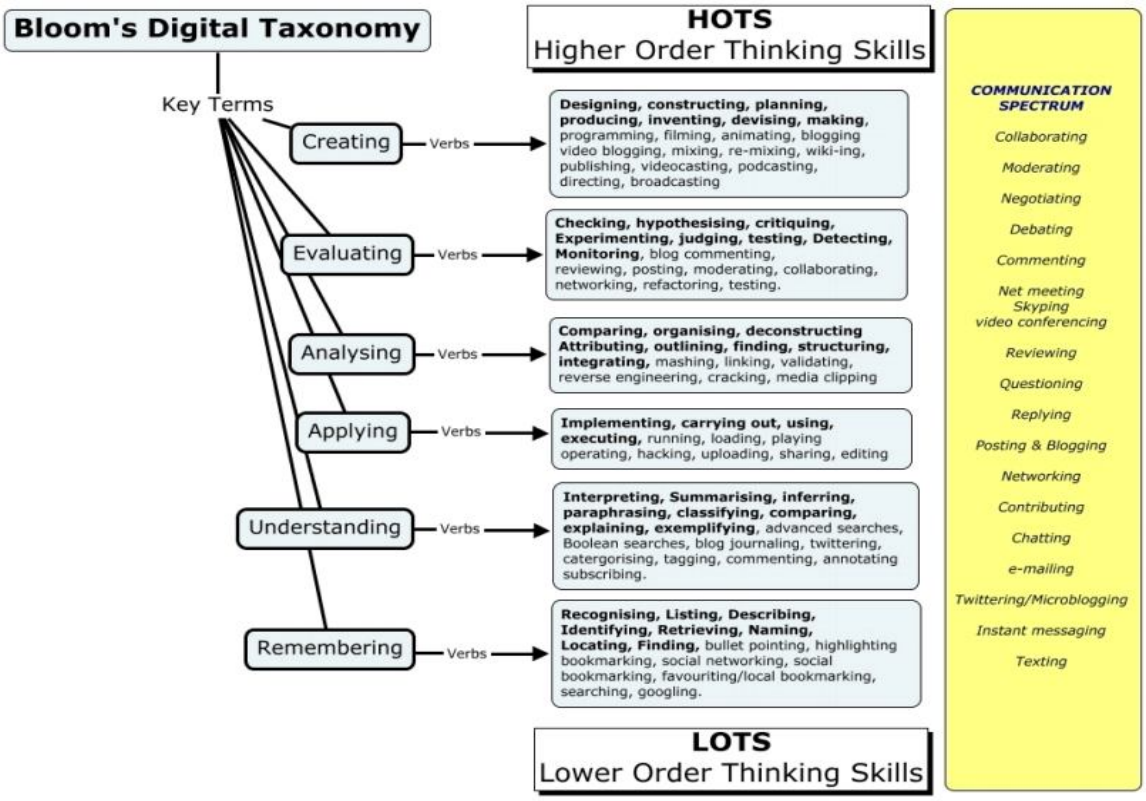
The six originally categories of this dimension were retained, but important changes were made. According to Krathwohl (2002) three categories were renamed, the two categories that keep the original names changed to the verb form to stay in line with objectives, and their order was interchanged. The author continues in that *knowledge* was changed to **remember** and *comprehension* was changed to **understand** as they saw it to be a widespread synonym for comprehending. The remaining dimensions: *application, analysis* and *evaluation* were changed to their verbs forms of **apply, analyze,** and **evaluate**. Finally *synthesis* was renamed to **create**. Ultimately, the revisions made provided breadth and depth to each category and their process in the cognitive domain (Krathwohl, 2002). The structure of the cognitive dimension can be seen in Appendix C.

Overall, the Taxonomy of Educational Objectives was created to classify goals, objectives, and standards that must be met by educators (Krathwohl, 2002). Its current structure provides meaning to the objectives therefore enhancing communication.

## *6. Bloom's Taxonomy: A Digital Update*

As of now, the landscape of education can be considered that of a revolution with technology being the engine powering it. The proliferation of digital technology has given birth to the biggest generational gap since the induction of rock and roll music (Robinson, 2011); hence this article calls for an update to Bloom's revised taxonomy. Granted this is not a call for restructure, but an attempt to account for new behaviors and actions that have developed through the use of educational technology.

An example of the changes happening can be found in the use of language today. In the past decade, new technological verbs have emerged as descriptors for the communication tools used on sites (i.e. googling, tweeting and podcasting). The primary purpose of technology is to act as an educational aid to help teachers facilitate learning, which in turn is the ultimate purpose of education. Sir Ken Robinson summed up the role of education best stating, "education is not only a preparation for what may come later; it is also about helping people engage with the present" (Robinson, 2011, p. 59).




**Source: Churches, 2009**

Andrew Churches first proposed the idea of "Bloom's Digital Taxonomy" in 2001 and noted that this taxonomy is "not restricted to the cognitive domain rather it contains cognitive elements as well as methods and tooling" (Churches, 2009, p. 2). In development of Bloom's Digital Taxonomy, Churches (2008) added a number of digital additions to each key term in Blooms' Revised Taxonomy, which can be found in Appendix D. Churches (2009), fused the Revised Taxonomy to the digital age by adding in ways to use Web 2.0 technologies to each cognitive level as shown in Figure 1. Although the hierarchical arrangement of categories is retained from Bloom's Revised Taxonomy, the digital taxonomy asserts that lower-level skills such as searching can be used and learning within the context of critical thinking activities (Munzenmaier & Rubin, 2013). Churches' proposal did not alter the content of the revised taxonomy as the key terms remain the same, but the verb list has grown to incorporate terms used with technology.

## *7. The Generational Paradigm Shift*

Over the past few years, there has been a decline in the American education system, but there is a critical flaw that has been overlooked. Today's students have radically changed the way they learn and absorb information. These students represent the first generation to grow up with advanced versions of technology, specifically educational technology (Prenksy, 2001).

"There is a growing appreciation that the old approach [of didactic teaching] is ill-suited to the intellectual, social, motivational, and emotional needs of the new generation" (Tapscott, 1998, p. 131). In addition, language barriers have prohibited advancement and there is no exception in its relation to education and technology. What is indisputable is that fact that these new generations of students have been heavily influenced by the incorporation of information technology (IT) into their lives (Oblinger, 2003). Therefore the best question to ask is how do we educate these newer generations? More specifically, how do we educate the Millennial Generation?

### 7.1. The Millennial Generation

Given the characteristics that define them (i.e. globalization, rapid technological advancement, increasing demographic diversity) a multitude of authors have labeled them as Generation Y, Millennials, Nexters, and the Nexus Generations (Barnard, Cosgrave & Welsh, 1998; Burke & Ng, 2006; Zemke, Raines & Filipczak, 2000). For the purpose of this article, the authors will use the term "Millennials." In reviewing the popular literature, Ng, Schweitzer and Lyons (2010) found that the millennial generation "want it all" and "want it now," when it comes to benefits, compensation and career advancement, work/life balance, self gratifying work and societal contributions. Michele Monaco (2007) observes in her writing, notable characteristics of Millennial students as "lacking professional boundaries influenced by socialization, a need to have immediate feedback, a sense of entitlement, lack of critical thinking skills, unrealistic expectations, high level of parental involvement, and an expected "how to" guide to succeed in and out of the classroom" (p. 42). This frame of thinking could be partially due to Millennials having access to more information that any other generation that preceded them because of IT (Foehr, 2006; Lenhart, Arafeh, Smith & Macgill, 2008; Lenhart & Madden, 2005; Lenhart, Madden & Hitlin, 2005; Rideout, Roberts & Foehr, 2005). Millennials used technology extensively but this has aided the creation of a false sense of competency and misconceptions among adults that society's youth are "media savvy" (Considine, Horton, & Moorman, 2009). Although this generation has developed newfangled outlooks, attitudes and characteristics as result of their environment, an imbalance may have been created between student expectations and experiences found in higher educational institutions (Oblinger, 2003).

The idea that Millennials place a high value on technology was validated with the Pew Internet & American Life Project. Lenhart et al. (2005) interviewed a sample of 1,100 American 12 to 17-year-olds and a parent/guardian. It was found that 84% reported owning at least one personal media device, 87% uses the Internet and 51% reported going online daily. Thusly, this study found that the millennial generation is more likely to use technology to communicate with friends and peers (Considine, Horton, & Moorman, 2009).

This new generation, termed the "Millennial generation," is now entering higher education and has many different characteristics in comparison to their siblings who are just a few years older. Strauss and Howe (2000) highlight seven characteristics that all Millennials share: "special; sheltered; confident; conventional; team-oriented; achieving and pressure" (p. 9). It must be noted, that Millennials are not just consumers of Internet content, but are engaged in the creation of content as well (Lenhart & Madden, 2005). This content includes, but is not limited to artwork, photographs, stories, videos; web pages, blog creation and online journals (Considine, Horton, & Moorman, 2009)

## *8. Teaching the New Generational Paradigm*

Although educational institutions mean well, public school place heavy restrictions on the use of the Internet. These protections and restrictions, although well intentioned, fail to build a bridge between the technological world and the classroom that Millennials experience (Considine, Horton, & Moorman, 2009). In terms of crisis, educators need to address the perception that students' believe school to be boring and irrelevant to life preparation (Strauss & Howe, 2006; Prensky, 2008).

There is a fundamental difference between the Millennials and previous generations. The Millennials' tend to refer to themselves as the "us generation" whereas the Bloomers consider themselves as the "me generation" (Koeller, 2012). It is because of this difference that the Millennials value interaction and collaboration with their peers and are no longer restricted to brick and mortar classrooms. With innovations like Adobe Connect, Skype and Google Hangouts, group work can be facilitated at anytime maximizing productivity between peers. Millennials now expect a vast amount of learning options and educational services to be offered from colleges and universities (Koeller, 2012). These instructional strategies and learning opportunities are needed in classrooms in order to keep student attention on learning.

Tools such as Ipads, Kindles and their applications along with instructional YouTube videos can provide instructional differentiation. In addition, these tools address the Millennial's short diminishing attention span by re-enforcing material covered in class in different formats. The particular forms of educational technology come with a caveat, however. These forms of educational technology expose students to a plethora of information, but fail in giving them the ability to reflect on the content they are exposed to (Koeller, 2012). It is for this reason that educational technology must be used in conjunction with traditional teaching pedagogy.

## *9. Implications and Conclusion*

The relationship between practice and theory in the knowledge of teaching and professional development of teachers has been a long-standing debate in teacher education, but the most controversial topic has been technology (Tomei, 2005). It is important to make teaching and learning personal to students, particularly the Millennial Generation (Koeller, 2012) and generations to come. Although his claims have been deliberated, Prensky (2001) was correct in stating that future professional development should focus on the use of technology and its necessity in education. Looking at theory, technology has a number of uses including: (1) an understanding of basic operations and concepts, (2) enhancing productivity and professional preparation and (3) and understanding of social, ethical, legal and human issues of technology use in educational institutions (Tomei, 2005). With concern to practical application technology may aid in designing efficient and effective learning environments and experiences, curriculums that enhance student learning, and offer a vast number of instructional strategies (ISTE, 2003).

Many teachers are dependent on the assertion that their students possess the technical skills to effectively use technology in the classroom. Hence, classroom learning is at its best in the presence of teachers and students learning together (Tomei, 2005). Education is constantly moving forward and the instructional philosophy we use decide to used will be a critical factor in how the students of today and the engaged citizen of tomorrow is educated. The use of technology in the classroom should not over power the constructs in the previous versions of Bloom's Taxonomy, but used to improve and facilitate instruction.

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## Appendix A: Structure of Bloom's Original Taxonomy

**Structure of the Knowledge Dimension of the Revised Taxonomy**

- ***A. Factual Knowledge*** – The basic elements that students must know to be acquainted with a discipline or solve problems in it.
  - **Aa. Knowledge of terminology**
  - **Ab. Knowledge of specific details and elements**
- ***B. Conceptual Knowledge*** – The interrelationships among the basic elements within a larger structure that enable them to function together.
  - **Ba. Knowledge of classifications and categories**
  - **Bb. Knowledge of principles and generalizations**
  - **Bc. Knowledge of theories, models, and structures**
- ***C. Procedural Knowledge*** – How to do something; methods of inquiry, and criteria for using skills**,** algorithms, techniques, and methods.
  - **Ca. Knowledge of subject-specific skills and algorithms**
  - **Cb. Knowledge of subject-specific techniques and methods**
  - **Cc. Knowledge of criteria for determining when to use appropriate procedures**
- ***D. Metacognitive Knowledge*** – Knowledge of cognition in general as well as awareness and knowledge of one's own cognition.
  - **Da. Strategic knowledge**
  - **Db. Knowledge abut cognitive tasks, including appropriate contextual and conditional knowledge**
  - **Dc. Self-knowledge**

**Source: Krathwohl, 2002**

## Appendix B: Structure of the Knowledge Dimension of the Revised Taxonomy

**Structure of the Original Taxonomy**

*1.0 Knowledge*
*Knowledge of specifics*
*Knowledge of terminology*
*Knowledge of specific facts*
*Knowledge of ways and means of dealing with specifics*
*Knowledge of conventions*
*Knowledge of trends and sequences*
*Knowledge of classification and categories*
*Knowledge of criteria*
*Knowledge of methodology*
*Knowledge of universals and abstractions in a field*
*Knowledge of principles and generalizations*
*Knowledge of theories and structures*
*Comprehension*
*Translation*
*Interpretation*
*Extrapolation*
*Application*
*Analysis*
*Analysis of elements*
*Analysis of relationships*
*Analysis of organizational principles*
*Synthesis*
*Production of a unique communication*
*Production of a plan, or proposed set of operations*
*Derivation of a set of abstract relations*
*Evaluation*
*Evaluation in terms of internal evidence*
*Judgments in terms of external criteria*

**Source: Krathwohl, 2002**

## Appendix C: Structure of the Cognitive Process Dimension of the Revised Taxonomy

**Structure of the Cognitive Process Dimension of the Revised Taxonomy**

***1.0 Remember*** – Retrieving relevant knowledge from long-term memory.
- ***1.1 Recognizing***
- ***1.2 Recalling***

***2.0 Understand*** – Determining the meaning of instructional messages, including oral, written, and graphic communication.
- ***2.1 Interpreting***
- ***2.2 Exemplifying***
- ***2.3 Classifying***
- ***2.4 Summarizing***
- ***2.5 Inferring***
- ***2.6 Comparing***
- ***2.7 Explaining***

***3.0 Apply*** – Carrying out or using a procedure in a given situation.
- ***3.1 Executing***
- ***3.2 Implementing***

***4.0 Analyze*** – Breaking material into its constituent parts and detecting how the parts relate to one another and to an overall structure or purpose.
- ***4.1 Differentiating***
- ***4.2 Organizing***
- ***4.3 Attributing***

***5.0 Evaluate*** – Making judgments based on criteria and standards.
- ***5.1 Checking***
- ***5.2 Critiquing***

***6.0 Create*** – Putting elements together to form a novel, coherent whole or make an original product.
- ***6.1 Generating***
- ***6.2 Planning***
- ***6.3 Producing***

**Source: Krathwohl, 2002**

## Appendix D: Bloom's Digital Taxonomy

| Key Terms | Digital Additions | Operational Definitions |
|---|---|---|
| **Remembering** | Bullet pointing | This is analogous to listing but in a digital format. |
| | Highlighting | This is a key element of most productivity suites; encouraging to pick out and highlight key words and phrases is a technique for recall. |
| | Bookmarking or Favorite-ing | Where students mark and organize web sites, resources and files for later use. |
| | Social networking | Where people develop networks of friends and associates. It forges and creates links between different people. |
| | Social bookmarking | An advanced online version of local bookmarking of favorites. Enables a person to draw on others' bookmarks and tags. |
| | Googling | Key elements of student research. This skill does not refine the search beyond the key word or search term. |
| **Understanding** | Advanced and Boolean Searching | Progression from the previous category. Students require a greater understanding to be able to create, modify and refine searches to suit research needs. |
| | Blog journaling | Simplest use of a blog. Student writes or types a daily or task-specific journal to show basic understanding of the activity reported. |
| | Twittering | Twitter site's fundamental question is "what are you doing?" The most simplistic answer can be in the form of a one or two word answer. More developed answers promote understanding and collaboration. |
| | Categorizing | Digital classification of files, websites and materials through the use of folders. |
| | Commenting and annotating | Develop understanding by commenting on the visited web pages, but is more powerful as the student can link and index pages. |
| | Subscribing | The act of subscribing to websites allows for the process of reading and revisiting the feeds for greater understanding. |
| **Applying** | Running and operating | Act of initiating a program or operating and manipulating hardware and application to obtain a basic goal or objective. |
| | Playing | Students who successfully play or operate a game are showing understanding of process, task, and application of skills. |
| | Uploading and sharing | Simple form of collaboration through uploading materials to websites and the sharing of materials via sites like flickr, dropbox, etc. |
| | Hacking | Hacking in its simpler forms is applying a simple set of rules to achieve a goal or objective. |
| | Editing | With most media, editing is a process or procedure that the editor employs. |
| **Analyzing** | Mashing | Mashing data is currently a complex process with the integration of several data sources into a single resource. |
| | Linking | Establishing and building links within and outside of documents and WebPages. |
| | Reverse-engineering | Analogous with deconstruction. |
| | Cracking | Understanding and operation of the system being cracked. Analyze its strengths and weaknesses and exploit these. |
| | Validating | Analyze sources and make judgments based on what information is available. |
| | Tagging | Organizing, structuring and attributing online data, meta-tagging web pages. |
| **Evaluating** | 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. |
| | Posting | Good postings are not simple one-line answers, but are structured and constructed to evaluate the topic or concept. |
| | Moderating | Moderator must be able to evaluate a posting or comment from a variety of perspectives, assessing its worth, value and appropriateness. |
| | Collaborating and networking | 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 people via a network of associates. |
| | Testing | Testing of applications, process and procedures is a key element in the development of any tool. Effective testers 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** | Programming | Whether 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, video casting, podcasting, mixing and remixing | Students frequently capture, create, mix and remix content to produce unique products. |
| | Directing and producing | A highly creative process that requires the student to have vision and understand the components and meld these into a coherent product. |
| | Publishing | Whether via the web or from home computers, publish in text, media or digital formats is increasing. The student requires a massive overview of the content being published as well as the process and product. |