Strategies for Dynamic Formative Assessment with Digital Tools

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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 dynamic, ongoing 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, was designed according to these research-based principles 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 been achieved at the end of each unit of study and which have not.
- 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 students 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 contributes 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 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 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. 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.

Timely, substantive feedback
Research shows that students who receive focused, helpful comments about their performance learn to better evaluate their learning needs, readjust their strategies, develop critical thinking skills, engage more productively in their work, and become reflective, self-managing learners. 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.

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. Following the same sequence and emphases in instruction and practice would never benefit each student equally. Ongoing formative assessment evidence from students’ learning tasks guides teachers as to how to re-teach, re-direct, or move students on to new learning goals and helps students understand what they need to do next.

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 help to motivate students to continue moving along in a program as they gain “points” and recognition.

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 re-teach some parts in the afternoon or the next day. Readjustment of 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 takes time, online tools have the ability to automatically highlight key areas of need or pinpoint students who are struggling and send alerts to teachers.

Finally, learning goals and content can be customized to each student with adaptive online programs, providing a richer formative assessment experience that meets students where they are and generating better data for
teachers on student progress. Online programs can make real-time adjustments in students’ learning paths by analyzing student activity and responding to it with more or less challenging tasks depending on student performance. This amplifies teachers’ instructional 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, including active time on task, number of attempts made, and length of time 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 which goals they are working on and take charge of their learning. They can view the skills that lead to the goals and track their progress via the Dashboard Battery Meter. 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 he or she 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**

![Waggle Goals and Skills](image)

*High-quality, goal-aligned learning tasks at appropriate levels of challenge in Waggle*
All of the academic content in Waggle was developed to move students through increasing levels of rigor and to provide varied item types to stretch student learning and application. Waggle’s eleven different item types include tasks that require typing in text and graphing. Varying the item tasks engages students in different ways to ensure that they master skills and standards.
By continuously analyzing students’ knowledge and behavior, and the academic content, Waggle delivers items that are at the right level of challenge and determines which content will help close skills gaps and advance student learning.

### What Waggle Considers in a Recommendation

<table>
<thead>
<tr>
<th>Learner’s knowledge</th>
<th>Learner’s behavior</th>
<th>Content factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learner Proficiencies</td>
<td>Learner Pace</td>
<td>Asset Relationships</td>
</tr>
<tr>
<td>Assessment Needs</td>
<td>Repetition of Material</td>
<td>Instructional Value</td>
</tr>
<tr>
<td>Need for Remediation</td>
<td>Learner Strategies</td>
<td>Assessment Value</td>
</tr>
<tr>
<td>Where to Move Forwards</td>
<td></td>
<td>Question Difficulty</td>
</tr>
</tbody>
</table>

**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 practice items wrong, instead of revealing the answer, Waggle offers specific feedback that helps students approach the problem in a different way. Students can then reset the problems and try again.

The feedback for each student depends on factors beyond just right and wrong. In the following math example, 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

| 5 × 90  | 450  |
| 28 × 6  | 140  |
| 6 × 70  | 420  |
| 80 × 9  | 720  |

Match each multiplication with its product.

Drag the product to the multiplication. Click or tap the Reset button to start over.

Take another look: This is not the correct product. Remember to look for the basic fact by covering the 0 of the factor that is a multiple of 10. If you place a 0 at the end of that product, what is the product of 20 × 6?

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 answering several questions in a row correctly.

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 are struggling with, how much time they have spent, and their gaps in prerequisite skill knowledge. Using this information, teachers can immediately create ad hoc student groups to work on a specific skill. Based on student progress, Waggle recommends specific lessons and assignments that teachers can either assign to the whole class, small groups, or individuals within Waggle or use during class to re-teach content to all or select students.
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.

Conclusions
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:


