What should We Teach in Higher Education for the MOOC Era? A Review of Taxonomies as Design Guide

Katsuaki Suzuki **Yuki Ichimura** **Peter Roux**
ksuzuki@kumamoto-u.ac.jp **{yichimura, proux}@st.gsis.kumamoto-u.ac.jp**
Professor **Doctoral Student** **Doctoral Student**

Kumamoto University
Kumamoto, Japan

Abstract: If the knowledge that has traditionally been taught in colleges becomes available for free with MOOCs and search engines, what should be taught? This paper reviews taxonomies as guides to re-design college curriculum beyond knowledge, including Bloom's, Gagne's, Reigeluth's, and Perry's frameworks. It is argued that "more knowledge" should not be the goal of higher education, nor should it be generic 21st century skills per se; rather, a commitment to an area of study, together with the love of learning together should be paramount.

Keywords: taxonomy, higher education, commitment, love of learning together

Introduction

If the knowledge that has been taught in colleges becomes available for free on Massive Open Online Courses (MOOCs) and with search engines, what should we teach then? Although MOOC was "educational buzzword of 2012" only some years ago, 4200 courses had been created at 550 universities in 2015, and total student enrolment had reached 35 million in 2015, which was almost double from the previous year (Class Central, 2015). Their rapid penetration cannot be ignored, which is a good opportunity for colleges to re-think what they are teaching today as in the days before MOOCs.

Researchers in educational media and technology are interested in how the latest technology can be incorporated to improve education and trends include the flipped classroom, active learning, blended e-learning, and e-portfolio. It is important to try to utilize what has become available to improve education. However, it is more important to make sure where we are heading; i.e., what the goals of college education are, especially given the rapid changes in society. The roles of college should be reconsidered to prepare graduates to the world of the future.

To guide the re-designing of college education beyond the mere dissemination of knowledge, we reviewed taxonomies and frameworks proposed to date.

Bloom's Taxonomy of Educational Objectives

Bloom's Taxonomy of Educational Objectives (Bloom, et al, 1956) is probably the best-known scheme when we examine the goals of education. It was the result of a project called for by the American Psychological Association (APA) in 1948 to facilitate smooth communication between researchers who

were making examinations in colleges. The researchers gathered examination questions, categorized them one by one and broke them up into several levels, inductively through a bottom-up approach (Table 1).

Behind the attempt, there was a criticism of "language-oriented education based on rote learning" around that time. At the Knowledge level, students only repeat what they learn (so called rote learning). But, at and above the Comprehension level, students are required to think for themselves, to translate, to interpret and to extrapolate. The message was that we should not make examinations for the sole purpose of checking learners' knowledge. It also told us that we can upgrade the goals of education by making higher-level examination questions without sticking to Knowledge level. This notion is still important now, 60 years later from this discussion.

Revision efforts of Bloom's taxonomy include Anderson's revision (Anderson & Krathwohl, 2001), who adopted two dimensions of cognitive process and knowledge itself, while Bloom's original had only one dimension of cognitive process in his taxonomy. Anderson added to the dimension of knowledge itself, suggesting four main structures: (A) Factual, (B) Conceptual, (C) Procedural, and (D) Metacognitive Knowledge. Metacognitive knowledge was not included in Bloom's framework. To represent what is to be done with or to that content knowledge, Anderson adopted verbs to Bloom's taxonomy and made some alterations in the levels, including flipping the levels of 5.0 and 6.0 (Table 1).

Table 1

Revision Efforts of Bloom's Taxonomy

6.0	Evaluation	Creating	Self-System
5.0	Synthesis	Evaluating	Metacognitive System
4.0	Analysis	Analyzing	Cognitive System (Knowledge Utilization)
3.0	Application	Applying	Cognitive System (Analysis)
2.0	Comprehension	Understanding	Cognitive System (Comprehension)
1.0	Knowledge	Remembering	Cognitive System (Knowledge Retrieval)
	Original (Bloom)	Anderson's Revision (2001)	Marzano's New Taxonomy (2000)

In contrast, Marzano's (2000, 2007) revisions proposed a division of the knowledge domain into three kinds: (1) Information, (2) Mental Procedures, and (3) Physical Procedures, in which three types of Systems (Cognitive, Metacognitive, and Self-System) function in different ways. The Cognitive System has a similar hierarchy of 1.0: Knowledge Retrieval, 2.0: Comprehension, 3.0: Analysis, and 4.0: Knowledge Utilization, as shown in Table 1. On the other hand, the 5.0: Metacognition System includes functions of specifying learning goals, and monitoring the execution of knowledge, clarity and accuracy. It is a major difference from Anderson's revision, where Metacognitive Knowledge is placed as a kind of

knowledge itself, but here placed as a higher-order function to all kinds of knowledge. The 6.0: Self-System includes beliefs about the importance of knowledge about self-efficacy, and one's own emotions associated with the knowledge, which was in Affective domain separately in Bloom's original framework.

It was not a new idea of Anderson nor Marzano to have two dimensions in classifying learning objectives. Merrill (1983) proposed to classify learning objectives based on a two-dimensional matrix of Performance (What does the learner do?) and Content (What does the learner deal with?), as shown in Figure 1. Performance is divided into three levels: Remember, Use, and Find. The content is divided into four types: Fact, Concept, Procedure, and Principle. Since the objective of Fact is merely to remember (i.e., not to use or to find), the two cells are shaded as shown in Figure 1.

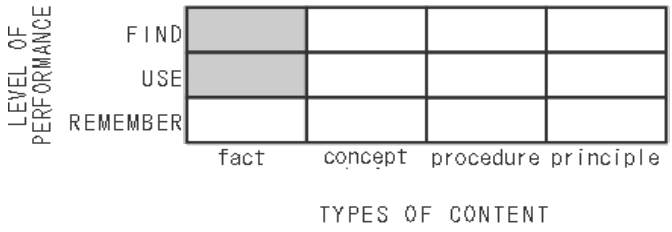

Figure 1. *Behavior-Object Matrix (Merrill, 1983, p.286)*

Gagne's Taxonomy of Learning Outcomes

Gagne's taxonomy of learning outcomes is to classify different kinds of learning outcomes that call for different kinds of internal information processes, which in turn call for different kinds of external help to facilitate internal processes of learning (Gagne, et al, 2005). The series of external events to facilitate internal processes that constitute learning is known as the night events of instruction (Gagne, et al., 2005), which is the second main contribution of this theorist. Gagne (1977) proposed five kinds of outcomes: Intellectual Skills, Verbal Information, Cognitive Strategies, Motor Skills, and Attitudes, whereas Bloom's taxonomy has three domains of Cognitive, Affective, and Psychomotor. Learning outcomes in Bloom's cognitive domain are grouped into three dimensions: Intellectual Skills, Verbal Information, and Cognitive Strategy. Among these, Intellectual Skills have subcategories set by Gagne, based on his research findings over the years (Gagne, 1977).

Categorization of educational objectives proposed by Gagne is not based on the difficulty levels of learning tasks, except for the sub-categories within Intellectual Skill domain, but on qualitative differences of learning outcomes. Focusing on the differences in necessary conditions for learning and evaluation, it has become a major framework in designing instruction. Accordingly, hints for effective instructional methods for each outcome can be obtained as instructional strategy (methods to implement differently the nine events of instruction) . Instructional objectives belonging to the same category have

the same conditions to promote their achievement and such common conditions can be shared widely. So, when you wonder why a certain method successfully teaches a certain learning task, the answer can be pursued in terms of Gagne's categories of the learning outcomes. It is also possible to judge to what extent similar teaching methods can be effectively applied for teaching different subject matters, or for different grade levels.

Revisions or extensions of Gagne's taxonomy should be sought out whenever research reveals qualitative differences in the internal processes of learning that calls for different sets of external conditions to make instruction more effective. Martin & Briggs (1986) suggest ways to succeed and expand Gagne's taxonomy in the attitude domain. Later work by Jonassen (2011) in proposing a taxonomy of problem solving subdomain of Gagne's intellectual skills can also be considered as a refinement of the taxonomy with the same intention of guiding the design of instruction.

Reigeluth's Model of the Learner-Centered Paradigm

Reigeluth et al. (2017) propose a paradigm shift in education by integrating instructional design with assessment and curriculum theories. For a learner-centered paradigm of education, they suggest that the following are highly valued as the outcomes of education:

- Development of intrinsic motivation and love of learning.
- Development of learner self-regulation skills (how to learn).
- Mastery of knowledge and skills, including transfer to varied and real-world contexts.
- Development of collaboration skills.
- Emotional, social, and character development, including empathy and desire to contribute to one's community. (p. 7)

To realize these outcomes for education, Reigeluth et al. (2017) propose an attainment-based, task-centered and personalized instruction, where pace, content, and method of instruction and assessment are customized for each learner (based on individual needs, interests, talents, and goals). Learners should typically learn by doing, in an authentic task-centered and challenging environment that is risk-free. Just-in-time support is provided by teachers, and learning is enhanced by peers through collaboration. The leaner-centered paradigm calls for changed roles of teachers (to assist learners in setting goals, designing or selecting tasks, facilitating task performance, facilitating learning, evaluating performance and learning, mentoring the learner), as well as learners (to be an active learner, self-regulated learner, and learner as teacher). Technology should play new roles of recordkeeping for learning, planning for learning, instruction for learning, and assessment for/of learning in the leaner-centered paradigm.

Reigeluth et al. (2017) call for a fundamentally restructured curriculum, replacing the four pillars of math, English, science, and social studies (MESS) with four new pillars of (1) thinking effectively, (2) relating effectively, (3) acting effectively, and (4) accomplishing effectively, based on Prensky's (2014) idea of P-16 curriculum for Volatility-Uncertainty-Complexity-Ambiguity (VUCA) world.

Perry's Model of Intellectual and Ethical Development

Based on an interview series at Harvard University in 1950-60's, Perry developed a 9-stage model of intellectual and ethical development which, with modification, is widely used in college teaching. Table 2 shows an example from a student's perspective, simplified across four stages.

Table 2.

A student's perspective of Perry's stage of cognitive development

	Dualism	Multiplicity	Relativism	Commitment
Knowledge perspective	I believe knowledge is either right or wrong, good or bad. Answers exist somewhere for every problem and authorities know them. Knowledge is quantitative.	When authorities do not know the answer, everyone has a right to their own opinion; none can be called wrong. Authorities are still searching for the answer.	I view knowledge in relation to context---everything is valid, but not always equal. Point of view is relevant. I evaluate knowledge based on evidence and logic. Knowledge is qualitative.	I make a commitment, an affirmation, or a decision. Major commitments include choosing a career, choosing religious and political affiliations, and choosing a mate.
Instructor	She is responsible for teaching me. She is the ultimate source of my learning.	He is the authority on the topic; he will provide the answers to difficult questions.	She provides guidance and sources of learning. She facilitates discussion. She challenges me to create new questions.	He is interested in my commitment, affirmation, or decision. He allows me to form my own opinion.
Goal of learning	Learning is mastered by memorizing. I memorize facts, dates, places, and events.	I comprehend the material. I do not just memorize it. I begin to see the importance of ideas.	I apply and analyze what I am learning. I consider differing points of view and grapple with difficult issues.	I synthesize and evaluate the information. I form an opinion and seek personal relevance.
Expectations	Please tell me what to learn. Stick to the syllabus. Will this information be on the test?	Help me understand how different pieces of information relate. You want me to search for the answers, but eventually you will tell me what is correct.	Do not give me answers; let me struggle to solve problems. There may be many correct answers.	My answer is correct as long as I can support it with evidence. I need to find personal relevance with what I am learning.
Method of testing	I prefer objective tests---true/false, multiple choice, matching.	I prefer objective and some subjective tests---short answer and fill-in-the-blank questions.	I prefer subjective test where I can support my answers through logic and evidence.	I prefer subjective tests that ask me to make some kind of commitment to a choice or an option.
Grades	If I get all the correct answers, then I will earn an A.	I hope my teacher allows for effort, especially if I understand the process of getting the correct answers.	My grades should reflect my ability to support my answers with sound reasoning, logic, and evidence.	I understand grades are important, but I learn for the sake of learning and expanding my knowledge.

Source: Seller, Dochen, and Hodges (2015), Figure 11.2 (p. 194)

If students enter a college with a Dualism mindset, they often seek correct answers, which they think should be given by a professor. It is an attitude of: "You're the teacher. You tell us." They might be frustrated when expected to take part in a discussion, "Because if there is only one correct answer, why should we exchange our opinions." Discussion can be valued only when they accept that opinions are only as good as the evidence that supports it, which normally only appears at the Relativism stage. At the final stage of Commitment, students not only learn, but use the learned knowledge to pursue their lifetime

goals. If colleges are places for young and prospective students in the beginning of their career, they must transform their epistemological standpoint from the Dualism to the Commitment stage.

According to Seller et al. (2015), it is recommended to create a developmental mismatch, or "Plus-on Staging", instead of tailoring the tasks to the stage of the target student, in order to facilitate transformation from a stage to the next. For example, the task to 'compare and contrast' different authorities' views in a field would help a student in the Dualism stage to realize that there may not always be one correct answer to every issue. This task is better than asking the same student to publicly state her opinion, which may be too difficult for her and considered a non-developmental mismatch.

Discussion/Conclusion

If the knowledge that has been taught in colleges becomes available for free with MOOCs and search engines, what should be taught instead? This paper reviewed taxonomies as a guide to re-design college curriculum beyond the mere dissemination of knowledge. It is authors' opinion that "more knowledge" should not be the goal of higher education, nor should it be generic 21st century skills per se; rather, a commitment to an area of study, together with the love of learning together should be paramount. Colleges should seek new goals and strategies of instruction, which assist the students to reach Commitment stage, by providing series of authentic and challenging tasks in a leaner-centered manner, instead of keeping rock-step traditional curriculum for all, which was created in the industrial age.

Acknowledgement

This work has been supported by JSPS KAKENHI Grant Number 16H03081.

References

Anderson, L. W., & Krathwohl, D. R. (2001). *A taxonomy for learning, teaching and assessing: A revision of Bloom's taxonomy*. New York: Longman Publishing.

Bloom, B. S., Engelhart, M. D., Furst, E. J., Hill, W. H., & Krathwohl, D. R. (1956). *Taxonomy of educational objectives: The classification of educational goals. Handbook I: Cognitive domain*. New York: David McKay Company

Central (2015). By the numbers: MOOCS in 2015: How has the MOOC space grown this year? Retrieved May 2016 from https://www.class-central.com/report/moocs-2015-stats/

Gagne, R. M. (1977). *The conditions of learning* (3rd Ed.). Thomson Learning.

Gagne, R. M., Wager, W. W., Golas, K. C., & Keller, J. M. (2005) *Principles of instructional design* (5th Ed.) Wadsworth.

Jonassen, D. H. (2011). *Learning to solve problems: A handbook for designing problem-solving learning environment*. Routledge

Martin, B. L., & Briggs, L. J. (1986). *The affective and cognitive domains: Integration for instruction and research*. Educational Technology Publications, U.S.A.

Marzano, R. J. (2000). *Designing a new taxonomy of educational objectives*. CA: Corwin Press.

Marzano, R. J. (2007). *Designing a new taxonomy of educational objectives* (2nd Ed.). CA: Corwin Press.

Prensky, M. (2014). The world needs a new curriculum. *Educational Technology*, *54*(4), 3-15.

Reigeluth, C. M., Beatty, B. J., & Myers, R. D. (Eds.) (2016). *Instructional-design theories and models* (Vol. IV)*: The learner-centered paradigm of education*. Routledge.

Seller, D., Dochen, C.W., & Hodges, R. (2015). *Academic transformation: The road to college success* (3rd Ed.). Pearson.