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Designing Tools and Interventions for a more Engaging Formative

Feedback Process

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Designing Tools and Interventions for a more Engaging Formative Feedback Process

by

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Report

Presented to the Faculty of the Graduate School of

The University of Texas at Austin

in Partial Fulfillment

of the Requirements

for the Degree of

Master of Fine Arts

The University of Texas at Austin

May 2014

Acknowledgements

Abstract

Designing Tools and Interventions for a more Engaging Formative Feedback Process

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The University of Texas at Austin, 2014

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Abstract: To teach effectively, teachers rely on feedback from their students. But students often dislike conventional forms of feedback such as taking tests or answering questions in front of their peers. For my MFA thesis project, I have designed tools that k-12 educators can use to elicit formative feedback, even from quiet and reserved students and those who do not feel their feedback is of value. My overarching intent with these low-stakes, low-tech, inexpensive tools is to improve teaching and learning. By giving teachers tools that generate useful feedback in a way that is low-stakes for the students, all students are given a voice. Through this design process, I also developed some generalizable principles about the way in which good formative feedback can be elicited in learning environments.

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Introduction

The notion of speaking in class is one I will always inherently associate with fear and discomfort. This is because of an experience I had as an elementary school student. The teacher listed several multiplication problems on the black board and students whom she called upon were expected to stand up and answer the problems aloud. At the very moment of being called upon, I had an epileptic seizure. It was not my first seizure, but it was the first one I ever had in front of my teacher or classmates. I was not frightened by the seizure itself, but rather by the embarrassment it caused me in front of my peers. The seizures subsided eventually, but the panic of being called upon did not. I often tuned out during high school lectures, and the fear of having a seizure in front of my peers was soon replaced by the fear of being "caught" not paying close enough attention.

From that point forward, I chose to avoid the teacher's eye and became invisible in class. The risk I perceived of speaking up in class outweighed the incentive to participate in the process of providing my teachers with feedback. In reflection, I see that my silence as an adolescent limited how deeply my teachers could understand and cater to my educational needs.

What happens when high school students are disengaged from the process of providing teachers with feedback? Useful feedback is essential to effective teaching and learning in any classroom because it gives all parties, the teacher and the students, leverage. When teachers receive informative feedback, they can identify problems and respond to the needs of their students. Effective feedback loops allow students to display expertise, which builds the confidence needed to think and participate critically. It also gives students the opportunity to actively engage with the material. A classroom in which

students are not participating in the feedback process is one where the teacher will inevitably struggle to do his or her job as a facilitator of learning.

As an undergraduate student and later as a graduate student, I eventually overcame my fear of speaking in class. By inquiring out loud, answering questions, and engaging in dialogue with my peers, I became engaged in the process of, and fully devoted to, building upon my own knowledge. The classroom is no longer a place of fear for me, but a place of achievement and pride. These are emotions I wish I had known as a high school student.

This personal experience as a silent high school student is what led me to the overarching questions that directed my research for this MFA thesis project:

1. What types of feedback are teachers gathering, how are they gathering it, and what feedback tools or mechanisms are they using to do so?

2. What happens during the feedback process?

3. What motivates students to participate in the feedback process, and in what ways do students perceive a benefit from this process?

Those questions led to more design-specific questions focusing on ways of addressing the problem of disengaged students. These are the questions that have framed my design work for the MFA thesis project:

1. What interventions can I design that will help teachers elicit the most and best quality feedback in a way that does not alienate or disengage students from the feedback process?

2. Can an iteration of these interventions be tested in a different arena of learning? Can iterations of my interventions function in a gallery or museum setting, which is fundamentally also a space of learning?

In seeking to answer those questions, I was able to devise a set of principles to guide my design process. Those principles are as follows:

1. Formative feedback from learners is necessary for facilitators because the source of the feedback is external to the facilitator.

2. Feedback mechanisms that entail too much risk for the learner will not yield high participation.

3. Feedback mechanisms that fulfill the psychological needs of the learners will encourage higher participation.

4. For learners to want to participate, they need to know that their ideas are valuable.

This MFA thesis Report documents the contextual research, methods, and processes that shaped my design of a series of interventions intended to improve the ways in which teachers in secondary school classrooms, and, secondarily, curators within gallery settings, gather feedback.

Chapter 1: Research

WHAT TYPE OF FEEDBACK ARE TEACHERS GATHERING?

The word "feedback" in the context of conventional secondary level education conjures a very specific image: a test. But tests are summative assessments that measure student learning at the end of instruction. Once the student's learning has been evaluated, it is measured against curriculum benchmarks. In other words, summative assessment evaluates learning that should have already occurred, which does not help teachers redirect and adjust (Black and William, 1998, pp. 1-2). Yet, U.S. curriculum standards tend to measure school performance and apportion funding through summative assessment (Black and William, 1998; Black and William, 2005, p. 257).

In contrast, formative assessment provides feedback during instruction that allows teachers to adjust quickly in order to better serve their students (Bloom et al, 1971, p. 117). Formative assessment is not a measurement tool, but rather "a process that is fundamental and indigenous to the practice of teaching and learning" (Heritage, 2010). Black and William (1998) say that this process is embodied in many activities in which teachers and students engage: "Teachers can find out what they need to know in a variety of ways, including observation and discussion in the classroom and the reading of pupils' written work" (Black and William, 1998, p. 2).

Intent is the fundamental difference between summative assessment and formative assessment. Policy dictating federal curriculum standards has been constrained to emphasize summative testing over less formal, less measurable formative assessment (Black and William, 1998). In the United States, this is because school accountability is measured through summative assessments, and school accountability determines school funding beyond local taxation (Black and William, 2005, p. 257). As a result of policy, literature on student feedback interventions heavily stresses summative assessment. To

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understand how formative feedback is useful, I needed to look beyond educational literature to find relevant metaphors.

The feedback loop is a mechanism employed to change behavior. Thomas Goetz (2011) describes the phenomenon by exploring how dynamic speed display signs change behavior. Dynamic speed display signs are often the answer when new speed-limit signs and increased ticketing both fail to curtail speeding and the subsequent automobile-pedestrian-cyclist accidents that are a result of speeding in school and shopping zones.

Illus. 1. Dynamic Speed Display Sign: a feedback loop used to curtail speeding. Photo: Serenethos/Shutterstock.com (editorial use only license).

Dynamic speed displays, often labeled with "Your Speed" in big bright colors, give drivers information in real time about how fast they are driving. However, this information is already available inside each driver's vehicle. Speedometers inside cars are easy to ignore, in part because the feedback they provide feels private and subjective. Dynamic speed displays work better because they are an outside source of feedback that confirms the accuracy of the car's speedometer and calls attention to it publicly. They encourage drivers to change their behavior because the drivers know the numbers are visible to others. Goetz (2011) says that this is because feedback loops, like the dynamic speed sign, work by tapping into human aspirations:

> Like any organism, humans are self-regulating creatures, with a multitude of systems working to achieve homeostasis. […] Feedback loops are how we learn, whether we call it trial and error or course correction. In so many areas of life, we succeed when we have some sense of where we stand and some evaluation of our progress. Indeed, we tend to crave this sort of information; it's something we viscerally want to know, good or bad. (p. 5)

Feedback loops, like the dynamic speed display signs, give us knowledge about where we stand by offering feedback that is external from our own judgment, thus encouraging us to self-regulate by changing or maintaining some behavior. Without that external feedback, we only have our personal insight to guide our behavior.

In the classroom scenario, the teacher is responsible for getting students to meet a series of benchmarks in each lesson. By asking the right questions and encouraging students to answer, teachers are creating a feedback loop. For this loop to work, students must actively participate. Without their participation, the teacher has no external source of feedback. The act of gathering feedback alone is not what makes the feedback loop effective. It is the adjustments that teachers make to the subsequent lesson, the change in behavior, that close the loop.

Review of Various Formative Feedback Strategies and Tools

My goal with the MFA thesis project was to design a strategy or tool that would help teachers create an effective and dynamic feedback system. A series of useful precedents gave me a more concrete understanding of the strategies and tools already available to teachers. While some of these kinds of tools are useful, not all of them are necessarily available to every teacher. Furthermore, some tools and strategies work to engage certain types of students, but not others.

The most commonly used method for gathering formative feedback is the oral question-and-answer or dialogue format used by public school teachers at all grade levels. A teacher poses a question to a classroom of students, and those students who choose to participate raise their hands. The teacher then calls on one student and that student responds to the question. Teachers can adjust this method to call on each student in the classroom by cycling through names alphabetically or by moving from seat to seat and row to row. This traditional mechanism for gathering formative feedback is indeed useful to the teacher because it is instantaneous. Classroom discourse in general is important because it promotes better learning.

> When something is put into words, it promotes control of the knowledge that is being expressed […] Questioning generates the kind of talk and communication that can lead to learning; questioning reveals to the teacher the readiness of the student to take control; and questioning by both students and teacher establishes the communicative nature of the classroom. And it is the nature of the discourse that dictates the quality of learning (Morgan & Sexton, (2002) p. 74)

Morgan and Sexton (2002) contend, however, that not all questioning is fruitful. The quality of the responses a teacher is looking for is impacted by everything from the wording, timing, and tone that the teacher takes with a question to the background, experiences, and prior knowledge of the students (p. 75). If these factors are not addressed, a teacher may have the dilemma of few or no students raising their hands and

answering when called upon. In that case, the teacher is left with little feedback. How, then, can a teacher adjust the lesson to the students' current state of knowledge?

Teachers use written work as another outlet to gather formative feedback. One example of a tool developed specifically for the purpose of low-stakes, written formative feedback is the Minute Paper, which was originally developed by T.A. Angelo and K.P. Cross (1993) for *Classroom Assessment Techniques: A Handbook for College Teachers*. This written assessment gives the teacher an idea of whether or not the objective he or she had for the lesson is what the students understood the objective to be. The prompt is worded in a way that elicits a fairly fluid and open-ended response from a willing student participant. As the title of the handbook suggests, this tool was initially intended for use by learners at a higher post-secondary level. However, teachers at various levels from elementary to high school have adapted the premise of the Minute Paper.

The Minute Paper and its adaptations are usually completed and turned in at the end of class or at some break in the lesson. While these tools do provide teachers with the opportunity to gather feedback from each student, the medium of writing has its drawbacks. The most notable disadvantage is that the Minute Paper is a document that looks very similar to most other assignments that students turn in everyday in classrooms. Although the intent of the Minute Paper is to provide a formative assessment, this tool can easily be misconstrued by students as a summative tool similar to a test or a quiz.

New technology has opened the door for a wider selection of tools in the field of education. Another precedent I studied is the Student Response System (SRS) or Classroom Response System (CRS), a device often referred to as a "clicker." The teacher poses a multiple-choice question, usually by projecting it or writing it on the board. Students respond by punching in their choices on a handheld device provided for them to

use. These tools allow students to engage with the feedback process from their seats instantly. They also allow teachers to collect and store data (Bruff).

Illus. 2. Student Response System Clicker: a new student feedback technology. Photo: Spmcpeak/Wikimedia Commons, 2012 (Creative Commons Share-Alike 3.0 license).

There are a few problems with this tool. Post-secondary universities, where SRS clickers are used frequently, can afford to invest in this technology. Public high schools, in contrast, do not generally have funding for tools like these. Even the least expensive clickers are often slow and cumbersome, relying on network connectivity inside the school. So, SRS technology is not a feasible option for every school.

Another problem with the SRS clicker is that the system lacks fluidity in the responses that students provide because clickers work like polling systems. Students can click a number or letter answer to a question, but they cannot generate an original response. Multiple-choice questions, in general, are problematic because the answerer may not actually know the answer or understand why a certain answer is correct, but they may still choose that answer (Bruff). This creates a dilemma, because a student may want to elaborate in order to comprehend the material better.

After the development of SRS technology, companies who develop mobile device applications saw an opportunity to increase access to SRS-type feedback. For example, applications such as Poll Everywhere and Coursemodo allow teachers to create polls that students can respond to via smartphone or tablet. These tools are inexpensive and often convenient because they tap into technology that most adolescents already have right in their pockets. These tools are a positive development as they provide teachers with more nuanced feedback and allow them to store data.

The main problem with mobile device polls in the classroom is the device itself. Most high schools have policies regarding cell phone usage. Allowing cell phones in class for academic purposes alone confuses the students, who would like to be able to use them to text or browse the Internet. Teenagers are more concerned with fairness and justice than they have been previously (Wood, 2007, p. 163). This group tends to look for holes in a system of rules, which can be pushed against and weakened. In the next section of this chapter, I will outline my own observations of the problems that cell phones cause in the classroom. The question of equal access in terms of smartphones and cell phone data may still remain.

Conclusions on Feedback

Research on feedback has led me to several conclusions about the feedback process. Formative feedback is useful and necessary. It provides teachers with an opportunity to adjust during lessons. The process must be a feedback loop, with the exterior source being the students. This whole process relies on both the teacher and the class of students to actively participate. Many of the methods that teachers use to gather feedback are flawed because they either do not garner enough participation or they do not elicit the most useful feedback.

WHAT HAPPENS DURING THE FEEDBACK PROCESS?

To understand how students react to the classroom feedback process, I decided to observe teachers and students in person. This fieldwork research helped me understand the needs and concerns of both groups. I enrolled in a course titled Drama-Based Pedagogy and Practice in the Theater Department at the University of Texas, which gave me the opportunity to do my fieldwork research at Travis High School in Austin. I took on the role of observer and facilitator in two ninth and twelfth-grade English Language Arts classrooms. As a design research method, gaining an intimate insight from the perspective of the target users allowed me to analyze the feedback process more rigorously. In the end, I was able to determine what about this process disengages or alienates students.

The classes I observed at Travis High School were scheduled in 90-minute blocks. I began my observations by mapping all of the activities that took place during those 90 minutes. What I found was that there were three different intervals in which teachers collected feedback, each of which for served a different purpose.

Near the beginning of the class period, teachers gathered feedback about homework assignments or material discussed in the previous class meeting. In most of

my observations, the length of this type of feedback varied, but typically took place within the first 15 minutes of class. This interval helped the teachers prepare students for the current period's upcoming lesson, and allowed teachers to gauge whether or not students needed more explanation of previous concepts. In some cases, the teachers would skip this activity.

The second interval of feedback gathering took place during the teachers' instructional part of the class period. This lecture-style section of time usually lasted between 20 and 30 minutes, but feedback gathering usually only occurred two or three times during this time in the form of targeted or voluntary questioning. This feedback helped the teachers gauge how well students were following along and whether some concept needed further explanation before moving forward.

The third section of feedback gathering took place after students had time to engage in individual or group work. This interval was always at the end of the class period, and always lasted around 10 minutes. In most cases, the teachers employed verbal questioning. In some cases, the twelfth-grade teacher would ask for written formative feedback in some form.

Observations of Feedback Processes

During feedback gathering that took place at the beginning of class, both the twelfth- and ninth-grade students had problems getting seated and started. With both groups of students, much of the teachers' time was spent correcting students who were disruptive. The first few minutes of class time were typically the most chaotic, with students walking in late, socializing, and generally not paying attention to the teachers' questions. In some cases, students would deliberately provoke the classroom teachers and

myself as facilitator with inappropriate comments, which would further delay class time because the teacher would have to take disciplinary action.

The feedback that took place during the teachers' instructional time was much calmer, but almost to a fault. In both groups, there were no more than five students who voluntarily answered questions. In some cases, during the times that I facilitated lessons with the students, I found it difficult not to break the silence in the room by giving away the answer, which would not provide the teacher with any useful feedback. I recall one ninth-grade student who made several particularly insightful responses, but only when she quietly spoke out of turn. The teacher wanted the students to raise their hands when they had an answer, but this student never did so, and her teacher often did not hear what she had to say. In some cases, she was coaxed to answer more loudly, but very reluctantly so.

The teachers I observed spent about 10% of every class period correcting behavioral problems. However, students who continued to break the rules during much more of the 90-minute class period. Cell phones were the most notable disruptor. Despite a sign on the twelfth-grade teacher's door, which stated in large red letters "TURN OFF CELL PHONES," students still used them all throughout her class period. At this point in the latter half of the fall semester, it was not as though this was a new rule. The teacher did not correct this behavior during most of my observation and facilitation sessions. When I asked one student what he was doing with his cell phone, he said, "I am looking for pictures to use in a project." He then told me that he was actually using his smartphone to look at a website unrelated to school.

The ninth-grade teacher had a different approach. She allowed students to have their cell phones out during tests and quizzes, but only as long as students were using them to listen to music, and nothing more. She told me that she had tried to eliminate

phones from the classroom, but it was impossible. So, she tried to negotiate with the ninth-grade students, allowing phone-use but only for music. In my observations, I noticed students using phones to text and otherwise distract themselves.

Written work typically took place during the latter part of the class period, where students worked individually or in groups. Although the focus of my observations was not on summative assessment, I did observe the ninth-grade students during a test. Out of the 30-some students in class that day, I counted only a few who took the test with no disruptions. I noticed one student who literally did not pick up his pencil. He sat and stared at the test the entire class period. Several students were looking at their cell phones periodically during the testing, and many students were sharing answers. Many students asked questions during the test period, which I found interesting because this group rarely asked questions of their own during other activities. Some students who did not complete the test begged the teacher to allow them more time. Some negotiated after-school sessions and lunch-sessions to either finish or re-take the test. Students from other class periods even came to the teacher to find out how the test would affect their overall grade. It was clear to me that tests were perceived as a negative thing to many of these students.

I was able to view some of the twelfth-graders' written formative feedback about a poetry unit the class had completed. What I found was that responses were rushed and rather nonchalant. The wording of the questions did not encourage students to elaborate. One student's written response stuck out for me. His response read, "It was boring." A cynic might assume that this student is simply too lazy or defiant to engage with poetry. I had the opportunity to speak with this student. I asked him why he thought that the unit was boring, and he said, "It would not be if we were reading someone like Edgar Allen Poe." At the time the twelfth-grade students were reading *Beowulf*.

Conclusions from Fieldwork Research

From these observations, I came to a series of conclusions about formative feedback, which later helped me develop criteria for designing useful in-class feedback strategies. I will discuss those criteria in Chapter 2.

1. Teachers want feedback from previous work and instruction, current instruction, and in-class work to help guide the direction of the lesson.

2. The verbal questioning and targeted answering that is the most common method of gathering feedback limits the amount of participation in the feedback process, which limits the quality of the feedback.

3. Teachers and students benefit from feedback processes that allow them to elaborate. Questions that are too pointed do not allow students to express their opinions in a way that they find useful. The students disengage from answering questions that they do not see as useful.

4. Students see written summative assignments, like tests and quizzes, as carrying more weight than other assignments, but this does not mean that they engage better with this type of feedback process. Tests have a permanent affect on the students' grade and ability to move up grade-levels, and this causes the students anxiety.

5. Cell phones are a distraction.

STRATEGIES THAT WORK AND SUPPORTING THEORIES

The occasion on which both the twelfth- and ninth-grade students were the most engaged I ever saw them throughout the month-long observation and facilitation sessions was when another graduate student and I facilitated a drama-based instructional module. We asked the students at both grade levels to work as a class or in large groups in order to act out scenes from the poems and novels they were reading. Students whom I had

never heard speak offered ideas to make the performance better. With the ninth-grade students, we asked what they enjoyed about the activity. They said they enjoyed getting out of their seats and creating something together. One student said the activity was fun because it was not "real" classwork.

What was it about the large group performative activities that got the ninth- and twelfth-grade students to engage? Students, who had previously seemed unconfident, disengaged, and disruptive during activities suddenly wanted to participate. Dr. Jeffrey D. Wilhelm (2002), who describes activities in which we "play to learn" as enactments or action strategies, says that students who are at-risk, reluctant, and not privileged in traditional classrooms are particularly receptive to this kind of facilitation (pp. 8-9). These specific performative techniques, which are often referred to as role work or image work, are not entirely risk-free because they require students to demonstrate in front of their peers. However, when these strategies are facilitated in such a way that the students see their demonstration as creating something separate from their identities, some of that risk is eliminated. This is because the learner has "taken on a unique lens or angle of perception all her own, or perhaps she'll assume the different perspective of another person, character, object, force, or idea" (Wilhelm, 2002, p. 61).

These action strategies offer teachers greater participation and can help students build knowledge in a variety of visual and kinesthetic ways, which "work our understandings and responses into the physical fabrics of our being, our body memory" (Wilhelm, 2002, p. 117). Greater participation in more varied ways diversifies feedback for the teacher, but it also diversifies knowledge in general, so that the classroom is a place where the teacher's ideas are not the only ones being heard. The theoretical framework for the benefits of such strategies comes from a theory of learning called

Constructivism. This theory of learning was hugely influential in building criteria for my thesis project.

Constructivist learning is described by Marlowe and Page (2005) as being the process and the result of questioning, interpreting, and analyzing information; using this information and thinking process to develop, build, and alter our meaning and understanding of concepts and ideas; and integrating current experiences with our past experiences and what we already know about a given subject (p. 7). Page and Marlow (2005) say that learning "is about *constructing* knowledge, not receiving it" (p. 8). This is a paradigm that resonates with me because it implies that any perception about information is valuable. It also explains why the high school students I observed were much more engaged with strategies that employed their own ideas.

Constructivists assume that because life experience is unique to each person, the knowledge that is constructed from interpreting new experiences will also be unique to each individual. The implications are that one does not learn by absorbing information, but rather through intellectual activity that draws upon experience. This is the foundation of the constructivist-learning paradigm.

Lev Vygotsky (1978) argues that there is a zone of proximal development (ZPD), or a difference between what one can do with guidance and what one can do on his or her own. The process of getting to this ZPD is referred to as scaffolding (Wood, 1976). In gathering formative feedback, the teacher is measuring that difference for each student. In doing so the teacher has the opportunity to structure the rest of a lesson in a way that helps students get closer to the point where they can do something on their own (Wood, 1976).

The high school students I observed wanted to participate in the performative group activities because these activities met some need that the other activities did not.

Self-motivation is crucial to an effective feedback process. Motivation "is therefore of preeminent concern to those in roles such as manager, teacher […] that involve mobilizing others to act" (Ryan & Deci, 2000, p. 69). The teacher is moving his or her students into action. It is the type or quality of motivation that determines what form the action will take.

Ryan and Deci's (2000) research focuses on "the conditions that tend to support people's natural activity versus elicit or exploit their vulnerability" (p. 76). They define natural activity as being intrinsically motivated. The authors posit intrinsic motivation as a sort of catalyst for the type of activity one might hope to see in our public schools: "The prototypic manifestation of the human tendency toward learning and creativity" (p. 69). This type of motivation is fostered when three psychological needs of autonomy, competence, and relatedness are met within the individual. In the context of a public school classroom, students whose psychological needs are not being met may feel alienated.

Conclusions about what Engages Students

Students have to want to engage in the feedback process with their teachers. It is vitally important that students view their ideas and perceptions on the information they are learning about as valuable. The ninth- and twelfth-grade students I observed at Travis High School were engaged with the role work strategies because that work met their needs of autonomy, or freedom to express themselves, competence with the subject matter and task at hand, and relatedness to their peers through shared perspectives. Students were able to display some expertise and see that their ideas were valuable because those ideas were used as part of the activity.

CONCLUSIONS ON RESEARCH AND IMPLICATIONS FOR DESIGN

Through the research portion of this thesis project, I gained a comprehensive understanding of what formative feedback is and why teachers want to gather formative feedback. I also explored the methods and mechanisms that teachers employ to gather this feedback, and discovered flaws and deficits in these methods and mechanisms. The flaws and deficits can impact students negatively in terms of risk, which decreases student participation in the feedback process. I have also outlined the Constructivist theory of learning and the theoretical framework behind self-determination, which suggest that teachers can derive better feedback by motivating students to engage with the process.

From these conclusions, I have developed a hypothesis that has guided the design component of this thesis project: Formative feedback from learners is necessary for facilitators because the source of the feedback is external from the facilitator. Feedback mechanisms that impose too much risk for the learner will not yield high participation. Feedback mechanisms that fulfill the psychological needs of the learners will encourage higher participation. For learners to want to participate, they need to know that their ideas are valuable.

Chapter 2: Methods

In the design component of this thesis project, my intent was to design an intervention that helps teachers elicit the best quality formative feedback and the most participation. In order to set parameters for my design process, I outlined a list of criteria based on my conclusions about feedback precedents, disengagement, and motivation (Chapter 1). These parameters helped me determine whether or not my goals for this project were met.

1. Fluid. Fluid, rather than fixed, feedback strategies enable students to elaborate on concepts or problems they might be having with concepts. The well-worded Minute Paper is an example of a more fluid feedback tool, while the SRS is more static because it employs multiple-choice style questions.

2. Low Risk (a). Feedback mechanisms that do not require students to speak aloud are a lower risk to an individual like myself, who associates those speaking aloud with something negative.

3. Low Risk (b). Feedback mechanisms should not look or feel like a test, quiz, or other summative and permanent form of assessment. While the Minute Paper is not meant to be a test, because it is a written assignment that is turned in, it can be perceived as one.

4. Low Cost. Public school funding is already spread very thin in the United States. My goal is to help any teacher in any environment facilitate the process of feedback. Technology like the SRS is useful, but it is costly to both purchase and maintain to the point where it is not currently feasible for the majority of public schools to purchase.

5.   Scalable. The feedback mechanism needs to be useable by individuals, small groups, or an entire class.

6.   Participatory. Participation is the key to formative feedback. If only a few students are participating, the feedback does the teacher little good. Furthermore, a strategy that requires groups to work together creates an incentive not currently present in most of the precedents I looked at.

7.   Tactile. Most of the precedents I looked at do not facilitate a particularly sensorial classroom experience. A tactile experience helps create a unique memory of the material for the students.

8.   Visible. Ideally, for the same reasons, the feedback will be visible to the teacher and to the students.

Teachers who Share and the Value of Do-It-Yourself Tools

Number 4 on the list above speaks to a need expressed by teachers for low-cost tools to augment what is provided by the school district. Both the twelfth- and ninth-grade teachers that I observed at Travis High School had relied on their own resources to help create better experiences for their students. Because her whiteboard was so small, the twelfth-grade teacher had a large blue plastic tarp on one side of the room, suspended against the wall, which she used as an extra writing surface. Both teachers developed interactive activities for their students.

Teachers are already sharing ideas for do-it-yourself classroom tools online. Websites like Pinterest and Teachers Pay Teachers encourage this open-source lesson development. There are whole sections devoted to ideas for making the classroom more interactive. There are also sections where teachers have developed their own adaptations of the Minute Paper and other written assessments. On Pinterest, there are many posts

about do-it-yourself instructions for unique tools to use in the classroom. Many of the materials needed to achieve these tools are things that teachers can find in any office supply store if they aren't available in the schools already.
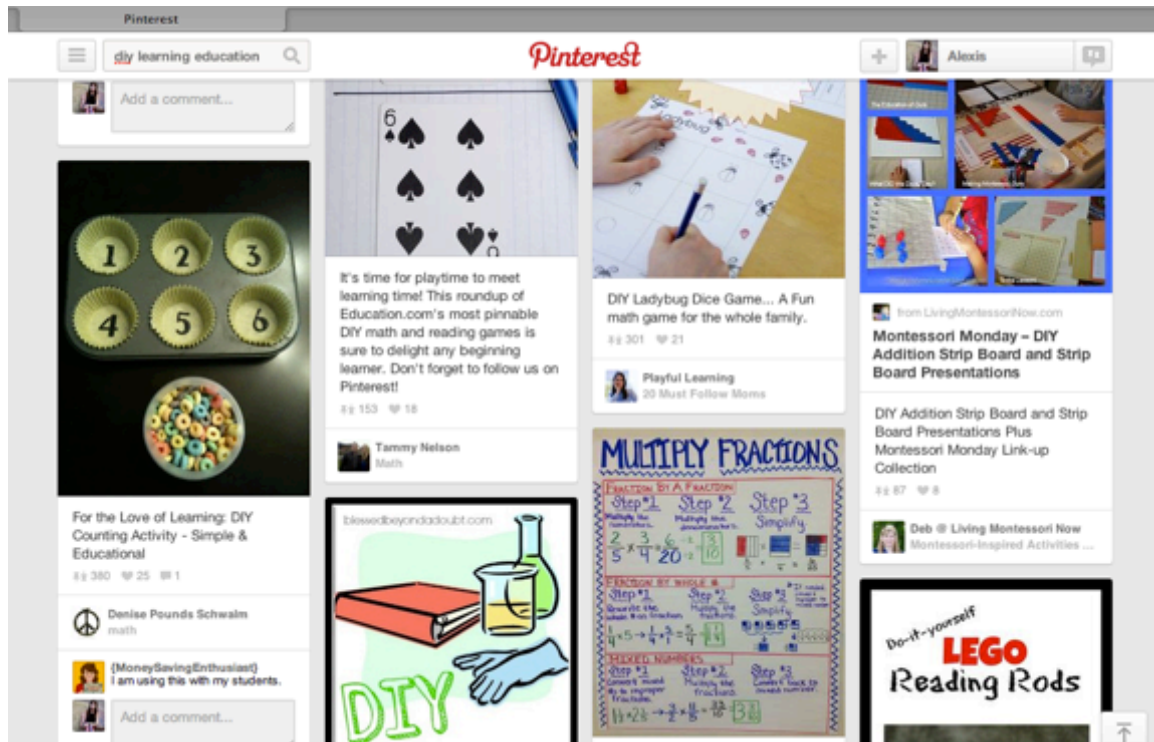
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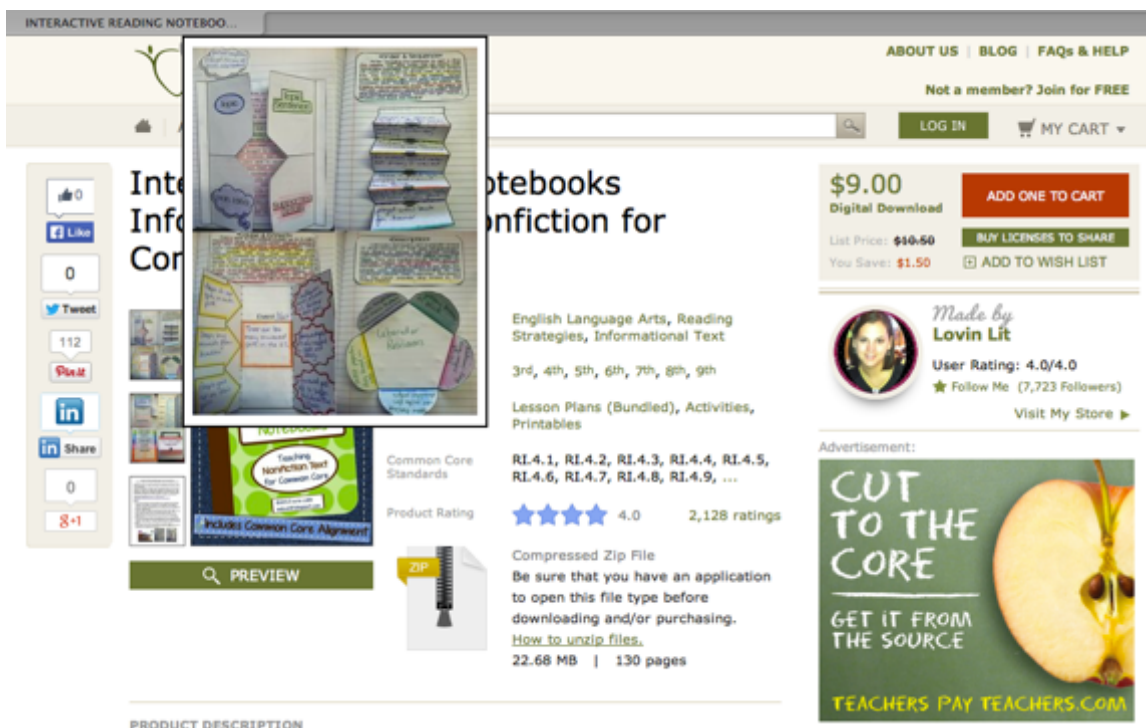
Illus. 4. Teachers can sell their instructional strategies and lesson plans on
        Teacherspayteachers.com.
        http://www.teacherspayteachers.com/Product/Interactive-Reading-
        Notebooks-Informational-Text-Nonfiction-for-Common-Core-4-8-
        790642. Screenshot by author.

DESIGNERS WHO DISSEMINATE INSTRUCTIONS

Because cost is an issue, I wanted to explore the option of developing a tool that
could be made by teachers themselves. This increases access. High-tech tools like SRS
clickers limit access.

In the scenario where the designer's intention is to disseminate access quickly,
providing downloadable materials online is a good way to do so. One well-known
example of this method is frog's Collective Action Toolkit (CAT), which is available
online in the form of a downloadable .PDF document. CAT has been downloaded by an
estimated 10,000 people and translated into various languages. It contains a wide range of
activities, spanning visual strategies, action strategies, and written strategies, which

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intend to enable groups of people to "organize, build trust, and collaboratively create solutions for problems in their community" (Fabricant, 2012).

Some designers use their personal websites as a place for their plans, patterns, or manuals to live. This is the case with designer Dave Hakkens's project, Memo Blocks. Aside from the obvious relationship to my work with constructible and erasable writing boards, the interesting thing about Memo Blocks is that Hakkens is not manufacturing and selling them. Instead, he provides a downloadable instruction manual and three different patterns to work with, all for free (Hakkens, 2012).

Illus. 5. Dave Hakkens provides free downloadable instructions for Memo Blocks on his website. http://www.davehakkens.nl/work_memoblock.html. Photo used with permission from Dave Hakkens.

Another designer, Noa Haim, has implemented a similar project with Collective Paper Aesthetics. On her website, Haim has presented instructional manuals with printable patterns for constructible toys. She also uses her website as a way to catalog how and what people are creating with the patterns she has supplied (Haim, 2010).

I decided that at least one version of my feedback tool should exist as a do-it-yourself version with a free, downloadable .PDF manual, which would instruct teachers on how to make these tools and how to use them in the classroom.

DESIGN AND THE ITERATIVE PROCESS OF MAKING

Constructivist theory, which suggests that knowledge is built rather than absorbed, influenced the formal qualities of the interventions I began to design. The concept that students would literally participate in building to provide their teachers with feedback became a strong metaphor. Buildables allow for individual use and for groups to work together. Assuming these tools would be used in public high schools, where classes are crowded, a tool that requires students to collaborate could save teachers space in their classrooms. Initially, the idea was for each student to have a "block" to build with.

Recognizing that risk is diminished and participation amplified when contributions are seen as less permanent, I chose to explore the use of erasable surfaces. Formative feedback emphasizes an evolving process rather than a right or wrong answer. Tests and other summative feedback methods involve a permanent record of performance, which can be seen as high-risk. The risk is reduced or removed when successful formative feedback strategies are implemented.

I chose to work with chalkboards in the first iteration of my design because they are almost infinitely reusable. The first boards were designed to function autonomously

and collectively through building activities. I prototyped these buildable chalkboards with cardboard and chalkboard paint. This low-tech approach to prototyping made it easy to run through a list of scenarios that might facilitate a process where students need to build something together. To prototype more quickly, I switched from hand cutting to laser cutting each chalkboard block.

Illus. 6. Initial Chalkboard Iterations. Photo by author.

Because I wanted teachers to have the option to make these tools themselves, the chalkboard paint became an issue. The paint, which is somewhat expensive, is messy when wet and dries irregularly. The dry paint is easy to scratch and chip, which is a problem because it contains lead, which is environmentally unsafe and toxic to humans when breathed. Using wood and particleboard allowed the paint to dry better, but those materials are heavier and more expensive. A do-it-yourself version of this iteration was not feasible. Moreover, chalk-writing itself is not very easy to read. Whiteboards have many of the same attributes that drew me to the chalkboard concept. Because whiteboard paint is prohibitively expensive, I decided to start out with poster board with a

whiteboard-like surface. Initially, it was my intention to move back to cardboard, but I found that the thinner material was sometimes easier to maneuver and build with. The idea that a tool could be made with something from a cheap office supply store was exciting for me, because these are materials that teachers are very familiar and comfortable with. This is the direction I chose to take with the do-it-yourself version of these blocks, which I began calling "Feed Blocks," because they are blocks that facilitate the feedback process.

The poster board did prove too thin. I needed to explore better material that could still be accessed by teachers. I returned to Dave Hakkens's Memo Blocks for inspiration. These blocks are an organizational tool that Hakkens made for himself. Essentially, what Hakkens has created is a 3-dimensional writing block with a whiteboard-like surface that the user can keep on his or her desk in place of notepads and loose Post-It notes. He suggests exploring different plastics to create that surface, and then gluing them to the material you want to use to make the block.

Illus. 7. Memo Blocks Materials: Dave Hakkens encourages makers to use his stencils with their own materials to create blocks with dry-erase surfaces. http://www.davehakkens.nl/work_memoblock.html. Photo used with permission from Dave Hakkens.

By using clear packaging tape, I could eliminate the gluing from Hakkens's process, which can create a mess. The plastic used in packaging tape is erasable with dry erase markers. The adhesive on the tape is strong and durable, making it ideal for a tool that is meant to be reusable.

The final iteration of this project had only two components: cardstock from cereal boxes and packaging tape. This iteration became the preeminent prototype for Feed Blocks. Each Feed Block surface measures 10-inches by 10-inches total with an 8-inch by 8-inch writing surface. Feed Blocks have four 4-inch tabs, which are used to connect one block to another. The tabs slide into 4-inch slots. The thickness of the slots is the same as the thickness of the cardstock, which is typically about .5 or .6 millimeters.

This version can be adapted by the maker in a number of ways. The maker can use thicker or thinner cardboard, chipboard or cardstock, as long as the thickness of the slots correlates with the thickness of the material. The materials best suited for Feed Blocks are no thinner than .5 millimeters and no thicker than 1/8 inch. The maker can also paint the material first if there are graphic elements that need to be covered.

Illus. 8. Do-It-Yourself Feed Blocks: Packaging tape and cardstock are used to create blocks with a dry-erase surface. Photo by the author.

THE DO-IT-YOURSELF INSTRUCTION MANUALS

The next step with the do-it-yourself version of Feed Blocks is to disseminate an open-source instruction manual. Before launching the project I will test the feasibility of this prototype and observe a group of local teachers making and using these tools. I created a dual-purpose instruction manual and stencil to educate teachers about this project and to give them an opportunity to make their own Feed Blocks. This printed document was also part of the MFA thesis exhibition.

One side of the manual outlines the uses of Feed Blocks as a tool for formative feedback gathering. The other side can be used as a stencil and instruction manual for individuals to make Feed Blocks.
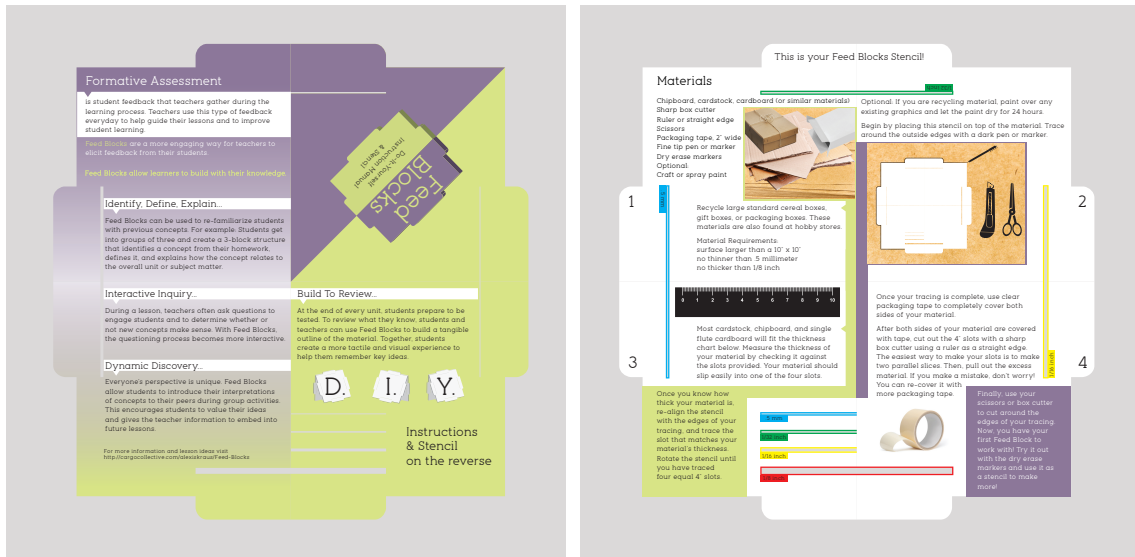
Illus. 9. Feed Blocks Instruction Manuals & DIY Stencils: These instruction manuals both educate teachers about the Feed Blocks system and give teachers a stencil and do-it-yourself instructions. Photo by the author.

A FORMATIVE FEEDBACK STARTER KIT: FEED BLOCKS

As I have stated, one of my objectives with this thesis project was to encourage as many teachers as I could to use Feed Blocks. One method I chose was to create a do-it-yourself version of Feed Blocks. But I also felt compelled to create a pre-manufactured version of Feed Blocks for teachers who are less willing to undertake making a do-it-yourself tool. A "starter kit" would also allow teachers to explore how Feed Blocks work, and might encourage them to make the do-it-yourself version of Feed Blocks in the future.

I had already begun experimenting with whiteboard surfaces while prototyping the do-it-yourself version of the kit. But melamine, the material used to make whiteboards, was too expensive and only available for purchase in larger quantities than I needed to start the prototyping process with. IdeaPaint, or whiteboard paint, is also rather expensive. I began using white acrylic 1/8-inch acrylic because it was easier to obtain and

quick to prototype with on the laser cutter. I soon realized that the acrylic was perfectly suitable for the Starter Kit Feed Blocks because the material, like melamine, has a surface that is glossy enough for dry-erase markers. The Starter Feed Blocks can thus be fabricated quite easily, as can the do-it-yourself Feed Blocks.

Illus. 10. Feed Blocks Starter Kit Prototype Blocks: Each block is made out of white acrylic, providing users with a dry-erase surface. Photo by the author.

Chapter 3: Four Classroom Strategies Developed for Feed Blocks

Like any other tool, the Feed Blocks could not exist as artifacts alone. Feed Blocks needed a system within which to function. I began testing strategies for how these tools could be used, based on the processes that teachers already use to gather formative feedback. During my fieldwork observations, I noted three primary intervals in which teachers collected formative feedback. I developed four strategies for Feed Blocks that can be used in each of those three intervals. These strategies can engage students on an individual scale, on a small group scale, and as an entire class. Some of the strategies have adaptions and variations, which teachers can also explore.

INTERVAL 1: IDENTIFY. DEFINE. EXPLAIN.

The teachers I observed used time at the beginning of the class period to talk with their students about previous material, assignments, and homework. What I observed was teachers using this interval as an opportunity to look for misconceptions about the previous material and to help students recall concepts they will need to understand moving forward.

I developed a strategy for using Feed Blocks during this interval called "Identify. Define. Explain." The intent of this strategy is to re-familiarize students with previous concepts before getting into the current lesson of the day. This gives teachers an opportunity to ensure that their objectives for the day are the right ones.

The teacher arranges students to work in small groups of three. Each individual has one Feed Block. The teacher assigns each group a different problem, concept or term. Students are asked to create a 3-block structure that:

1. Identifies the problem, concept, or term from a previous assignment or homework assignment

2.   Solves the problem or defines the concept or term

3.   Explains how the problem, concept or term relates to the overall unit or subject matter.

After the groups have completed their structure, the teacher is encouraged to ask for groups to present their structures to the rest of the class. Most importantly, the teacher should use this as an opportunity to correct any inaccuracies or misconceptions before moving forward into the current day's lesson. The teacher might also encourage students to pick their own problem, concept, or term with which to create the 3-block structure.

INTERVAL 2: INTERACTIVE INQUIRY AND DYNAMIC DISCOVERY

Another interval in which teachers seek feedback is during the instruction process. During my observations, teachers would break from their lectures to pose a question. This is the interval in which a teacher might employ SRS clickers to gather feedback, which offer students little opportunity to elaborate. But with targeted or voluntary questioning methods alone, teachers receive little feedback because of risk and disengagement. Often, students have ideas, questions, and comments that may be very insightful, but students see no opportunity to share those insights.

I developed a strategy for Feed Blocks called "Interactive Inquiry" to help facilitate the questioning process during the instructional interval. For this strategy, each student should have two Feed Blocks, which will be clasped together so that they stand upright on the student's desk. Each time the teacher poses a question, the students are to answer with a written response with a red dry-erase marker on one of their Feed Blocks. Teachers are still encouraged to ask for answers verbally; however, they will have an opportunity to review all of the answers at the end of the instructional time.

The second of the two Feed Blocks on the students' desks can be used for a strategy called "Dynamic Discovery". This strategy is meant to act as an opportunity for students to voice their unique perspectives and pose questions they might not feel inclined to ask out loud. With a blue dry-erase marker, or any color marker other than that used for the Interactive Inquiry strategy, students are to write down any questions or comments they might have during the instructional interval.

After this interval or at the end of class, teacher should arrange for ten minutes of time where students work in groups to create structures based on their answers and insights. Afterwards, the teacher may still want the students to turn in their Feed Blocks so that the teacher may review answers more in-depth. Teachers may want their students to sign the Feed Blocks with their names, but I would not encourage this. The point of this tool is to facilitate the process of formative feedback, and signatures might imply too much permanence.

INTERVAL 3: BUILD TO REVIEW

The last interval in which the teachers I observed gathered feedback was at the end of the class period. This type of feedback, whether written in the form of the Minute Paper, or verbal, seeks to review what students are going to take with them. Teachers might also use this type of reviewing to prepare students for future assignments or summative evaluation.

I developed "Build To Review" as a means to facilitate the feedback process of reviewing at the end of a class period. For this strategy, the teacher and the students work as one group. Together, they use the Feed Blocks to create an outline or physical diagram of the day's lesson with the Feed Blocks.

The first level of the outline is the key objectives of the day's lesson. From there, students use one Feed Block for each important concept from the teacher's instruction. The teacher may assign different duties to the students. For example, a couple of students may be tasked with writing on the Feed Blocks and a couple of students may be tasked with building. The important aspect of this strategy is that the whole class is working together. These structures can be as large or small as needed, and utilize only as many Feed Blocks as needed. The teacher should note any misconceptions and inaccuracies and work to correct them for the class.

Teachers can use parameters for building to guide the process of student collaboration. Feed Blocks can be slotted together to create three-block structures, which can then be connected to other three-block structures and built upon in a pyramid-like shape. The blocks can also be slotted together to create linear shapes of any length. Teachers can designate sections of a larger structure to represent certain aspects of the whole lesson or of a specific concept. Students can build "foundation" layers with many three-block structures and build layer-upon-layer to reach a more central idea at the top of their structure. Teachers are encouraged to come up with their own parameters for building activities.

Once a structure is built, the teacher can adapt this activity by photographing what the students have created as documentation for later use. The documentation can be used to help students prepare for summative assessments. In this adaptation, students can view the structures from lessons throughout the unit at large. The students can then rebuild those structures to help them recall past lessons.

Illus. 11. Larger Structures built with Feed Blocks: Both versions of Feed Blocks can be built with in a number of ways. Photo by the author.

Chapter 4: Formative Feedback in the Museum Setting

THE MUSEUM AS A SPACE OF LEARNING

A museum space can be equated with a classroom, in which learners participate in voluntary learning beyond their childhood years. This space facilitates a voluntary form of lifelong learning (Lord, 2007, p. 3). In Chapter 1 of *The Manual of Museum Learning*, Gail Lord (2007) describes the museum space as a cultural accelerator, intensifying the learner's awareness of social change (p. 5). In this scenario, the facilitators of knowledge are the curators, designers, historians, and artists who contribute to the gallery space with their art and expertise. The audience-member or gallery attendee is the learner.

THE MFA DESIGN EXHIBITION

The Design Division of the Department of Art and Art History at the University of Texas at Austin explains the purpose of the thesis exhibition in the *Design MFA Handbook:*

> a. The exhibition will present the work as a complex design research project, rather than an object or objects, left open for interpretation. Students should both embody and explain their design methods to a general audience.

> b. In the exhibition the student shall differentiate between the subject of his/her work from the methods used in his/her work (p.9)

With the MFA thesis exhibition, I wanted to test my hypothesis on formative feedback outlined in Chapter 1 in a different arena of learning. The aspect of my hypothesis that is so novel compared to other formative feedback mechanisms is the assumption that learners will participate if they see that their ideas are valuable. With Feed Blocks, the learner understands the value of his or her feedback because that feedback becomes part of something the class creates together. My goal was to recreate this phenomenon during the MFA thesis exhibition.

The four other MFA students and myself each presented our work as a larger research project for the exhibition. We each had project titles and written information to accompany the artifacts we presented in the exhibition. The projects all varied significantly in terms of themes and aesthetics within the gallery space. In a sense, we were acting as the facilitators of new information for the audience.

This space of the gallery became an access point for me to test out my hypothesis about formative feedback in this arena. For the MFA thesis exhibition, I created a site-specific participatory activity. This pilot project encourages gallery-goers to offer feedback about what they have seen in the space, using similar criteria used for Feed Blocks:

1. Fluidity. Participants are offered an open-ended prompt rather than a pointed question.

2. Low risk. Participants use an erasable surface and do not have to sign their names. The activity does not distinguish between a right or wrong response, but only asks participants to mention something about a specific project in the MFA thesis exhibition.

3. Incentive. The participants are contributing in a way that creates a compelling visual component of the exhibition, which shows participants that their ideas are important.

To participate, gallery-goers take a blue acrylic writing tag, which measures 6 x 6 inches. Each tag is inscribed with a simple prompt: "Tell me something about," followed by the title of the MFA student's project as it is displayed in the MFA exhibition. The participants are instructed to write responses on each tag with the dry-erase markers provided. To help guide the feedback process, I also provided a list of keywords, which

represent themes from each of the five MFA projects. The participants contribute their feedback by placing the tags directly onto the gallery wall.

Illus. 12. Participatory Feedback Activity in the Museum Setting: The participants would take the blue tags from the table, write their responses on the tags with the dry-erase markers provided, and then place their tags on the gallery wall. Photo by author.

ANALYSIS OF THE FEEDBACK ACTIVITY IN THE MUSEUM SETTING

This installation was a pilot project. If the participants had not contributed feedback, the activity would have failed to offer any insight about either the MFA exhibition or my hypothesis about formative feedback. But on the contrary, the gallery-goers were very receptive to the activity. Within one week's time, every hook on the gallery wall had a tag, creating a compelling diamond-like lattice pattern.

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The feedback provided was visible to both the gallery-goers and the MFA students. This may have encouraged even more people to participate because they had an idea of what they were supposed to do. The four other MFA students found the feedback quite useful. One of my peers suggested that future cohorts be encouraged to ask gallery-goers for feedback. Another peer may use some of the feedback in her thesis report.

The content of the feedback varied significantly. Some of the responses were extremely well written and specific to themes of each MFA project, while some did not address the MFA exhibition at all. A few of the participants drew pictures and wrote their names on the tags. Many of the responses offered words of praise and encouragement about the projects. While those responses are appreciated, they do not really address the prompt. However, many more of the responses pose specific insights, questions, and comments that relate to the various themes and aspects of each MFA project.

What this varied collection of responses tells me is that perhaps the prompt was not displayed prominently enough. If I were to run this activity again, I might display the prompt prominently somewhere. While the collective feedback contributions created an aesthetically appealing display, some participants commented that the blue acrylic made the feedback hard to read. Thus future iterations of this installation might employ a different, more legible writing surface.

OBSERVATIONS ON FORMATIVE FEEDBACK IN THE MUSEUM ENVIRONMENT

The participatory installation allowed me to test my assumptions regarding formative feedback in a different learning space. This pilot activity provided interesting but mixed results. The gallery-goers were very receptive to participating in the activity and this tells me that the activity was designed in a way that motivated them to participate. However, only some of the responses directly addressed the MFA students'

projects. This tells me that not all of the participants saw their contributions as feedback. Establishing that the contributions are meant to be feedback requires further investigation and iteration. The feedback that was collected was useful to the MFA students-as-facilitators. We all found something useful to take away from the responses, which will influence our continuation of these projects.

Overall Conclusions

I never expected that my negative experiences as a young learner would shape my values and inform my design work so significantly as an adult. The motivation behind my interest in educational tools was driven by the challenges caused by the conventional strategies that my own teachers used throughout my school years. Despite those challenges, I have always had a passion to learn. That passion was not fostered until I allowed myself to fully engage with my peers and teachers.

Through the process of gathering formative feedback, teachers have the opportunity to assess how well they are teaching and how well learning is occurring. If needed, teachers can adjust their methods. But teachers also have the opportunity to use the feedback process to encourage students to value their own insights so that students might be better motivated to share those insights. Feed Blocks can facilitate these opportunities.

CONCLUSIONS ON RESEARCH

Literature about formative assessment and feedback loops informed my decisions going into the design process. Similarly, reviewing literature on educational theory and motivation helped me develop my position on how good formative feedback might be elicited.

These assumptions were further solidified through the process of reviewing formative feedback precedents. The precedents all have advantages and disadvantages that I could learn from. Without these precedents, I would not have been able to create firm design criteria and principles for gathering good feedback in classrooms.

Both observing classrooms and taking on the role of the facilitator gave me a unique insight into the needs and procedures of teachers and students. The fieldwork

research was by far the most important aspect of the research process. Observation allowed me to map out the intervals in which formative feedback is gathered. It also gave me insight into how students participate in the feedback process and how and why that process might disengage or alienate students.

What I learned from my research, which I would propose as generalizable principles, are as follows:

1.   Formative feedback from learners is necessary for facilitators because the source of the feedback is external from the facilitator.

2.   Feedback mechanisms that impose too much risk for the learner will not yield high participation.

3.   Feedback mechanisms that fulfill the psychological needs of the learners will encourage higher participation.

4.   For learners to want to participate, they need to know that their ideas are valuable.

CONCLUSIONS ON FORMATIVE FEEDBACK TOOLS: FEED BLOCKS

Feed Blocks is a system designed to facilitate a successful feedback process by eliciting student contribution in a new way. The system works differently than conventional methods of eliciting student contribution. Feed Blocks provide opportunities for students to more actively participate by building confidence, diminishing risk, and allowing students to collaborate in a group negotiated understanding of concepts. Students also have more opportunities to elaborate in ways that other formative feedback tools and conventional methods do not provide.

The strategies that I developed for using both versions of Feed Blocks fit well within the three intervals in which teachers routinely gather feedback. These mundane

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intervals during that teachers go rotate through each class period can be made more interesting for students with new approaches and tools like Feed Blocks.

Feed Blocks, in all their forms, are still in the prototyping and testing phase and I intend to continue refining them in the coming months and years. I plan to do a more thorough investigation and review of the educational tookits already on the market, including the do-it-yourself tools and downloadable instructions that are freely available on the web. The results of these reviews and of further testing will inform the next phase of this work, which will be to disseminate a do-it-yourself version of Feed Blocks.

CONCLUSIONS ON FEEDBACK IN THE MUSEUM SPACE

My intent with the MFA exhibition was to test my assumptions about formative feedback gathering in an arena of learning outside of the classroom. My assumptions informed the criteria to be used in a participatory activity to take place during the MFA thesis exhibition. This activity allowed me to analyze whether or not a formative feedback process that embodies the principles of good feedback that I identified earlier really does elicit more and better feedback.

The participatory installation was successful in that participants recognized that their contributions were of value because those contributions became a part of a larger creation. This is similar to what Feed Blocks intend to do. The activity encouraged a significant amount of participation. However, I have not come to a conclusion on whether or not this activity elicited the best feedback that could have been elicited. Because the responses are so mixed, this aspect of my project needs further investigation.

Overall, this installation was useful to me because it provided me with some insight about how effective similar feedback mechanisms might be in terms of participation. This activity also provided the MFA students with feedback about the

projects that were displayed in the MFA thesis exhibition. As a result, I encourage future MFA students to look for ways to incorporate feedback mechanisms into their exhibition.

FUTURE RELEVANCE OF THIS WORK

Designers and educators who are interested in this type of work should search for new ways to circumvent risk by designing new approaches to gathering feedback. These must be sufficiently engaging activities that students—even jaded high schoolers—will want to participate in them. Together, designers and educational researchers can work to alleviate the lack of tools and methods available to high school teachers.

FINAL THOUGHTS

This design project began with a hunch, which informed a values-based approach to designing tools for formative feedback. While I must acknowledge that no report could have been written free from bias, I also believe that this project was stronger because it grew out of my personal values. In the upcoming months and years, I will continue to work on this project and similar projects which seek to improve teaching and learning through novel design interventions.

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