# Level of Engagement and its Application to Learning Resources

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## Abstract

The level of engagement (LoE) at which learners attend to instructional activities can determine the depth at which content learning occurs. Engagement at higher levels of learning suggest deeper learning. Learning outcomes have traditionally been defined in three domains, cognitive, affective, and psychomotor. Cognitive represents progressively varying levels of mental or thinking skills. Affective represents progressively varying levels of feelings and emotions. Psychomotor represents progressively varying levels of physical skills. Each level of learning provides a foundation for the next higher level. Focusing instruction to engage learners at the appropriate level(s) of learning suggests the need to identify expected learning domain outcomes. Thus, the more learners successfully engage at the higher domain levels, the deeper the learning of content. Incorporating LoE principles into learning resource design thus, may ensure that learners engage at desired LoE to reach desired learning outcomes. This paper provides an overview of theoretical, research, and practical LoE principles, summarizing points for learning resources design.

## Instruction and Learning

Instruction is purposeful (Merrill, 2001). Instruction's purpose is to guide and facilitate achievement of specified learning outcomes. Learning outcomes must therefore be defined during the process of designing instruction (or instructional resources) to establish learner engagement in the instruction, its content, and the types of activities and resources that will support learners in achieving expected outcomes. Engagement refers to how these students are involved with the content based on instructional purposes. Outcome identification provides guidance for developing instructional strategies that can effectively engage learners at the correct level with content. Thus, it is critical to identify the type of learning expected as a result of participating in the instruction.

## Domains of Learning

In order to promote higher levels of thinking in education, Benjamin Bloom (1956) proposed three domains of learning: cognitive, affective and psychomotor. *Cognitive learning* refers to the mental (thinking) skills used to develop and demonstrate knowledge. These cognitive, or mental, skills range from low levels of thinking like fact recall and understanding to higher order thinking like applying and creating new forms of knowledge (Atherton, 2013; Bloom, 1956). *Affective learning* emphasizes a learner's feelings, values, motivations, and attitudes which are learned responses to new phenomena, information, or situations. Affective levels range from awareness to making one's behaviors consistent with internalized values learned from new phenomena, information, or situations (Krathwohl, Bloom, and Masia, 1964). *Psychomotor learning* focuses on the behavioral or physical skills that learners use to react to different situations (Harrow, 1972). Psychomotor learning also involves the cognitive skills of the behavior, e.g., knowing the *when* or *how* of the new skill. Psychomotor levels of learning range from imitating a behavior to naturalizing it as part of one's routine. Simpson (1972) suggested psychomotor skills include both simple physical tasks, such as running, and complex physical tasks, such as operating a machine. Thus, first defining the level at which the learning outcome in any of the domains is expected will help to design activities and resources that meet the LoE required for learners to accomplish desired outcomes.

## Levels of Learning

***Cognitive Learning - mental skills.*** Bloom and other scholars proposed that each cognitive learning domain progresses from lower to higher order levels of thinking. Each level of progress provides the foundation upon which the next higher level is built. For cognitive learning, six levels of thinking were initially identified (Bloom, 1956). The hierarchy of levels include knowledge (lowest), comprehension, application, analysis, synthesis, and evaluation (highest) (Atherton, 2013; Bloom, 1956).

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It was stipulated that *fact* knowledge must be developed (learned) before moving into the next cognitive levels which are considered higher levels of thinking skills and abilities. Therefore, learners must be engaged in learning the facts of content prior to comprehending (understanding) content and eventually moving on to deeper thinking. See table 1.

**Table 1. Original and Updated Versions of Cognitive Domain Levels of Learning**

| **Cognitive Domain: Levels of Learning** *Bloom, 1956* | | **Cognitive Domain: Levels of Learning** *Anderson, Krathwohl, Airasian, Cruikshank, Mayer, Pintrich, Paths, & Wittrock, 2001* | |
|---|---|---|---|
| **Level of Learning** | **Definition** | **Level of Learning** | **Definition** |
| Knowledge (low) | Recalling of information, methods and processes | Remembering (low) | Recalling of information, methods and processes |
| Comprehension | Understanding of what is being communicated | Understanding | Understanding of what is being communicated |
| Application | Applying skills or knowledge to a concrete situation | Applying | Applying skills or knowledge to a concrete situation |
| Analysis | Clarifying complex knowledge through deconstructing it into separate components | Analyzing | Clarifying complex knowledge through deconstructing it into separate components |
| Synthesis | Putting together all components and observing them as a whole. | Evaluating | Valuing the knowledge or skills for given purposes |
| Evaluation (high) | Valuing the knowledge or skills for given purposes | Creating (high) | Synthesizing and creating new knowledge |

Figure 1. Cognitive Domain Hierarchy

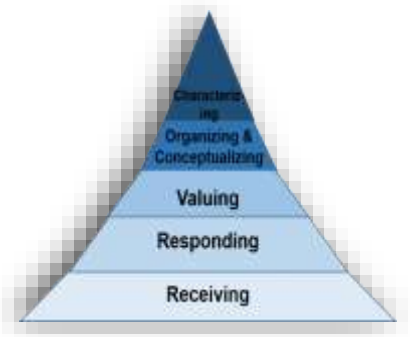

Figure 2. Affective Domain Hierarchy

Learning theorists tend to use pyramid diagrams to demonstrate the levels of learning, since a pyramid clearly emphasizes the hierarchical nature of the levels as building a foundation for the next higher level of thinking.

In reaction to Bloom's taxonomy, Anderson et al., modified the levels of learning to emphasize the importance of interactions between content taught and complex processes required to learn. This revised taxonomy progress from remembering (lowest), to understanding, applying, analyzing, evaluating, and finally creating (highest). See figure 1.

Most of the terms in the revised version are similar to the initial version, however the newer terminology reflects a more active form of thinking. An indication of the active form of thinking is, for example, using *remembering* rather than the *knowledge* as the lowest level of hierarchy. Anderson et al., (2001) also made another conceptual change believing that creating includes synthesis and is the highest level of learning.

***Affective Learning – feelings and emotions.*** Krathwohl, Bloom, and Masia (1964) went developed a hierarchy related to affective learning. The five levels - receiving (lowest), responding, valuing, organizing and conceptualizing, and characterizing by value (highest), are also represented as hierarchical. See figure 2.

*Receiving* suggests that learners develop an awareness and willingness to learn new content. They begin to feel a sense that promotes their attention. Learners then actively participate with the content and develop a *responding* state based on their initial awareness. These initial states lead learners to accept, reject, or start *valuing* the new object, phenomenon, or behavior. With accepted value the learners begin *organizing and conceptualizing* new values in their broader system. Learners then develop consistent behaviors while *internalizing* into their value system. See table 2.

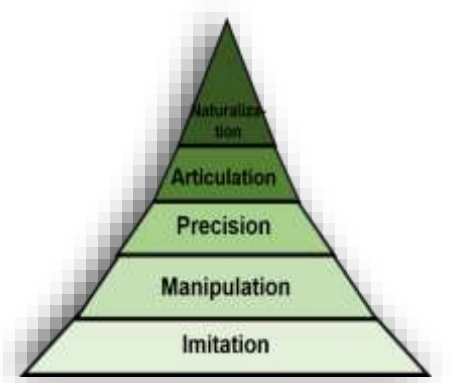

Figure 3. Psychomotor Domain Hierarchy

***Psychomotor Learning – physical skills.*** Dave (1971) proposed a 5-level model that represent learning in the psychomotor domain. The levels include *imitation* (lowest), *manipulation*, *precision*, *articulation* and *naturalization* (highest). Its lowest level begins with *imitation* where learners observe and begin to *imitate* new movements or behaviors. Learning continues with experience or instruction guiding further development of the movement, or *manipulation*. As learners pay more attention and develop better control they work into *precision*. As learners combine new skills into series of tasks they enter *articulation* and as these articulated movements become mastered and incorporated into everyday behaviors, they are *naturalized*. See table 2.

**Table 2. Affective and Psychomotor Taxonomies**

| **Affective Domain: Levels of Learning** *Krathwohl, Bloom, & Masia, 1964* | | **Psychomotor Domain: Levels of Learning** *Dave, 1971* | |
|---|---|---|---|
| **Level of Learning** | **Definition** | **Level of Learning** | **Definition** |
| Receiving (low) | Awareness and willingness to pay attention to learning | Imitation (low) | Observe and imitate behaviors from others. |
| Responding | Active participation in instructional activities, awareness and willingness to respond. | Manipulation | Perform behaviors according to previous experiences or instructions. |
| Valuing | Accepting or rejecting the worth or attaching value to a particular object, phenomenon, or behavior. | Precision | Refine behaviors through paying attention to details. |
| Organizing and Conceptualizing | Organize values into priorities, then create own value system by comparing different values. | Articulation | Combine a series of behaviors to finish a new task. |
| Characterizing/ Internalizing (high) | Make behaviors consistent with value system. | Naturalization (high) | Master a high level performance and do it naturally. |

## Levels of Engagement

As noted, instruction is the mechanism that engages learners in learning. The defined expected learning types and outcomes inform the types of learning activities thought to be required to support learning, or the closure of identified gaps in learner knowledge, attitudes, or skills. Learning outcomes are further defined by objectives that are observable and measureable statements articulating learning outcomes (Smith & Ragan, 2005). Thus, level of learning is aligned to LoE based on expected domain learning outcomes. See table 3.

**Table 3. Level of Learning and Instructional Engagement in Three Domains**

| Cognitive | | Affective | | Psychomotor | |
|---|---|---|---|---|---|
| **Level of Learning** | **Instructional Engagement** | **Level of Learning** | **Instructional Engagement** | **Level of Learning** | **Instructional Engagement** |
| Remember-ing (low) | Read, highlight text, use flash cards, rote by repetition, define concepts, recall a process | Receiving (low) | Listen with respect, take notes, share learning experiences, participate in activities | Imitation (low) | Watch model / demo and repeat the action |
| Understand-ing | Create an analogy, take notes, storytelling, search on the Internet, paraphrase, translate | Responding | Participate actively, give presentation, write feedback, question content, suggest interpret, provide references and examples | Manipulation | Carry out the task according to the written or verbal instruction |
| Applying | Solve a practical problem, manage an activity, demonstrate, put a theory into practical effect | Valuing | Decide idea worth and relevance, accept stance or action, demonstrate belief in process, propose a plan to improve | Precision | Perform a task with expertise and without assistance, demonstrate an activity to other learners |
| Analyzing | Identify process components or concept, troubleshoot equipment, recognize logical fallacies, measure requirement or need, debate | Organizing and Conceptual-izing | Qualify and quantify personal views, state personal position and reasons, state beliefs | Articulation | Use the skills to implement a new task, relate and combine activities to develop methods meeting novel requirements |
| Evaluating | Review options/ plans, assess performance and ability, return on cost-effectiveness, calculate effects of a plan, survey, perform a risk analysis | Character-izing / Internaliz-ing (high) | Use self-regulation skills in learning, behave consistently with personal value set | Naturaliza-tion (high) | Define arm, approach and strategy for use of activities to meet strategic need |
| Creating (high) | Write essay, develop plan, build team, create new model, integrate different ideas | | | | |

Note: Based on Clark (2015)

Hess, et al., (2009) created a matrix based on levels in the cognitive domain to critique the rigor of curricular materials in education in terms of match between domain and level of learning and level of engagement. Harrow (1972) created a similar matrix for the psychomotor domain. These types of frameworks provide blue prints to design activities that can prompt learners in appropriate LoE to meet specified learning outcomes. Each objective can then be aligned to specific types of learning activities and assessments. For example…

Learning objectives* in the *cogintive domain* at different levels of learning may include:

- *List* the six levels of Bloom's taxonomy cognitive domain *(remembering, low level)*
- *Explain* the purpose of Bloom's taxonomy cognitive domain *(understanding)*
- *Write* an instructional objective for each level of Bloom's taxonomy *(applying)*
- *Compare and contrast* the cogntive and affective domains *(analyzing)*
- *Judge* the effectiveness of writing objectives using Bloom's taxonomy *(evaluating)*
- *Design* a classification scheme for writing educational objectives *(creating, high level)*

Learning objectives* in the affective domain at different levels of learning may include:

- *Listen* to others' comments on a social justice issue *(receiving, low level)*
- Actively *communicate* with others in discussions about the social justice issue *(responding)*
- *Demonstrate* beliefs *(valuing)*
- *Recognize* the need for balance in a debate of that social justice issue *(organizing and conceptualizing)*
- *Change* perspective on a social justice issue and *participate* in ethical practices on a daily basis *(characterizing & internalizing, high level)*

Learning objectives* in the psychomotor domain at different levels of learning may include:

- *Observe* and imitate a dancer's moves *(imitation, low level)*
- *Perform* a dancing skill after take dancing lessions *(manipulation)*
- *Demonstrate* a dance movement to a beginner *(precision)*
- *Combine* a series of moves to peform a dance *(articulation)*
- *Complete* a dance without any guidance *(naturalization, high)*

(*note: based on Huitt, 2011)

Using the taxonomy for cognitive, affective, or psychomotor domains, as shown above, learning objectives can be developed that focus learners on what they should be able to *know*, *feel*, or *do* after successfully *engaging* at approriate levels in various types of activities during instruction.

## Research Studies on Levels of Learning

Many studies have been conducted to investigate the effectiveness of instructional activities consistent with level of learning and engagement. Four recent studies describe findings in which levels of learning were investigated based on engagement in different contexts. Cognitive development is likely one the most studied contexts in investigations of LoE for different learning domains. For example, Koszalka, Grabowski, & Darling (2006) suggested that middle school students LoE with different learning resources affected their learned characteristics. As the LoE moved from teacher-centered (lower level) to more learner-centered (higher level) activities (e.g., presentation, active learning) both the depth of learning and learner affect towards specific careers (learned characteristic) were significantly more highly developed. Spector, Dennen, & Koszalka (2006) also posit that when adults engage often and more fully in higher order thinking activities their learning advances toward higher levels of expertise. They found that novices in medical diagnostics, environmental engineering, and biology contexts may develop stronger cognitive skills in complex domains as a result of engaging with content in more expert-like ways. In each of the studies novices' conceptualization of complex problems were different from their peers and from those of experts in their domain, suggesting lesser understanding. However, experts within the domain had similar conceptualizations of common problems. These types of results suggest that engaging in progressively higher levels of practice situations over time may support deeper and higher level learning outcomes.

Su and Osisek (2011) also studied cognitive learning. They developed a learning session with three objectives aligned with three different levels of cognitive learning. Objective one was about "applying conceptual knowledge," objective two was about "analyzing procedural knowledge," and objective three

was about "evaluating procedural knowledge" (Su & Osisek, 2011, p. 324). Activities were designed to engage students specifically at the level defined by the objectives. Learning outcomes were found to be consistent with the level of objectives which drove the LoE for each type of learning activity. See table 4.

**Table 4. Summary of the Four Research Studies**

| Subject | Learning Type | Level of Learning | Instructional Activity |
|---|---|---|---|
| Nursing | Cognitive | • Applying (lowest)<br>• Analyzing<br>• Evaluating (highest) | • In "applying", present clinical examples, do small group discussions<br>• In "analyzing", simulate clinical situations, use case studies<br>• In "evaluating", pose questions to help participants to self-evaluate their thoughts, use visual display and concept mapping to improve learners' metacognitive awareness. |
| Math | Cognitive | • Evaluating (high) | Grade the solution/proof from a fictitious classmate |
| Business Computing | Affective | • Receiving (lowest)<br>• Responding<br>• Valuing (highest) | Use debate as a class activity:<br>• In "receiving" level, listen to others' opinions passively, take notes<br>• In "responding" level, question and pose ideas, suggest solutions<br>• In "valuing" level, accept a particular stance from others, organize or conceptualize ideas by summarizing relevant ideas |
| Sports Therapy | Psychomotor | All the levels of psychomotor learning | Present instructional videos helping students to learn the psychomotor skills. |

Note: Based on Su & Osisek (2011); Karaali (2011); Jagger (2013); Cooper & Higgins (2015)

Karaali (2011) developed an instructional intervention for calculus instruction using *evaluating-level* activities in cognitive learning. This research investigated whether students who engaged in evaluating instructional activities would engage in higher order thinking during the activity itself. Results suggested that students did participate in a higher LoE, level of thinking, and level of learning. See table 4.

There are also multiple studies on instructional objectives and LoE focused on affective and psychomotor domains. Jagger (2013) developed an instructional activity aligned with affective learning for undergraduates in a business computing course. The main instructional activity incorporated in the course to support affective development was debate. A series of sub-activities were developed to support debating to meet various learning objectives aligned with different levels of affective learning, e.g., receiving, responding, valuing. Results supported the hypothesis that such activities would be effective in improving LoE in the content. Cooper (2015) had similar results focusing on psychomotor learning in the sports therapy area using video resources for modeling behavioral techniques. Quantitative data did not establish conclusive evidence for the use of instructional videos, but demonstrated the use of instructional videos to model behaviors was a promising instructional activity to support various levels of psychomotor learning.

## Learning Resources Informed by LoE - Possibilities

Instruction is a compilation of informational, instructional, and learning resources (Grabowski & Small, 1997), each providing a building block upon which to purposively support learning. Whereas

informational and instructional resources support the overall content and direction of instruction, the learning resources, whether in analogue, digital or social/human format fully engage learners in learning processes. By integrating LoE tenets into learning resources students can be prompted to participate in learning activities that may help facilitate their achievement of established learning outcomes. LoE suggests that features of learning resources that could be of great value to learners will prompt LoE in activities that align with expected learning outcomes defined by the targeted learning domain(s). Further defining the level of learning expected informs the types of activities that will best support learning and assessment. Learning resources therefore focused on the furthering learners' depth of learning in the cognitive domain may include embedded activities that begin with recall and conceptualizing content, move into applying and analyzing, and ultimately support evaluating and creating new content. Learning resources focused on levels of the affective domain may have characteristics that engage learners early in developing awareness of, and responding to, new situations eventually moving toward displaying behaviors consistent with a developing value system. Learning resources focused on psychomotor skills may support LoE from observing and imitating new behaviors through combining and mastering new skills. There is also the possibility that learning resources embed LoE characteristics in multiple domains, at multiple levels.

## Synthesis

The design of instruction and supporting learning resources often begins with identifying expected learning outcomes. The three domains of learning − cognitive, affective and psychomotor – provide a framework upon which instructors can define learning that should be accomplished as a result of the instructional unit. The learning outcomes can be used to inform the LoE required to achieve the level of learning specified in the instruction. In the end, learning resources and activities designed to align with the levels of learning can support learners' achievement of expected learning outcomes.

Previous studies suggested that instructional activities aligned at different levels of learning can be effective in helping learning achieve low to higher order levels of learning. When learners reach the designated LoE with content, research findings suggest that thinking and learning processes can be triggered to support deeper understanding or mastery of performance. Studies investigating the effectiveness of instructional activities aligned with levels of learning support this theory. However, LoE is only one dimension that may influence the value of resources in facilitating deep learning. Other factors may include the properties of learning resources that prompt learners in flexible thinking (Cheng & Koszalka, 2016), reflection (Koszalka, 2016), and knowledge generation (Wilhelm-Chapin & Koszalka, 2016). The RIDLR team is developing and researching learning resources that incorporate multiple dimensions to support higher order thinking and the development of learning assessments. See http://ridlr.syr.edu/.

## References

Anderson, L.W., Krathwohl, D.R., Airasian, P.W., Cruikshank, K.A., Mayer, R.E., Pintrich, P.R., Raths, J., Wittrock, M.C. (2001). *A Taxonomy for Learning, Teaching, and Assessing: A revision of Bloom's Taxonomy of Educational Objectives*. New York: Pearson, Allyn & Bacon.

Atherton, J.S. (2013). *Learning and Teaching; Bloom's taxonomy* [On-line: UK]. Accessed July 2016: http://learningandteaching.info/learning/bloomtax.htm

Bloom, B.S. (1956). *Taxonomy of educational objectives. Vol. 1: Cognitive domain.* New York: McKay, 20-24.

Cheng, J., & Koszalka, T.A. (2016). *Cognitive flexibility theory and its application to learning resources.* (concept paper) Retrieved from: http://ridlr.syr.edu/publications/

Clark, D.R. (2015). *Bloom's Taxonomy of Learning Domains*. Accessed July 2016: http://www.nwlink.com/~donclark/hrd/bloom.html

Cooper, D. and Higgins, S. (2015), The effectiveness of online instructional videos in the acquisition and demonstration of cognitive, affective and psychomotor rehabilitation skills. *British Journal of Educational Technology*, 46: 768–779.

Dave, R.H. (1971). *Developing and writing behavioral objectives*. Tucson, AZ:Educational Innovators Press.

Harrow, A.J. (1972). *A taxonomy of the psychomotor domain: A guide for developing behavioral objectives*. Addison-Wesley Longman Ltd.

Hess, K.K., Carlock, D., Jones, B., & Walkup, J. R. (2009). *What exactly do "fewer, clearer, and higher standards" really look like in the classroom? Using a cognitive rigor matrix to analyze curriculum, plan lessons, and implement assessments.* Accessed August 2016: http://schools.nyc.gov/NR/rdonlyres/D106125F-FFF0-420E-86D9-254761638C6F/0/HessArticle.pdf

Huitt, W. (2011). Bloom et al.'s taxonomy of the cognitive domain. *Educational Psychology Interactive*. Valdosta, GA: Valdosta State University. Accessed August 2016: http://www.edpsycinteractive.org/topics/cognition/bloom.html

Jagger, S. (2013). Affective learning and the classroom debate. *Innovations in Education and Teaching International*, *50*(1), 38-50.

Karaali, G. (2011). An evaluative calculus project: applying Bloom's taxonomy to the calculus classroom. *Primus*, *21*(8), 719-731.

Koszalka, T. (2016). *Reflection and its application to learning resources.* (concept paper) Retrieved from: http://ridlr.syr.edu/publications/

Koszalka, T., Grabowski, B., & Darling, N. (2005). Predictive relationships between web and human resource use and middle school students' interest in science careers: An exploratory analysis. *Journal of Career Development*. 31(3), 169-182.

Krathwohl, D.R., Bloom, B. S., & Masia, B. B. (1964). *Taxonomy of Educational Objectives, Handbook II: Affective Domain*. New York: David McKay Company, Inc.

Merrill, M.D. (2001). Components of instruction toward a theoretical tool for instructional design, *Instructional Science,* 29(4) 291-310.

Simpson E.J. (1972). *The Classification of Educational Objectives in the Psychomotor Domain*. Washington, DC: Gryphon House.

Smith, P.L., & Ragan, T.J. (2005). *Instructional design*. New York: Wiley.

Spector, J.M., Dennen, V.P., & Koszalka, T. (2006). Causal maps, mental models and assessing acquisition of expertise. *Technology, Instruction, Cognition and Learning,* 3, 167-183.

Su, W.M., & Osisek, P.J. (2011). The Revised Bloom's Taxonomy: implications for educating nurses. *The Journal of Continuing Education in Nursing*, *42*(7), 321-327.

Wilhelm-Chapin, M.K. & Koszalka, T.A. (2016). *Generative learning theory and its application to learning resources.* (concept paper) Retrieved from: http://ridlr.syr.edu/publications/