Thinking Development Rubrics. Theory.

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The Erasmus project 2018-2022 *Building Skillful Thinking in Children* is an exchange between Colegio Lope de Vega, Benidorm, Spain, and Ramsta school, Uppsala, Sweden. The object of the project is to merge two methods used by the schools to enhance students' thinking: *Thinking based Learning* and the *Socratic seminar*. An interest in being able to follow the thinking development of the students at the two schools emerged during the project. This material is the result of the efforts to construct such an assessment tool: A research review resulted in rubrics that were assessed and tested by the participating teachers and revised accordingly.

The assessment tool is constructed in a matrix, clarifying to teachers and students what is important within the area of the targeted thinking abilities. A long-term goal, like the student being able to develop his or her thinking skills or abilities, is defined as a number of sub-components, *criteria*, visualizing the anticipated results (Wiggins & McTighe, 2011). Each criterion is broken down in observable characteristics, *rubrics* – behaviors or phenomena that describe the criteria (Jönsson, 2012; Wiggins, 1998). This will enable assessment of more complex skills and abilities that might be difficult to assess in traditional ways (Lindström et al., 1999; Lindström, 2002; 2006).

The criteria of good thinking

A problem to face when constructing rubrics for thinking skills or abilities is what might be considered good or productive thinking. What has been considered good thinking has changed over time and will also differ from one society or group to another. Hence, this is something that cannot be answered by consulting research alone, there is also a political or value aspect concerning what kind of citizens schools should foster. Howard Gardner points at this dilemma by stating that education, by its very nature, is a matter of human goals and values (Gardner, 2006).

However, Gardner, drawing on cognitive research, also points at five particular minds, five mental dispositions or specific cognitive abilities, that will be needed in the future (*Gardner website*):

- **The Disciplinary Mind:** The mastery of major schools of thought, including science, mathematics, and history, and of at least one professional craft.
- **The Synthesizing Mind:** The ability to integrate ideas from different disciplines or spheres into a coherent whole and to communicate that integration to others.
- **The Creating Mind:** The capacity to uncover and clarify new problems, questions, and phenomena.
- **The Respectful Mind:** Awareness of and appreciation for differences among human beings and human groups.
- **The Ethical Mind:** Fulfillment of one's responsibilities as a worker and as a citizen.

Gardner's five minds are comparable to most of the 21st Century Skills that has been identified as important educational goals by, among others, the OECD (*OECD website*): Critical thinking and problem solving, creativity and innovation communications and collaboration, information, diversity, lifelong learning and self-direction, leadership, professionalism and work ethics, and ethic and social responsibility. The same areas are defined by Roberts (in press) as future competences.

Gardner's five minds were used to form five criteria in the thinking development rubrics. The rubrics evaluate thinking in the age groups from preschool to high school, and describe an ongoing process, aiming at the desired criteria. The abilities that are bases for the five dispositions of mind that

Gardner identifies take time and experience to develop (Gardner, 2006). The students will most likely not reach the anticipated minds in school. The abilities described will help them to reach the criteria later in life.

Important features of thinking development

We know from extensive research that the child's learning start is important (Håkansson & Sundberg, 2012). Abilities start developing early in life (Cunha & Heckman, 2010). However, they are not mere products of genetics. Research shows that abilities like intelligence and creativity are results of individual combinations of biological predispositions, but that these can be developed and refined through education (Csikszentmihaly 1996; Gardner 1999). Knowledge is an important part of learning, and so is strategies of how to learn (Håkansson & Sundberg, 2012). Forming cognitive strategies is a long process, where the student will need much support and feedback. Håkansson & Sundberg (2012; 2016) call these strategies *learning identity*, including motivation, goal understanding, metacognitive strategies, give and use feedback, and problem solving. Other supportive factors are student's positive attitude to learning, and a learning community where collaborative learning is encouraged (Skolverket, 2012, 2013).

When taking on thinking in for example problem solving in learning it is important to understand the goal of the activity (Donaldsson, 1981; Bruner, 1960; Hattie & Timperley, 2007). The student should be confronted with the analytic concepts and basic knowledge of each subject (Gardner, 2006; Arevik & Hartzell, 2009). Creating, forming productive habits of mind, and experimenting are also important when forming abilities (DeBruin-Parecki et al. 2016; Doverborg, et al., 2013; Luria, 1981; Bruce & Riddersporre, 2012; Pihlgren, 2008). Learning is enforced when students get clear formative feedback on performance but also when they reason about how they think and learn meta-cognitively (Hattie & Timperley, 2007; Perkins, 1992). Metacognition supported by formative feedback will in time lead to self-regulated learning (Björklund Boistrup, 2005; Black & William, 2010; Lundahl, 2014). Some behaviors will support learning and thinking, like taking responsibility for organizing the activity, choosing the material needed, being able to tidy up after the process, time-disposing, and working with resilience, accuracy, autonomy, and self-discipline (Skolverket, 2012, 2013; Pihlgren, 2013; Håkansson & Sundberg, 2016).

The ability to be creative is relying on a thorough knowledge in the discipline in question (Csikszentmihaly, 1996; Lindström, 2006). To be systematic and conscious is also important (de Bono, 1998). A creative person uses several different elements (Lindström, 2006): Brainstorming, experimenting, as well as analyzing and critical examination by identifying questions, taking risks, being perseverant, using role models, self-assessing, and working autonomously.

Inner motivation, interest in the subject, and a will to learn will enhance learning and thinking (Jensen, 2015). Motivation can also be social, connected to collaborative actions. An important factor is that the student feels the support of the teacher and the context (Skolverket, 2012). This is also connected to the way that the student sees his or her learning capacity (Dweck, 2008). Students identifying long-term goals, having resilience and a belief that practice will make perfect have good chances to succeed (Duckworth, 2017; Dweck, 2008; Klingberg, 2016). Motivation, self-confidence, and autonomy are results from education and up-bringing (Håkansson & Sundberg, 2012; 2016). Bloom (1985) showed in an early investigation that students often passes through three stages of development. In the first stage they would work resilient if the tasks were interesting and exciting, in the next stage they would make it a habit to practice, and in the last stage they would form their own meaningful goals.

Communicating, interplay, and collaboration are other factors connected to sucessfull learning (Håkansson & Sundberg, 2012; 2016; Skolverket, 2011; Williams, 2006). Students will in interplay reconsider and develop their ideas, their communicative and social skills, as well as a sense of respect towards other perspectives and perceptions (Orellana, 2008; Pihlgren, 2008; Williams et al., 2001; Williams, 2006). All the mentioned factors were considered as rubrics for the thinking criteria.

Defining levels of understanding

The rubrics of each criterion were divided into five levels of development. Biggs & Collis (1982) describes the levels of understanding as five in the SOLO-taxonomy:

- **Prestructural**: Before understanding the area, not attacking the task appropriately, missing the point, failing
- **Unistructural**: taking in one relevant aspect, identifying, naming, following simple procedures
- **Multistructural**: Taking in several relevant independent aspects but not relating them, combining, describing, enumerating, performing serial skills, listing
- **Relational**: Integrating aspects into a structure or whole, analyzing, applying, arguing, comparing/contrasting, criticizing, explaining causes, relating, justifying
- **Extended abstract**: Generalizing aspects to new domains, creating, formulating, generating, hypothesizing, reflecting, theorizing.

An alternative way of analyzing thinking and learning activities is presented in Bloom's taxonomy (1956), which has been used since the 1950ies to evaluate learning and teaching, to plan lessons and in curriculum design. The taxonomy describes six levels of understanding, from basic to advanced:

- **Remember**: Exhibit memory of previously learned material by recalling facts, concepts, and answers
- **Understand**: Demonstrate an understanding of the facts by explaining ideas or concepts
- **Apply**: Use existing knowledge to solve new problems or apply acquired knowledge in new situations
- **Analyze**: Examine and break information into parts to explore relationships
- **Evaluate**: Defend opinions and decisions and justify a course of action by making judgements about information
- **Create**: Generate new ideas and products or complete information in a new way

A revision of Bloom's taxonomy was made 2001, taking into account contemporary research (Anderson & Krathwohl, 2001). The revised taxonomy analyzes understanding in two dimensions. A *knowledge dimension* clarifies what knowledge is in focus: factual, conceptual, procedural or metacognitive knowledge. A *cognitive process dimension* shows what kind of thinking procedures is used: remember, understand, apply, analyze, evaluate, or create. This results in twenty-four positions, which are considered equally important in teaching and learning:

THE KNOWLEDGE DIMENSION	THE COGNITIVE PROCESS DIMENSION					
	1. Remember	2. Understand	3. Apply	4. Analyze	5. Evaluate	6. Create
A. Factual knowledge						
B. Conceptual knowledge						
C. Procedural knowledge						
D. Meta-cognitive knowledge						

When constructing the levels in each criterion the highest level was set from Gardner's (2006) description of the mind disposition and from the results of the research review, taking into account an appropriate level for high school students. These rubrics were compared to Bloom's revised taxonomy to see that all positions were represented. The SOLO taxonomy and Bloom's original taxonomy were then consulted to find the earlier stages of development, and this was then compared to the TBL planning tool (*Profundidad de Conocimiento Niveles*). The assessment tool was later tested and revised by the teachers in the Erasmus project.

References

Anderson, L. W. & Krathwohl, D. R. (eds.) (2001). *A Taxonomy for Learning, Teaching, and Assessing. A Revision of Bloom's Taxonomy of Educational Objectives.* New York: Pearson Education.

Arevik, S. & Hartzell, O. (2009). *Att göra tänkande synligt. En bok om begreppsbaserad undervisning. [Making thinking visible. A book about cencept based education].* Didactica 11. Stockholm: Stockholms universitets förlag.

Biggs, J. & Collis, K. (1982). *Evaluating the quality of learning. The SOLO taxonomy.* New York: Academic Press.

Björklund Boistrup, L. (2005). Att fånga lärandet i flykten. [Catching learning in flight]. In: Lindström, L. & Lindberg, V. (eds.) *Pedagogisk bedömning*. Stockholm: HLS Förlag, pp. 11-129.

Black, P., & Wiliam, D. (2010). Inside the black box: raising standards through classroom assessment. *Kappan Classic*, pp. 81-90.

Bloom, B. S. (ed.). (1956). *The Taxonomy of Educational Objectives. The Classification of Educational Goals.* Handbook 1: Cognitive Domain. New York: David McKay Company.

Bloom, B. (1985). *Talent development in young people.* New York: Ballentine.

Bruce, B. & Riddersporre, B. (2012). *Kärnämnen i förskolan. Nycklar till livslångt lärande [Main subjects in preschool. Keys to life-long learning].* Stockholm: Natur & Kultur.

Bruner, J. S. (1960). *The process of education.* Lund: Gleerups.

Csikszentmihaly, M. (1996). *Creativity, flow and the psychology of discovery and invention.* New York: Harper Collins.

Debruin-Parecki, A., van Kleeck, A. & Gear, S. (2016). (red.) *Utveckla förståelse i förskolan. En grund för god läsutveckling [Developing understanding in preschool. A basis for good reading development].* Lund: Studentlitteratur.

Donaldsson, M. (1979). *Children's minds.* London: W. W. Norton & Company.

Doverborg, E., Pramling, N., Pramling Samuelsson, I. (2013). *Att undervisa barn i förskolan. [Teaching children in preschool]*. Stockholm: Liber.

Duckworth, A. (2017). *Grit. Why passion and resilience are the secrets to success.* London: Vermillion.

Dweck, C. S. (2008). *Mindset. Changing the way you think to fulfill your potential.* New York: Ballantine Books.

Gardner, H. (1999). *Intelligence reframed: Multiple intelligences for the 21st century.* New York: Basic Books.

Gardner, H. (2006). *Five Minds for the Future.* Harvard: Harvard Business School Press.

Gardner website. https://howardgardner.com/five-minds-for-the-future/. 2019-03-16.

Hattie, J. & Timperley, H. (2007). The power of feedback. *Review of Educational Research*, 77, pp. 81-112.

Håkansson, J. & Sundberg, D. (2012). *Utmärkt undervisning. Framgångsfaktorer i svensk och internationell belysning [Excellent education. Success factors in Swedish and international light].* Stockholm: Natur & Kultur.

Håkanson, J. & Sundberg, D. (2016). *Utmärkt skolutveckling. Forskning om skolförbättring och måluppfyllelse. [Excellent school research. Research about school improvement and goal reaching].* Stockholm: Natur & Kultur.

Jensen, M. (2015). Motivation och lärande. [Motivation and learning]. In: Pihlgren, A. S. (ed.) Fritidshemmet och skolan. Lund: Studentlitteratur, pp. 69–100.

Jönsson, A. (2012). *Lärande bedömning. [Learning assessment].* Malmö: Gleerups utbildning.

Klingberg, T. (2016). *Hjärna, gener och jävlar anamma: Hur barn lär [Brain, genes, and grit: How children learn].* Stockholm: Natur & Kultur.

Lindström, L. (2002). Produkt- och processvärdering i skapande verksamhet. [Product and process assessment in creative teaching]. In: *Att bedöma eller döma. Tio artiklar om betygssättning*. Stockholm: Skolverket/Liber distribution.

Lindström, L. (2006). Creativity: What is it? Can you assess it? Can it be taught? *Jade 25.1 Artwork* 9/2/06, s. 53-67.

Lindström, L., Ulriksson, L. & Elsner, C. (1999). *Portföljutvärdering av elevers skapande i bild [Portfolio evaluation in students' creating in art].* Stockholm: Skolverket/Liber distribution.

Lundahl, C. (2014). *Bedömning för lärande. [Assessing to learn].* Lund : Studentlitteratur.

Luria, A. (1981). *Language and cognition.* New York: Wiley-Interscience.

OECD website https://www.oecd.org/site/educeri21st/40756908.pdf. 2019-03-16.

Orellana, P. (2008). *Maieutic frame presence and quantity and quality of argumentation in a Paideia seminar.* Doctoral thesis. The University of North Carolina.

Perkins, D. (1992). *Smart schools. From Training Memories to Educating Minds.* New York: Free Press.

Pihlgren, A. S. (2008). *Socrates in the classroom. Rationales and effects of philosophizing with children.* Doctoral thesis. Stockholms universitet.

Pihlgren, A. S. (2013). *Det tänkande klassrummet. [The thinking classroom].* Stockholm: Liber.

Profundidad de Conocimiento (PDC) Niveles. Colegio Lope de Vega. 2019-03-18.

Roberts, T. (in press 2019). *The new smart: Why creative children will thrive in the future*.

Skolverket (2011). *Kunskapsbedömning i skolan – praxis, begrepp, problem och möjligheter. [Knowledge assessment in school – praxis, concepts, problems, and posibilities].* Fritzes: Stockholm.

Skolverket (2012). *Högpresterande elever, höga prestationer och undervisning. [High-performing students, high accomplishments, and teaching].* Rapport 379. Stockholm: Skolverket.

Skolverket (2013). *Betydelsen av icke-kognitiva förmågor. Forskning mm. om individuella faktorer bakom framgång. [The importance of non-cognitive abilities. Research etc about individual factors behind success].* Stockholm: Skolverket.

Wiggins, G. (1998). *Educative assessment. Designing assessments to inform and improve student performance*. San Francisco: Jossey-Bass.

Wiggins, G. & McTighe, J. (2011). *The understanding by design guide to creating high-quality units.* Alexandria: ASCD.

Williams, P. (2006). *När barn lär av varandra. [When children learn from eachother].* Stockholm: Liber.

Williams, P., Sheridan, S. & Pramling Samuelsson, I. (2001). *Barns samlärande – en forskningsöversikt. [Childrens' co-operative learning – a research review].* Stockholm: Liber.