# Messy Learning Environments: Busy Hands and Less Engaged Minds

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**Abstract:** In an environment where learners are engrossed in highly interactive and fun hands-on activities, how do we get their minds as engaged as their hands? We have found that busy hands help sustain learners' motivation and interest but can distract their minds from doing the necessary reflection on their actions. This paper and the accompanying poster describe conditions and affordances of media and prompts that focus and encourage distracted learners reflection.

## Introduction

Sixteen 5th grade learners scramble around the makeshift kitchen locating ingredients, reading off instructions, measuring, and mixing up wonderful baked creations. Flour dusts tabletops and everything else in its path, and hands are sticky with corn syrup. In this messy informal learning environment, children are engaged in hands-on cooking and science exploration. To learn from these activities, they need to step back from time to time to reflect on their actions and record observations for later reflection. Through the Kitchen Science Investigators (KSI) project, we are looking at how to facilitate science learning in such messy environments. One of the emergent goals of this design study is to understand the affordances of media that will not take the fun out of these interactive activities while promoting reflection-in-action and the note taking needed for later reflection-on-action (Schon, 1987). This type of media is needed because it is hard for young learners to disengage themselves from fun activities to record their experiences, but waiting until an activity is over to record experiences can result in too much being forgotten for productive learning. We found this to be especially true in an after-school study of 5th grade learners' engaged in cooking activities to learn the science behind cooking. Where there was often contention for learners' attention between the physical activity of cooking and the cognitive activity of reflecting, usually resulting in learners focusing their attention on the cooking. Analysis of learners' responses generated by prompts for reflection through use of different media, revealed affordances and conditions of use of the media that were successful in getting learners to reflect and others that were inhibitors. This paper and accompanying poster focuses on getting the learners to make observations to facilitate reflection-in-action which is a necessary condition for subsequent reflection-on-action.

## The Learning Environment and Description of Media

We studied sixteen 5th grade learners during an after-school science-cooking club we created in a suburban private middle school. The learners participated in ten 90 minute weekly sessions where they engaged in cooking and science experiment activities with the goal of learning the science behind the roles of various leaveners in brownies, cookies, pizza, and cake. During the first five weeks, their recipes, instructions for experiments, plans for altering and remaking recipes, and all observations were made using paper-and-pencil media. They were introduced to using all of their five senses for making observations using a *Five Senses Chart* on 8 ½ x 11 sheets of computer paper. Each of the column headers on the chart featured a human sense and each of the row headers was a short summary of the major activity of a recipe or experiment step and its number. Learners used these charts to record observations while they were cooking or experimenting for one session. They then began using large 2 ½ x 3 ½ feet posters posted on a wall near-by their workspaces to make observations. At first, each poster represented a step with the *same short step summary* as described in the five senses charts. Then as learners became more comfortable with making observations and began making alterations to the recipes, we changed the labels to the step number and then to just their group names. During the 6th week, we introduced software that learners used while cooking that displayed the recipe and strategically placed textboxes for jotting down observations. We used the software for the remaining four weeks of the program. During the entire ten weeks, we encouraged learners to use cameras to take pictures while preparing their baked goods as experience memory joggers. Learners worked in four groups of four using the different media to make observations.

The *short step summary* we used as prompts for learners to make observations are analogous to "stop and think prompts" and/or "generic prompts" used in Davis (2003). Davis found that generic prompts help middle school

learners to reflect (e.g. state what they are thinking) more broadly, allowing them to think about many different ideas. She also found that learners who used the opportunities provided by the prompts to identify where their knowledge needed improvement had reflection that was more productive for learning. Both Schon (1987) and Davis (2003) agree that learning requires reflection and cite a number of others that demonstrate this to be true as well. We couple Davis's use of prompts "to get learners to reflect on many ideas" with Schon's idea of "reflection-in-action" and Davis's "opportunities for learners to identify their weaknesses" as activities that are associated with Schon's "reflection-on-action" (Schon, 1987).

Our use of generic prompts to promote reflection-in action extends Davis's work on placement of generic prompts within activities. We analyzed the learners' responses to the various prompts (i.e. prompts with different levels of descriptiveness) against one another for each day, each type of prompt, and each media using the prompt (within and across groups) and coded the responses based on descriptiveness of articulation. Use of video data and field notes were used to triangulate these findings. We didn't explicitly set out to explore the affordances of different media, our initial research goal involved characterizing the learning environment without computer technology and then characterizing and measuring the introduction and impact of technology on the learning environment. As such the fading descriptiveness of generic prompts was a byproduct of quick prototyping. The impetus for analysis of prompts based on the media was an emergent trend found in the learners' responses.

## Findings and Discussion of Findings

Affordances and conditions of media use for success in getting learners to reflection-in-action include: (1) Making media visible enough that its presence reminds learners to reflect (e.g. media is hanging on a very visible wall that learners can't miss); (2) Prompts that tell them when reflection is useful (e.g. after you have added an ingredient or after each step); (3) Use of media for reflection when the cognitive load of the interactive activity has plateaued (e.g. when the initial overwhelming excitement of "we're cooking" wears off); and (4) Fading the specificity of when to reflect as learners become better at remembering to make observations (e.g. they are making them more frequently and the descriptiveness in increasing). Affordances and conditions for learner success in reflection-on-action: (1) Ease of indexing and locating observations, and (2) Fun and contextualized activities that illustrate the importance of good observations for science learning. The presence of these features in a given medium and learning environment made for more descriptive observations. Inhibitors to reflection-in-action: (1) not seeing others explicitly making reflections and the lack of presence of each groups reflections (e.g. media that allows learners to make reflections at their own workstations without being visible to others); (2) reflection that requires finer levels of granularity while learners are engaged in highly interactive activities; and (3) bad interfaces for making observations that leads to loss of observations.

Overall, regardless of the media for observation, the more engaged learners were in the activity, the less interested they were in doing the kinds of reflection that lead to learning. We are still searching for the right level of engagement in the cooking that won't sacrifice the fun, sustaining the motivation and interest that is necessary for implementing science learning interventions. However, these findings show that getting to reflection-in-action is a function of learners remembering to reflect, followed by knowing when to reflect, and finally having the flexibility to reflect in ways that are meaningful to them. It is hard to get learners that are cognitively overloaded with the physical part of the interactive activity to stop and think. Thus, patience and waiting on the part of the researcher and teacher for the grand novelty of the highly interactive physical activity to fade and/or making the appropriate adjustment in the activity design is needed before abandoning a prompt intervention. It is also equally important to physically situate the media in the learning environment so that its persistent presence is a reminder to reflect. In this way, when they have learned to manage the cognitive load of the physical activity then they can start attending to the reflection part of the activity and see other people doing it as well. The second important affordance of a medium is to tell learners when to reflect, skillfully reducing this scaffold to allow learners to record their observations at times *they* think are valuable, as they are more willing to invest time in describing them.

## References

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