

## **Formative Assessment and Flipped Teaching**

Mikhail M. Bouniaev Ph. D.

School of Mathematical and Statistical Sciences, University of Texas Rio Grande  
Valley, Texas, USA

Analyzing the literature related to active learning, we found many definitions of active learning. On one hand, almost all of them from our point of view contain the following two ideas: “information communicated to learner that is intended to modify his or her thinking or behavior for the purpose of improving learning” [1]. This is a definition from a “learner's perspective” complementing the definition from the instructor's perspective “formative assessment is generally defined as assessment for the purposes of instruction”[2].

Among other recently developed methods of teaching, the flipped classroom environment deserves a special note. First of all, it is clear that regardless of what definition of active teaching we adopt, flipped teaching evidently falls into the group of active methods of teaching/learning. Having said that, we also need to add that very often, (especially among math educators), Inquiry Base Learning (IBL) is perceived as an equivalent to Active Learning. Second, the shift of methodology from instructor centered methodology to student centered methodology requires developing and incorporating elaborate methods of formative assessment into the curriculum of flipped classroom environment. As some authors argue, most of the assessment methods that are currently incorporated into curricula could be described as summative assessment. And last, though not least, based on the analysis of existing literature we can say that instructors have been incorporating active learning (with some elements of flipped learning) even into large lecture classrooms, and we can observe this trend across most disciplines.

Most scholars in curriculum development and faculty members who are actively involved in developing curriculum admit that there are four components of curriculum development: objectives (learning outcomes), content, teaching strategies (methods), and assessment [3]. It is clear from the theoretical perspective that in planning assessment we should keep in mind objectives, strategies, and content. However, traditionally the focus in the curriculum development process was on the first three components. The shift from the traditional lecture based leaning to active learning in general, and flipped learning specifically, requires focusing much more on assessment and integration of formative assessment into curriculum development.

Based on the data analysis presented by Freeman and his co-authors [4], who reviewed more than 300 published and unpublished studies on active learning, there is no doubt that active learning can be very successful and students benefit from it. However, analyzing Freeman's list of references (as well as results of the internet search), we found significantly fewer references to the “assessment of active learning” compared to “organizing active learning”. So we can assume

that either the science of assessment of active learning still has to be developed to reach the same level as active learning per se, or there is no significant difference between assessing traditional learning and active learning. The last hypothesis, to the best of our knowledge, has been neither confirmed nor refuted.

One of the challenges in development of formative assessment of active learning is to find a helpful for practicing teachers/instructors answer to two questions about what and when to assess. There is no lack of the answers to both of these questions from theoretical perspectives. Though formative assessment can be organized in many different forms, some psychologists argue that formative assessment can employ three main methods for gathering data, namely, observation, test, and clinical interview [5]. By gathering data "... the teacher needs to learn about performance, thinking/knowledge, learning potential, and affect/motivation." [6]. Bloom's Taxonomy and its multidimensional modifications also provide some indications where to look for the answer to what to assess. More challenges occur in answering the second question "when or how often to collect data for formative assessment" There are some studies that show that efficacy of formative assessment depends on motive, means, and opportunity [7].

Some scholars in the area of assessment and curriculum development argue that all forms of assessment should be "based on psychological ideas and can be only as good as those ideas .... The theory should make sense to teacher ... behavior[6]. We are going to discuss our experience from the perspective of social constructivism, SSDMA (Stage-by-Stage Development of Mental Actions Theory as developed by Bouniaev [7] application to higher education mathematics teaching, and recent developments in Bloom's Taxonomy.

## References

- [1] Shute, V.J. (2008), Focus on formative feedback, *Review of Educational Research* ,78, 153-189.
- [2] Heritage, M., Kim, J., & Vendlinski, T., 2008, From Evidence to action: A seamless process in formative assessment. Paper Presented at the American Educational Research Association Annual Meeting, NY.
- [3] Tyler, R. (1949). *Basic Principles of Curriculum and Instruction*. Chicago; University of Chicago Press
- [4] Freeman S., Eddy S.L., McDonough M., Smith M.K., Okoroafor N., Jordt. H., and Weneroth M.P. (2014). Active learning Increase student performance in science, engineering, and mathematics. *Proc. Natl. Acad. Sci. USA*. 111(23) 8410-8415.
- [5] Piaget, J. (1976). *The child's conception of the world* (J. Tomlinson & A. Tomlinson transl.) Totowa: Littlefield.
- [6] Ginsburg H. P. (2009). The challenge of Formative Assessment in Mathematics Education: Children's Minds, Teachers' Minds; *Human Development*, 52:109-128.

[7] Bouniaev, M.M. (2004). (Stage-by-Stage Development of Mental Actions and Online Mathematics Instruction, *Society for Information Technology and Teacher Education International Conference 2004, Vol. 1*, pp. 4366-4373.