

# How Students Learn



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## To Improve Student Learning, We Must Understand How Students Learn

In the wilderness of educational practices, programs, and interventions, ranging from charter schools, to phonics instruction, to peer instruction, one practice has been shown, time and time again, to greatly improve student learning: **feedback**. It is one of the most researched and documented ways of how students learn. In this white paper, we review the educational research literature about how students learn through feedback and how educational assessment technology can be an effective tool for teachers to improve feedback and consequently improve student learning.

### What is Feedback?

Feedback is information regarding aspects of one's performance or understanding that reduces the discrepancy between what is understood and what is aimed to be understood.<sup>i</sup> According to John Hattie, Professor of Educational Psychology at the University of Auckland, the purpose of feedback is to reduce the discrepancy between current performance and a desired goal. Feedback can provide cues that capture a person's attention, direct attention to the processes to accomplish the task, provide information about erroneous hypotheses, and be motivational so that students invest more effort or skill in the task.<sup>ii</sup> Similarly, Valerie Shute, Professor of Educational Psychology and Learning Systems at Florida State University, argues that the goal of feedback is to enhance learning, performance, or both, engendering the formation of accurate, targeted conceptualizations and skills.<sup>iii</sup>

### Types of Feedback

Feedback comes in many forms and styles. Shute presents a summary of different types of feedback, loosely organized by complexity. In the simplest case, feedback can be **verification** -- such as giving information about whether the performance was correct or incorrect. Feedback can be **error-flagging** -- locating the mistake for learners, without providing the correct answer. At a more complex level, feedback can be **elaboration** -- providing

explanations why a specific response was correct, and allowing the learner to review part of the instruction. It can be **topic-contingent** -- providing learners with information relating to the target concept or skill being studied. It can be **response-contingent** -- providing feedback that focuses on the learners' specific responses, describing why the answer is incorrect and why the answer is correct.<sup>iv</sup> Regardless of the complexity level of the feedback, Shute finds that feedback is effective when it is non-evaluative, supportive, timely, and specific. Feedback that lacks specificity may cause students to view it as useless and lead to uncertainty about how to respond to the feedback.

*Feedback is effective when it is non-evaluative, supportive, timely, and specific.*

Not all feedback is beneficial. Feedback produces negative learning effects when it is constructed as critical or controlling. It also has negative effects when it interrupts a student who is actively engaged in problem solving. It doesn't have positive learning effects when it is just praise on performance or effect (i.e., "you did great" or "you really tried hard").

### Why Feedback Works

Hattie posits that feedback is effective because it incorporates three major questions and four major dimensions of learning.

The first question is "**where am I going?**" When students understand their goals and what success at those goals look like, then feedback is more powerful and effective. These goals should be transparent and well communicated.

The second question is related to progress feedback: **How am I going?** It is important for students to know their current status relative to the desired goal or standard. This is information about progress and how to proceed.

The third question, “Where to Next?” is more consequential. This helps students choose the next most appropriate challenges, and different strategies and processes to accomplish those tasks.

### *Three Feedback Questions:*

*Where am I going?*

*How am I going?*

*Where to Next?*

To maximize student learning, feedback should aim to address one or more of these questions specifically and in a timely manner. When providing feedback, teachers should be cognizant of the feedback question that it addresses.

Feedback is also effective because it can work at four levels or dimensions. First, at the **Task** level, feedback can let a student know whether the performance on the task was correct or incorrect or whether more information is needed. At the **Process** level, students are provided feedback on the strategies that are needed to perform the task. Students may be given alternative strategies to consider or use. Feedback at this level helps students learn the relationships among ideas.

### *Four Dimensions of Feedback:*

*Task*

*Process*

*Self-Regulation*

*Self*

Third, at the **Self-Regulation** level, students monitor, direct, and regulate actions towards the learning goal. This is the capability to create internal feedback and to self-assess. This can be where students develop confidence in the correctness of the response. Feedback at the fourth level, **Self**, is ever present and almost useless. This is personal evaluation and affect about the learner. Praise such as “good girl!” or “you’re doing great!” does not have positive learning effects.

### **Effect of Feedback**

How effective is feedback? The effect on student learning and achievement can be measured by a statistic called the effect size. A value of 0 has no effect. Negative values have decreased effects; they actually hinder student learning. Positive values enhance student learning.

Across more than 800 meta-analyses and 50,000 studies, Hattie found that reducing class size has an effect size of .20.<sup>v</sup> This translates to a 10% improvement in the rate of learning. Across all the studies, the average effect size was 0.40. The effect of feedback was 0.73, almost 4 times more powerful than reducing class size. This is in the top ten among the hundreds of programs and interventions investigated by Hattie.

Clearly, feedback is effective. It leads to improved student achievement and learning. It is most effective when it is timely, specific, and related to one of the three questions. Feedback that works at the self-regulation level, where it requires students to engage in metacognition (i.e., to think about what they know and don’t know) has also been found to be most effective. Feedback should not be praise regarding effort or performance.

*The average effect size of feedback is 0.73. That’s four times larger than the effect of reducing class size.*

## Feedback and Assessment

Feedback is a fundamental process in assessment. We have to measure to know where the students are, so that we can direct or instruct them to where they need to go. Based on assessment results, teachers can give feedback to verify the correctness of the student response. They can give feedback to explain the rationale for the correct answer and for incorrect responses.

Hattie found that feedback is most effective when it is frequent. He found that a typical student receives one piece of feedback every 25 minutes.<sup>vi</sup> That's a lot of data to collect and to monitor. As Shute found in her research, feedback is most effective when it is efficiently and timely given and received.

*Feedback should not be a one-way street.*

In today's world of bubble sheets, scanners, and crowded classrooms, teachers find it difficult to provide timely and specific feedback to their students. Students don't find assessment feedback that comes days or weeks later informative or useful. At that time, they probably have already forgotten about the strategies they used to solve the problems on the test. It is no longer timely and relevant. Students lack a mechanism to efficiently self-assess and self-regulate. Teachers lack a mechanism to aggregate and make sense of all the feedback data. This is where assessment technology can play a pivotal role.

Also, feedback does not have to occur in a vacuum. It should not be provided just after the assessment is completed. It can and should be provided during and post assessment. And feedback should not be a one-way street. It should not be just teachers giving feedback to students. What Hattie and Shute and other researchers have found is that student self-assessment (i.e., students giving feedback about and to themselves) can be equally or even more effective than feedback solely from the teacher. In fact, Hattie found that student self-assessment and self-reported grades were shown to have the largest effect size among educational practices and interventions.<sup>vii</sup>

This is where educational technology and, more specifically, educational assessment technology can greatly help teachers and students engage in effective and efficient feedback. A good assessment technology platform allows teachers to give more frequent and specific feedback to their students by efficiently and quickly identifying student performance by learning objective, and correlating that to additional information such as student confidence, reflection, and justification/journaling to provide a more complete picture of student performance. Online assessment platforms can provide teachers with immediate results about how their students performed on the overall assessment or on specific questions. It can provide them with feedback about the entire class, about a group of students, or about each specific student.

## Educational Assessment Technology and Feedback

When teachers use an online educational assessment system, they are able to quickly assess their students, and immediately receive feedback about their learning. They can know more than just whether the students got the answer right or wrong. They can gain knowledge about student learning by standards and gain insight into student thinking (e.g., what strategies they used and how confident they were in their answers).

*"I love that before students step out of the room I know if they are understanding what I taught."*

*Deb Meyer, Social Studies Teacher, Meyer Middle School*

The Naiku assessment platform is an example of such an educational assessment technology. Naiku provides teachers the ability to readily assess, monitor, and inform feedback on student progress in real-time. At the most basic level, Naiku moves assessment from number 2 pencils and Scantron bubble sheets to computers, tablets,

and smart phones. But it is a lot more than computer based testing. Naiku is a full solution assessment platform that allows teachers to collect student knowledge and provide feedback on a daily basis. Teachers can create, share, and give formative assessment, weekly short quizzes, or midterm or end of course exams with Naiku.

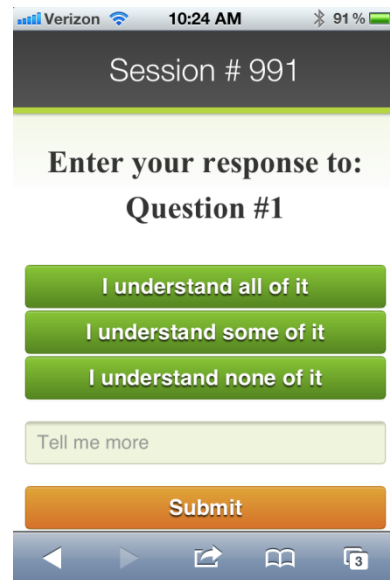
In terms of feedback, students can get immediate feedback at the task level about what they got right or wrong. For example, Deb Meyer, an 8<sup>th</sup> grade teacher at Meyer Middle School in River Falls, WI, who uses Naiku with her social studies class, finds that she knows what her students understand before they step out of the room and the students know as well. With Naiku, teachers can also give feedback at the process level to their students by giving rationale statements about strategies for obtaining the correct solution or by directing them towards different new activities and challenges based on their results on that assessment.

Assessment technology platforms not only give immediate feedback, they can greatly facilitate the giving and receiving of feedback by both teachers and students. Here's a look at some of the unique ways that Naiku incorporates and uses feedback in the assessment process.

### Naiku Quick Question

For daily, one-the-fly formative assessment, Naiku provide teachers with a tool called Quick Question. This is polling software that teachers can use to check for understanding at any time – whether they have an item or assessment prepared in advance or not. Did they understand today's lesson? Let's take a quick check with Quick Question. The teacher verbally asks a question, shows it on the projector, or other means, and students respond on their computer, tablet, or smart phone. Instantly, the teacher is given feedback from the students. For example, the teacher can ask an exit tag question before the class ends to see if the students understood the lesson for the day. Teachers click on Exit Tag to start accepting responses, and students respond by saying that they understood it all, some of it, or none of it. In addition, they also can tell the teacher more about that they know or do not know in a free field text entry to personalize their response.

Quick Question is essentially much like student response systems ("clickers") that are being used in many



classrooms, in that teachers can receive instant feedback on student knowledge. With today's web based technology in Quick Question, however, there is no proprietary hardware needed – students can use a Smartphone, tablet, or any other web enabled device. Plus, the range of item types – including Exit Tag and Short Answer/Text, are far more versatile than the simple T/F and Multiple Choice of the typical clicker. The best part about Quick Question, though, is that it is free formative assessment resource for teachers.

### Naiku Journaling, Confidence, and Reflection

In addition to Naiku's formative assessment features, Naiku also uniquely includes a student journaling, confidence, and reflection mechanisms. Journaling is where students can set goals, reflect on those goals, and share them with their teachers. This works at the self-regulation dimension as described by Hattie. Again, this is feedback that students can give daily to themselves and to their teachers.

Another key feedback mechanism in Naiku is our Confidence feature. This is where students engage in self-assessment as they take an assessment. As they answer each test question, they can rate their level of confidence in the answer. Corresponding to this they can also explain and justify their answer. Again, this is feedback via self-

assessment at the self-regulation level. Researchers have shown that when students predicted their performance in mathematics, it provoked the students to connect among mathematical ideas that they learned; which promoted understanding of mathematics. <sup>viii</sup>

Naiku

CLASSES RESULTS STUDY ROOM Buddy Holly LOG OUT

Sample Test with Varied Items: Reflection

1 2 3 4 5 6 7 8 9 10 Previous Next Save

If  $X \text{ km}^2$  is the surface area of the given prism, what is the value of  $X$ ?

NUMBER ANSWER  
212

RATIONALE  
The total surface area is the sum of the area of each of the six sides.  $212 = 2(8 \times 9 + 8 \times 2 + 9 \times 2)$

9 km 8 km  
2 km 9 km  
Your answer was 212

You rated your confidence: High  
Your "tell me more":  $2 \times 2 \times 9 = 36$   
 $2 \times 8 \times 9 = 144$   
 $2 \times 2 \times 8 = 32$   
Total = 212

Reflect on your answer

I Know and Understand  
 Succeeded Correctly  
 Simple Mistake  
 Don't Quite Understand Concept  
 Don't Understand At All  
 Difficult Time Personally

Lastly, Naiku also encourages students to reflect on their performance after the assessment. Immediately after submitting their test, students are able to review their score and individual answers. When coupled with automatically provided teacher rationale, students can quickly reflect on their answer selections and determine why they got the question right or wrong. For example, upon further reflection, a student may realize that she truly knows and understands the concept when she got the question correct, or she may realize that she guessed correctly. If the student got the question wrong, she perhaps made a simple mistake, or perhaps did not understand the concept at all. Reflection works closely with confidence. When students predict their performance by rating their confidence, and then reconcile their prediction against actual performance through reflection, they are working at the self-regulation level and are developing their meta-cognitive thinking skills.

## Conclusion

Feedback is a great mechanism for improving student learning. To maximize the potential for increasing student achievement from feedback, feedback must be frequent, specific, and related to the task. Educational assessment technology platforms like Naiku can be great tools that help teachers improve learning and achievement through effective and efficient feedback.

<sup>i</sup> Hattie, J.A. C., & Timperly, H. (2007). The power of feedback. *Review of Educational Research*, 77(1), 81-112.

<sup>ii</sup> Hattie, J.A.C., & Gan, M. (2011). The use of feedback to make learning visible to the teacher and learner. In R. Mayer & P. Alexander (Eds.), *Handbook of Research on Learning and Instruction*.

<sup>iii</sup> Shute, V. J. (2008). Focus on Formative Feedback. *Review of Educational Research*, 78(1), 153 -189.

<sup>iv</sup> *ibid*

<sup>v</sup> Hattie, J.A.C. (2009). *Visible learning: A synthesis of 800+ meta-analyses on achievement*. Oxford, UK: Routledge.

<sup>vi</sup> *Ibid*.

<sup>vii</sup> *Ibid*.

<sup>viii</sup> Kasmer, L. A. & Kim, O. (2012). The nature of student predictions and learning opportunities in middle school algebra. *Educational Studies in Mathematics*, 79(2), 175-191.