WHITE PAPER

Strategies for Dynamic Formative Assessment with Digital Tools

Marcella L. Bullmaster-Day, Ed.D.

Digital tools have wide applications in education, from online adaptive learning to social collaboration and real-time reporting. This paper focuses on how digital tools can support ongoing dynamic formative assessment, summarizing the scholarly research that demonstrates effective instructional assessment and discussing the advantages that digital tools offer for formative assessment. It concludes by focusing on how one digital tool, Waggle Smart Practice was designed according to these research-based principles and can be implemented for effective formative assessment.

What is formative assessment?

Instructional assessment takes three basic forms.

- *Diagnostic* assessment determines baseline knowledge and skills for purposes of appropriate placement within an academic program.
- *Summative* assessment provides information about which learning goals have or have not been achieved at the end of each unit of study.
- In between these measures, dynamic, ongoing *formative* assessment monitors student progress.[1]

Diagnostic and summative assessments are measures *of* what has already been learned. Dynamic formative assessment is assessment *of* learning, *as* learning, and *for* learning because it is a *process* that provides teachers with critical real-time data to inform their further actions, enabling them to offer immediate substantive feedback, differentiate instruction, and group students for further practice.[2] Therefore, a coherent process-based system of low-stakes assessment *of*, *as*, and *for* learning provides students, teachers, school leaders, parents, and policymakers with the information they need to improve the processes of teaching and learning.[3] These assessment types are not mutually exclusive; diagnostic assessments can serve formative purposes. Similarly, formative assessments can also be diagnostic.

When is formative assessment effective?

Effective formative assessment processes help the student to answer three key questions: *Where am I going? Where am I now? How can I close the gap?*[4] While a variety of factors contribute to an effective formative assessment process, four key elements are essential:

1. Learning goals that are clear to the student;
2. High-quality, varied learning tasks aligned to the goals at appropriate levels of challenge;
3. Timely, focused feedback; and
4. Responsive adjustment of teacher instruction and student practice.[5]

Clear learning goals

The very first step in dynamic formative assessment is ensuring that students understand exactly what they are working on. It is not enough for the teacher to simply identify learning outcomes—if students are to persist in working toward a targeted understanding, performance, or skill, they must be able to explain what the target is, how they will know when they have reached it, and how to gauge their progress along the way.[6] Showing students exemplars and/or creating descriptive rubrics for what the end product should include can help to clarify learning goals.[7]

High-quality, goal-aligned learning tasks at appropriate levels of challenge
Well-designed learning tasks and activities that "embody" the learning target provide the practice that is essential to students' academic success.[8] Types of learning tasks include problem-solving challenges, writing projects, and quiz items. Never one-size-fits-all, formative assessment learning tasks should be differentiated by content and process according to student responses and readiness levels. Effective learning tasks motivate students to engage with the material at their own pace and level of difficulty; and provide information about student understanding and skill.[9]

Timely, substantive feedback
Research shows that students who receive focused, helpful comments about their performance learn to better evaluate their own learning needs, readjust their strategies, develop critical thinking skills, engage more productively in their work, and become reflective, self-managing learners.[10] Clear, positive, low-stakes feedback affirms the ways in which students are on the right track and where they have improved, while guiding them to correct their misperceptions, plan next steps, or think about alternative strategies. In-the-moment feedback is most useful because it is offered while the student is still focused on the learning goal and motivated to reach it.[11]

Responsive adjustment of instruction and student practice
No two students are exactly the same. They differ in learning readiness, pace, and in which concepts and skills they still need to master. So following the same sequence and emphases in instruction and practice would never benefit each student equally.[12] Ongoing formative assessment evidence from students' learning tasks guides teachers as to how to re-teach, re-direct, or move students on to the next learning goals and helps students understand what they need to do next.[13]

Formative assessment with digital tools

Online learning environments are particularly suited to dynamic formative assessment. First, student interactions with online learning tasks and activities can be captured, stored, and analyzed for patterns of learning behavior and learning needs. A variety of metrics such as time on task and engagement level with a task can be analyzed in addition to proficiency to gather a better understanding of how a student is doing. Students can also be continuously informed about their performance with badges and rewards as well as any metrics that are available to them. These can also help to motivate students to continue moving along in a program as they gain "points."

Second, the real-time nature of data capture and reporting with digital tools can offer teachers up-to-the minute updates. They may know the effectiveness of the morning lesson by lunch time so that they might reteach some parts in the afternoon or the very next morning. Readjustment of the instruction can take place much faster without having to wait for quiz results. Digital tools can also save teachers time since they don't have to manually grade assignments or quizzes. While analyzing online data requires a learning curve and extra time, online tools have the ability to automatically highlight key areas of need or pinpoint students who are struggling and send alerts.

Lastly, learning goals and content can be customized to each child with adaptive online programs, providing a richer formative assessment experience for students that meets them where they are and better data about how

students are doing for teachers. Online programs can also make real-time adjustments in students' learning paths by analyzing student activity and responding to it with more challenging tasks or perhaps less challenging ones if the student is struggling. This amplifies the teacher impact and helps to differentiate instruction for every student.

Waggle Smart Practice as a formative assessment tool

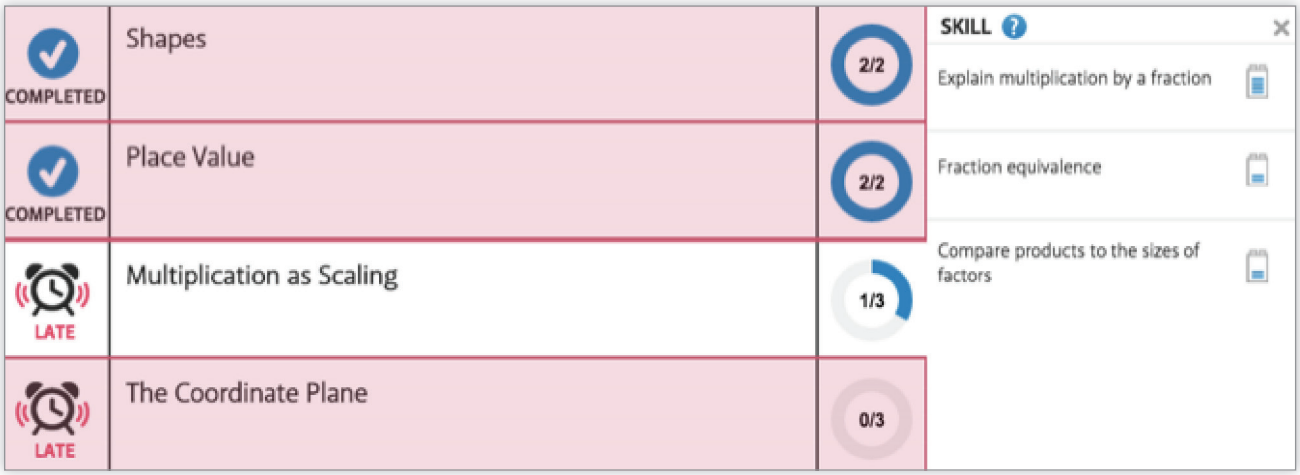
Waggle is one digital tool that offers students a safe, positive environment with scaffolded instruction, in-the-moment feedback, and personalized pathways to practice.Waggle utilizes Knewton's learning recommendation engine which continuously adapts as students work in Waggle and identifies each student's strengths, weaknesses, and learning patterns. As students practice in Waggle, Knewton's engine analyzes all of their activity and progress such as active time on task, how many attempts were made, and for how long a student retains material. Then it determines the next best item for each student to work on to address weaknesses and foster optimal learning progress.

Clear learning goals in Waggle

From their individual dashboards, students understand what goals they are working on and take charge of their own learning. Based upon the goals their teachers have assigned, students can view the skills that lead to the goals and track, via the dashboard battery meter, their progress in applying the skills to accomplish their goals. Students are empowered to choose from their assigned goals and educational games and to decide what they want to work on next.

In the student dashboard pictured below, the goal in progress is "Multiplication as Scaling," which relies upon three requisite skills. The student can easily see that one of the three skills, multiplication by a fraction, has been successfully demonstrated and can move on to practicing the other two skills, fraction equivalence and comparison of products to the sizes of factors.

Waggle Goals and Skills on Student Dashboard



High-quality, goal-aligned learning tasks at appropriate levels of challenge in Waggle

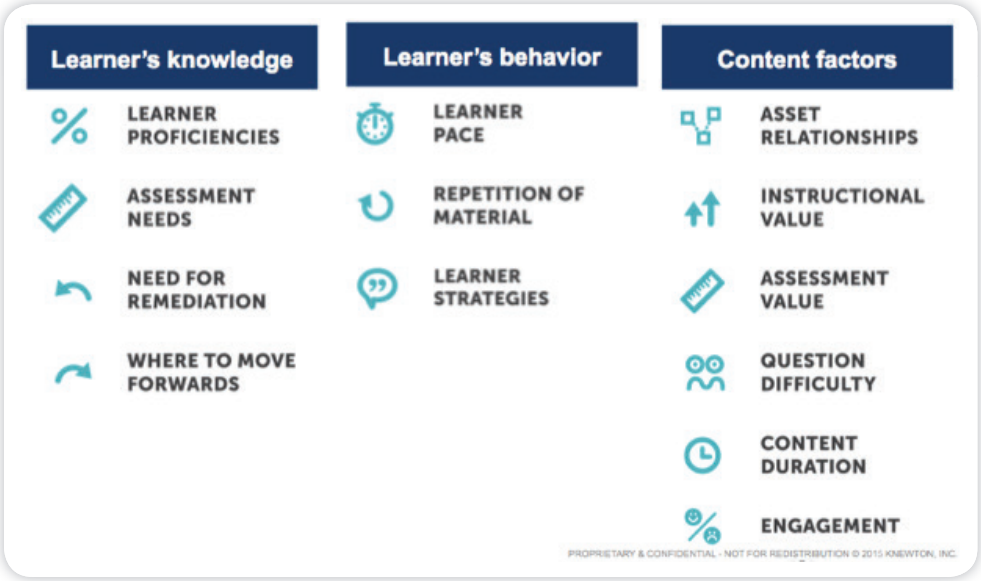
All of the content in Waggle was developed to move through increasing levels of rigor and to provide varied item types to stretch student learning and application. There are eleven different item types including those that require typing in text, graphing, and open response. Varying the item tasks engages students in different ways to ensure that they master skills and standards.

11 Item Types in Waggle

1. Multiple Choice
2. Hot Spot
3. Multiple Select
4. Hot Spot Click to Fill
5. Embed Text and Image
6. Drag and Drop
7. Highlight Text
8. Sorting
9. Embed Text in Text
10. Graph Point/Segment/Line
11. Open Response

By continuously analyzing all of the student's activity, Waggle delivers items that are at the right level of challenge and determines which content will help fortify skills gaps and advance student learning.

What Waggle Considers in a Recommendation

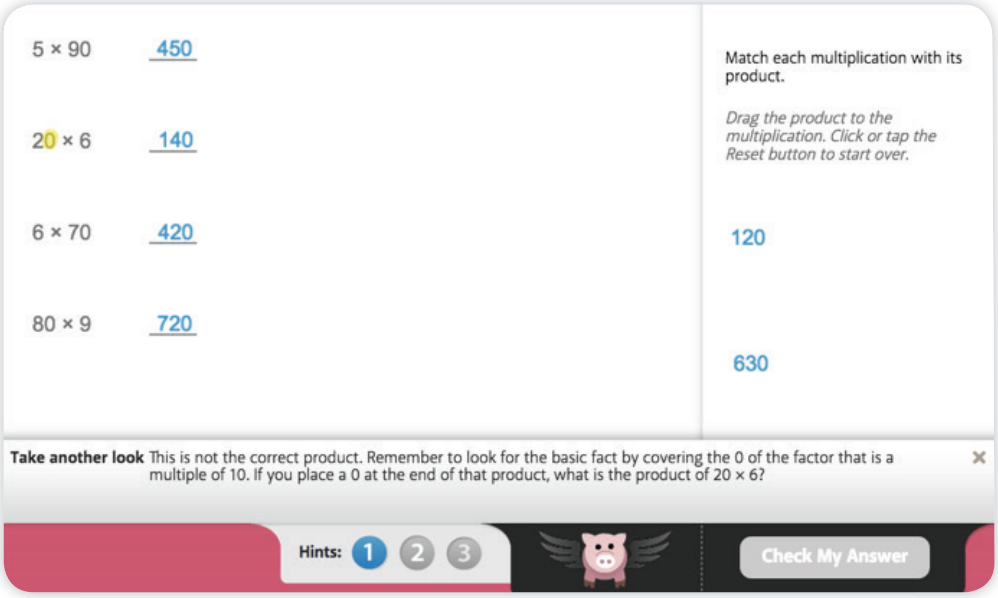


Timely, substantive feedback in Waggle

In every ELA or math practice item, Waggle offers students up to five hints that they can access if they get stuck. In addition, if they get the practice item wrong, Waggle offers specific feedback that helps students approach the problem in a different way, instead of revealing the answer. The student can then reset the problem and tackle it again.

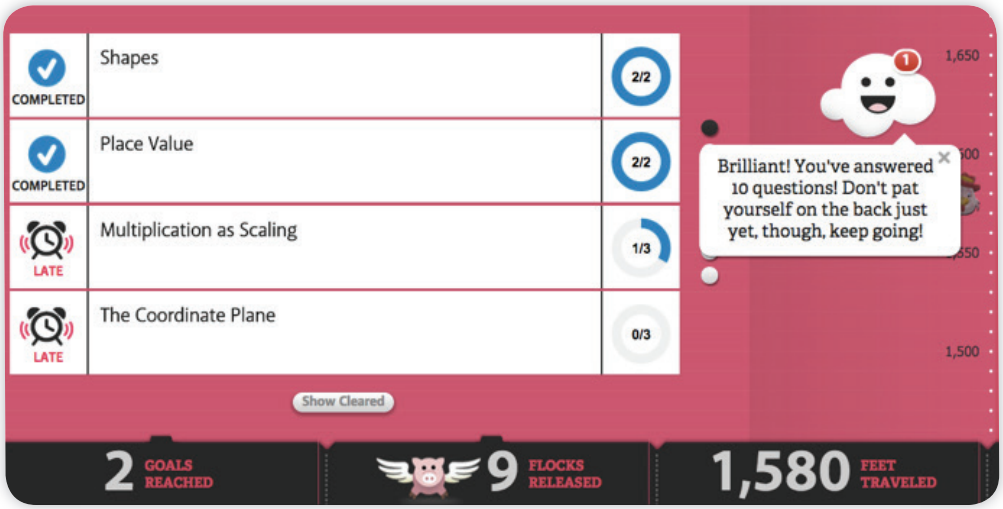
The feedback for each student depends on factors beyond just right and wrong. In the example below, the student has gotten some of the answers correct but has responded incorrectly to one item. Waggle provides specific feedback on that one item and offers guidance on how to approach the problem.

Customized Feedback on Waggle Math Problem



Students see their progress on their dashboard, get hints and explanations until they understand the skill, see the summary of how many learning goals they have reached, and earn rewards in the form of "feet traveled" and "flocks released" for getting several questions in a row correct.

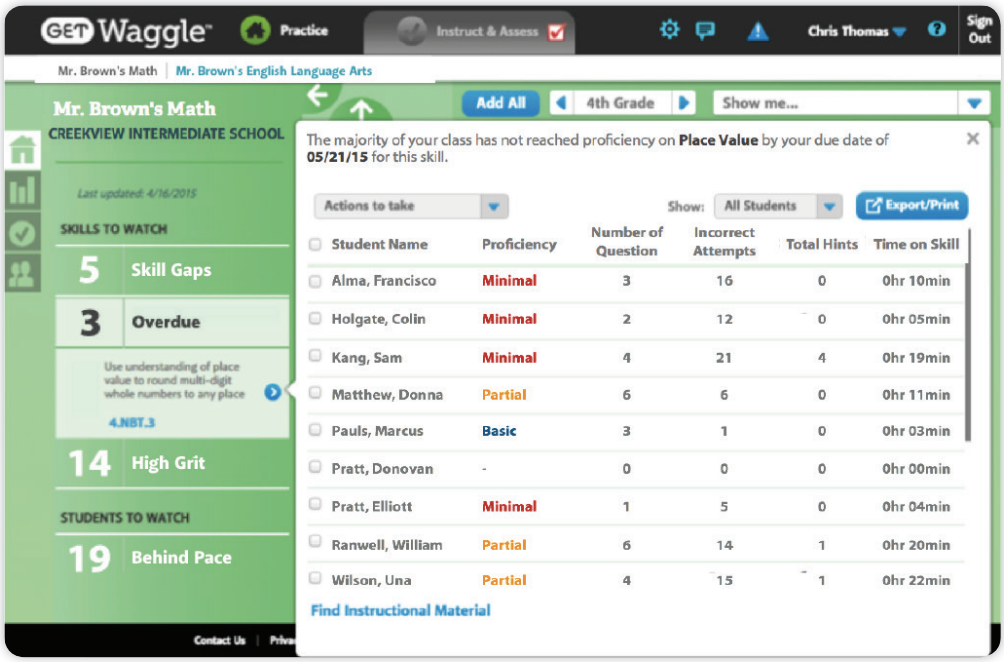
Waggle Student Dashboard with Rewards



Responsive adjustment of instruction and student practice in Waggle

Teachers see every student's progress in real-time and understand which skills students struggle with, how much time they have spent, and their gaps in prerequisite skill knowledge. Based on student progress, Waggle recommends specific lessons and assignments. Teachers can also search to find instructional, practice and assessment content within Waggle. They can then assign that content to the whole class, small groups or individuals to differentiate instruction in real-time.

Class Skills Report



In the above Class Skills Report, the teacher can see that four students are at minimal proficiency in the place value skill. The teacher can group these students in "Actions to take" after selecting their names and then "Find Instructional Material" to identify the lesson to use in a small group session. The teacher will also want to determine why Donovan Pratt has not spent any time on this skill yet. On the left panel, the teacher can view the skills and students needing the most attention.

Conclusion

Both teachers and students can benefit from the advantages that online tools offer for dynamic, formative assessment. Waggle is one digital tool uniquely suited to provide formative assessment that can effectively shape instruction with real-time data reporting, analysis, immediate feedback, and differentiation—critical capabilities educators should consider when evaluating online programs to ensure that they truly support effective student learning.

About the Author

Marcella L. Bullmaster-Day is the Director of the Touro College Lander Center for Educational Research in New York City. She has worked as a teacher, principal, researcher, university professor, corporate executive, curriculum and program designer, and professional development consultant in urban educational contexts for over three decades. Dr. Bullmaster-Day holds a doctorate in Curriculum and Teaching from Columbia University Teachers College.

Endnotes:

[1] McTighe, J. & O'Connor, K. (2005). Seven practices for effective learning. *Educational Leadership*, 63(3), 10 -17.

[2] Heritage, M. (2010). Formative assessment and next-generation assessment systems: Are we losing an opportunity? Report prepared for the Council of Chief State School Officers, Washington, DC. Retrieved 8/16/15 from http://www.ccsso.org/Resources/Publications/Formative_Assessment_and_Next-Generation_Assessment_Systems.html

Herman, J., Osmundson, E., Dai, Y., Ringstaff, C., & Timms, M. (2015). Investigating the dynamics of formative assessment: Relationships between teacher knowledge, assessment practice and learning. *Assessment in Education: Principles, Policy & Practice*, 22 (3), 344 – 367.

[3] Brookhart, S. M., Moss, C. M., & Long, B. A. (2008). Formative assessment that empowers. *Educational Leadership*, 66(3), 52–57.

Darling-Hammond, L. (2010). *Performance counts: Assessment systems that support high-quality learning.* Washington, DC: Council of Chief State School Officers. Retrieved October 7, 2011 from http://www.ccsso.org/publications/details.cfm?PublicationID=381.

Darling-Hammond, L., & Pecheone, R. (2010). *Developing an internationally comparable balanced assessment system that supports high-quality learning.* Paper prepared for the National Conference on Next Generation Assessment Systems, Washington DC, March 8-9, 2010. Retrieved October 7, 2011 from http://www.k12center.org/rsc/pdf/Darling-HammondPechoneSystemModel.pdf.

Lazer, S. (2010). *High-level model for an assessment of common standards.* Paper prepared for the National Conference on Next Generation Assessment Systems, Washington DC, March 8-9, 2010. Retrieved October 7, 2011 from: http://www.k12center.org/rsc/pdf/LazerSystemModel.pdf.

[4] Chappuis, J. (2005). Helping students understand assessment. *Educational Leadership*, 63(3), 39 – 43

Cahppuis, S., & Chappuis, J. (2008). The best value in formative assessment. *Educational Leadership*, 65(4), 14 – 18.

[5] Chappuis, J.; Stiggins, R.; Chappuis, S., & Arter, J. (2012). *Classroom assessment for student learning: Doing it right – using it well.* (Second Edition). New York: Pearson.

Leahy, S., Lyon, C., Thompson, M., & Wiliam, D. (2005). Classroom assessment: Minute by minute, and day by day. *Educational Leadership*, 63(3), 18 – 24.

Wiliam, D. (2011). *Embedded formative assessment.* Bloomington, IN: Solution Tree.

[6] Fisher, D., & Frey, N. (2007). *Checking for understanding: Formative assessment techniques for your classroom.* Alexandria, VA: ASCD.

Marzano, R.J. (2009). *Designing & teaching learning goals and objectives.* Bloomington, IN: Marzano Research.

Moss, C.M., Brookhart, S.M., & Long, B.A. (2011). Knowing your learning target. *Educational Leadership*. 68 (6). 66 – 69.

[7] Andrade, H. L., Du, Y., & Mycek, K. (2010). Rubric-referenced self-assessment and middle school students' writing. *Assessment in Education*, 17(2), 199–214.

Andrade, H. L., Du, Y., & Wang, X. (2008). Putting rubrics to the test: The effect of a model, criteria generation, and rubric-referenced self-assessment on elementary students' writing. *Educational Measurement: Issues and Practice*, 27(2), 3–13.

Arter, J. A., & Chappuis, J. (2006). *Creating and recognizing quality rubrics.* Boston: Pearson.

Arter, J. A., & McTighe, J. (2001). *Scoring rubrics in the classroom.* Thousand Oaks, CA: Corwin Press.

Brookhart, S.M. (2013). *How to create and use rubrics for formative assessment and grading.* Alexandria, VA: ASCD.

Chappuis, J. (2009). *Seven strategies of assessment for learning.* Boston: Pearson.

Handley, K., & Williams, L. (2011). From copying to learning: Using exemplars to engage students with assessment criteria and feedback. *Assessment & Evaluation in Higher Education*, 36(1), 95 – 108.

[8] Sweller, J., van Merrienboer, J., & Paas, F. (1998). Cognitive architecture and instructional design. *Educational Psychology Review*, 10(3), 251– 296.

[9] Moss, C.M., & Brookhart, S. M. (2009). *Advancing formative assessment in every classroom: A guide for instructional leaders.* Alexandria, VA: ASCD.

[10] Assessment Reform Group. (2002). *Assessment for learning: 10 principles.* London: Author.

Beyer, B.K. (2008). What research tells us about teaching thinking skills. *Social Studies*, 99(5), 223 – 232.

Black, P., & Wiliam, D. (1998). Inside the black box: Raising standards through classroom assessment. *Phi Delta Kappan*, 80(2), 139 – 144.

Black, P., Harrison, C., Lee, C., Marshall, B., & Wiliam, D. (2003). *Assessment for learning: Putting it into practice.* Buckingham, UK: Open University Press.

Black, P., Harrison, C., Lee, C., Marshall, B., & Wiliam, D. (2004). Working inside the black box: Assessment for learning in the classroom. *Phi Delta Kappan*, 86(1), 9 – 21.

Bransford, J.D., Brown, A.L., & Cocking, R.R. (Eds.) (2000). *How people learn: Brain, mind, experience, and school.* Washington, DC: National Academy Press.

Bransford, J.D., Brown, A.L., & Cocking, R.R. (2008). Mind and brain. In *The Jossey-Bass reader on the brain and learning.* San Francisco: Jossey-Bass.

Brookhart, S. M., Moss, C. M., & Long, B. A. (2009). Promoting student ownership of learning through high-impact formative assessment practices. *Journal of MultiDisciplinary Evaluation*, 6(12), 52 – 67.

Chappuis, J. (2009). *Seven strategies of assessment for learning.* Portland, OR: ETS Assessment Training Institute.

Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research*, 77(1), 81 – 112.

Marzano, R.J., Gaddy, B.B., and Dean, C. (2000). *What works in classroom instruction.* Aurora, CO: Mid-continent Research for Education and Learning (McREL).

Marzano, R.J. (2003). *What works in schools: Translating research into action.* Alexandria, VA: ASCD.

Marzano, R.J. (2007). *The art and science of teaching.* Alexandria, VA: ASCD.

Pressley, M., & Harris, K. (2001). Teaching cognitive strategies for reading, writing, and problem solving. In A. Costa (Ed.), *Developing minds: A resource book for teaching thinking*, pp. 266 – 270. Alexandria, VA: ASCD.

Qualifications and Curriculum Authority. (2003). *Assessment for learning: Using assessment to raise achievement in mathematics.* London: Author.

Sadler, D. R. (1989). Formative assessment and the design of instructional systems. *Instructional Science*, 18, 119–144.

Shepard, L. (2005). Linking formative assessment to scaffolding. *Educational Leadership*, 63(3), 66 – 71.

Stiggins, R., & DuFour, R. (2009). Maximizing the power of formative assessments. *Phi Delta Kappan*, 90(9), 640 – 644.

Tamim, M., & Zhang, D. (2008). Instructional interventions affecting critical thinking skills and dispositions: A stage 1 meta-analysis. *Review of Educational Research*, 78(4), 1102 – 1134.

Van-Tassel-Baska, J., Bracken, B., Feng, A., & Brown, E. (2009). A longitudinal study of enhancing critical thinking and reading comprehension in Title 1 classrooms. *Journal of Education for the Gifted*, 33(1), 7 – 37.

[11] Brookhart, S. M. (2008). *How to give effective feedback to your students.* Alexandria, VA: ASCD.

Butler, D. L., & Winne, P. H. (1995). Feedback and self-regulated learning: A theoretical synthesis. *Review of Educational Research*, 65, 245–281.

[12] Gregory, G., & Chapman, C. (2002). *Differentiated instructional strategies: One size doesn't fit all.* Thousand Oaks, CA: Corwin Press.

Lewis, S., & Batts, K. (2005). How to implement differentiated instruction? Adjust, adjust, adjust. *Journal of Staff Development*, 26(4), 26–31.

Medina, J. (2008). *Brain rules.* Seattle, WA: Pear Press.

Nordlund, M. (2003). *Differentiated instruction: Meeting the educational needs of all students in your classroom.* Lanham, MD: Scarecrow Education.

Rock, M. L., Gregg, M., Ellis, E., & Gable, R. A. (2008). REACH: A framework for differentiating classroom instruction. *Preventing School Failure*, 52(2), 31–47.

[13] Dean, C. B., Stone, B., Hubbell, E., & Pitler, H. (2012). *Classroom instruction that works: Research-based strategies for increasing student achievement* (2nd ed.). Alexandria, VA: ASCD