Students' Reflections on Mathematics Homework Feedback

By Mara Landers and Daniel Reinholz

Abstract: Homework is considered an important aspect of learning mathematics, but little research has considered how students utilize feedback as part of the homework process. This mixed methods, quasi-experimental study examines how community college students in a developmental intermediate algebra course participated in a feedback reflection activity throughout a semester and compares their outcomes with a class that did not engage in this activity. Although developmental math students are often positioned as deficient in skills and motivation, most students took this activity as an opportunity for self-assessment, documenting resources for success and critiquing their work for improvement. These students did not outperform peers on summative course assessments; however, there were differences in their growth as effective learners

Students must have regular opportunities not only to review feedback, but also to engage in self-assessment.

This paper reports on community college students' reflections on mathematics homework feedback. Researchers have documented the positive impact of homework on achievement in college mathematics and science courses (Sasser, 1981, Weems, 1998; Yalcin & Kaw, 2011); this is consistent with the well-documented positive impacts of homework in middle and high school (cf. Cooper 1989; Cooper, Lindsey, Nye, & Greathouse, 1998). Homework is especially beneficial when students receive feedback from teachers (Austin, 1976; Elawar & Corno, 1985; Paschal, Weinstein, & Walberg, 1984). Feedback on student work in general has been shown to have effects on achievement, though the effects are not always positive (Hattie & Timperley, 2007; Shute, 2008). Feedback is most effective when students receive "information feedback about a task and how to do it more effectively" (Hattie & Timperley, 2007, p. 84). Yet, as Sadler (1989) notes, this information is only considered to be feedback when it is used for improvement. Students can only use feedback for improvement if they come to understand how teachers judge their work, learn to judge themselves in the same ways, and use these standards as they are producing new work (Sadler, 1989). Thus students must have regular opportunities not only to review feedback, but also to engage in self-assessment, which is highly recommended for community college mathematics students (AMATYC, 2006). Accordingly, the current study examines a homework reflection strategy.

The strategy under study was developed through the first author's work as a facilitator of and participant in professional development focused on effective teaching practices related to homework in developmental math courses. The strategy, which prompted students to complete reflection logs, was designed to address the concern that students were not consistently reflecting on and utilizing the feedback they received on assignments. Our primary goal was to understand the extent to which students were able to incorporate reflection into their repertoire of homework practices. The study was conducted in two sections of a community college intermediate algebra course. Using a mixed-methods, quasi-experimental approach, we compared the performance of students who engaged in reflection with those who did not. Within the experimental section, we used qualitative analyses to describe how students did or did not incorporate reflection into their homework practices. The research questions addressed by this paper follow:

1. How did students utilize the logs as a structure for reflection?
2. How did students make meaning out of the reflection process?
3. Were there differences between the class that participated and the class that did not in terms of course performance and their growth as effective learners (i.e., their skills and habits related to student success)?

The first two research questions led to qualitative analyses of students' engagement; the third research question led to a quantitative comparison of student performance.

The paper is organized as follows: First, we describe the theoretical perspective that guides the study, and then we outline the research methods, including the context of the two courses, data sources, and methods of analysis. Following, we

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present the results of the study, organized by the three research questions. The findings lead us to outline implications for future implementations of the reflection activity and implications for future research.

Theoretical Perspective

Although most homework research defines homework as a *task*, we conceptualize homework as a *social practice* that students participate in with teachers and others in their lives (e.g., family members or peers). Following Wenger, we define practice as engagement in work or activities done in social contexts that "gives structure and meaning to what we do" (Wenger, 1998, p. 47). Researchers have long studied social practices as central to learning and development, examining how participation in a practice provides opportunities for learning, problem solving, and cognitive and identity development (e.g., Cole, 1996; Lave & Wenger, 1991; Rogoff, 2003). For several decades the field of mathematics education has seen a "social turn" or "the emergence…of theories that see meaning, thinking, and reasoning as products of social activity" (Lerman, 2000, p. 23). Often described as a sociocultural perspective, researchers in this tradition attend to the "socially and culturally situated nature of mathematical activity" (Cobb, 1994, p.13).

Researchers who take a sociocultural perspective often argue that the unit of analysis should be a "community of practice," like the world of the claims processors Wenger studied (Wenger, 1998), or the "figured world" of a school or classroom (Boaler & Greeno, 2000; Holland, Lachicotte, Skinner & Cain, 1998). That is, the unit of analysis is a social group or unit in which individuals engage in collective practice, occupy social positions, and negotiate the meanings of their experiences. However, the nature of homework as a practice leads us to a different analytical focus. Homework is different from other social practices in two ways. First, homework is done across contexts, specifically in a *cycle* of contexts: Students and homework artifacts move in and out of school, daily, over time. In classrooms, teachers assign tasks, and students may work on assignments with classmates and teachers. The practice continues when students leave school. They work on assignments outside of school, either with peers, family members, or independently. They then return to class to review, finish, and turn in work. Figure 1 illustrates this homework cycle. In the context of the current study, students not only participate in the cycle as described, but they also complete in-depth assignments using the resources of a drop-in lab, where they complete tasks with classmates, student tutors, and math instructors.

Second, although students do homework with other people, the students are positioned as the "owners" of homework (Varenne & McDermott, 1999). That is, they have a different role than other participants and they are held responsible for the artifacts produced in practice. Therefore, it is the student that we "zoom in" on (Lerman, 2001) as he or she participates in the practice of homework.

Through participation in practice, individuals negotiate the meaning of their work, which includes learning about the meaning of collective work for participants (Wenger, 1998). This process includes taking ownership of meanings: Some ideas become personally meaningful to students, and they may negotiate meanings, even constructing new ones. For example, students may come to see homework as "busy work" that should be done to satisfy teachers or, alternatively, as an opportunity to learn. When examining students' perspectives on homework, researchers have given more attention to K-12 students (see Landers 2013b for a summary of research on homework meanings). However, like their younger counterparts, college students do not necessarily view homework as a positive experience. High school and college students have mixed feelings about homework, and they admit that they copy in order to get assignments done and to earn the best grades possible (Pope, 2001; Robinson & Kuin, 1999). In the current study we seek to understand a specific aspect of students' participation in the practice of homework: how they incorporate reflection into their existing repertoire of practice and how they make meaning out of this work.

We define practice as engagement in work or activities done in social contexts that "gives structure and meaning to what we do."

Method

Setting and Participants

The current study was conducted in two sections of intermediate algebra at a community college in Northern California. With over 12,000 students, this college is one of three in a district that serves a single county in the San Francisco Bay Area. The college's student body is diverse along several dimensions, including age, race/ethnicity, and socioeconomic status. Although we did not formally collect demographic information in the sample populations, they were generally representative of the college as a whole, in which 18% of students identify as African American, 5% as Asian, 4% as Filipino, 36% as Hispanic, 7% as Multi-Ethnicity, and 27% White. In recent years the college has seen a growth in the number of students enrolling directly after high school and many of these students assess into developmental courses. As is the case at many of California's community colleges, the majority of students at the college must take developmental math and English courses before they can complete college-level courses needed to transfer to a four-year institution. Approximately 70% of students at the college place into developmental math and 80% place into developmental English. The National Center for Developmental Education (NCDE) defines developmental education programs as supporting "traditional and nontraditional students who have been assessed as needing to develop their skills in order to be successful in college" (NCDE, 2015). Developmental math programs include courses from arithmetic to intermediate algebra, and progressing through this sequence has proven to be a challenge and even a barrier to educational advancement for an alarming number of students (Bonham & Boylan, 2011).

Given these issues, the math department at this college created a developmental program

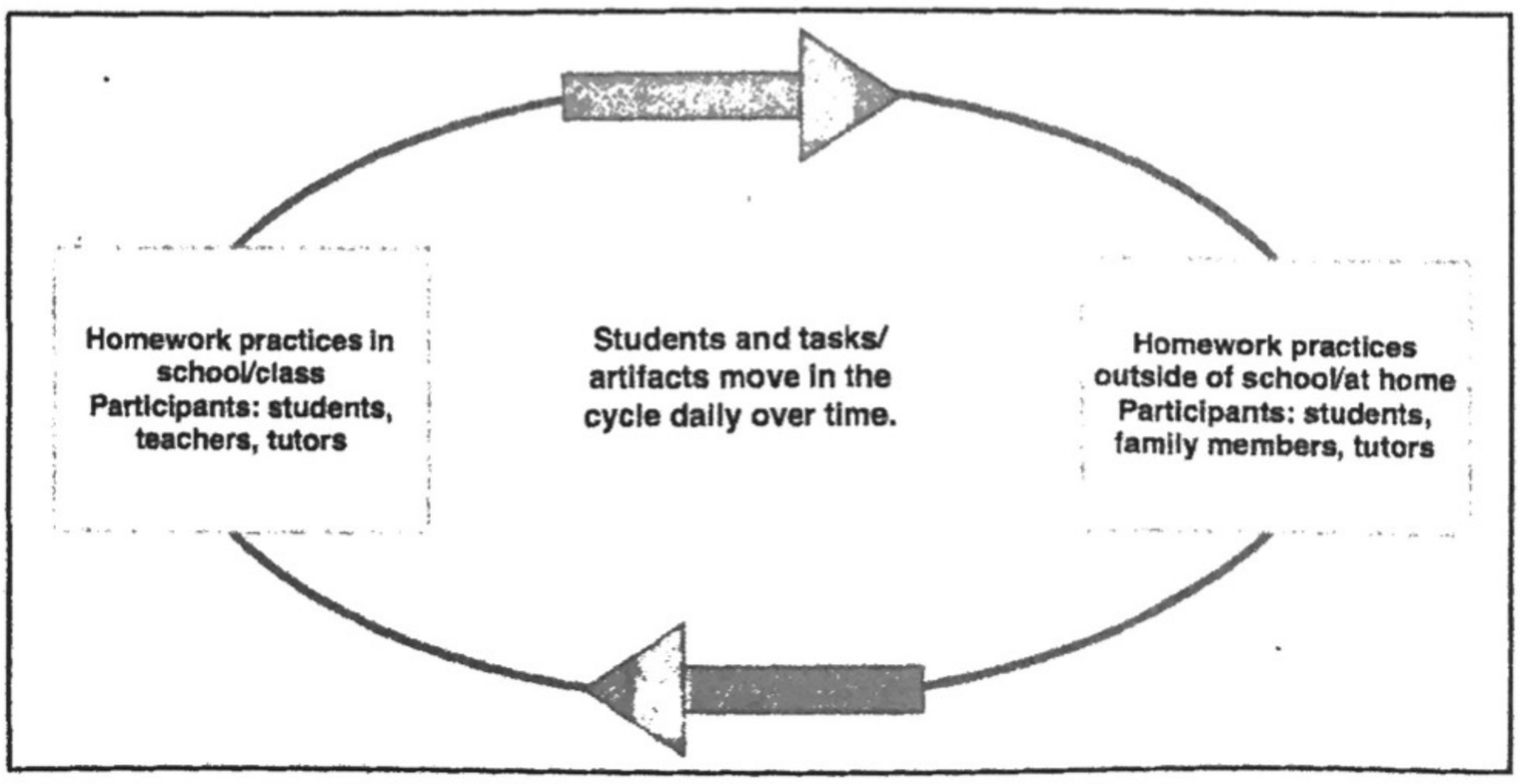

Figure 1. **The homework cycle involves practices inside and outside of school.**

grounded in research-based best practices of developmental education, including the integration of learning and study strategies and opportunities for faculty professional development (Bonham & Boylan, 2011). The developmental math program is designed around five learning outcomes: (a) mathematical communication, (b) reasoning and problem solving, (c) multiple representations, (d) skills and applications, and (e) effective learning. This last outcome includes the expectation that students are able to self-assess strengths and weaknesses (cf. AMATYC, 2006) and use appropriate resources and strategies to improve learning. As the capstone course in this program, intermediate algebra is intended to provide students with opportunities to develop and use these skills. Towards this effective learning outcome, the first author developed a strategy, described in the "Procedure" section, in order to help students incorporate reflection into their regular homework practices.

Procedure

The first author acted as both teacher and researcher in two sections of intermediate algebra. Both classes were taught using the same curriculum materials, assignments, and assessments. Assignments included skill-development software, worksheets, journal writing, and more in-depth written assignments designed around the learning outcomes described previously. These written assignments extended the work students had done in class activities, and they required students to develop and use skills such as explaining concepts and processes, and solving problems using multiple representations (i.e., tables, graphs, and symbolic algebra; see Figure 2 for a sample problem from one of the written assignments). Both sections met twice per week, and were given an assignment at the end of each class session, due the next. All assignments were graded and returned the following class session. Students in the "experimental logging section" (LS) also completed written reflection log sheets for 20 of these in-depth written assignments. Students in the "non-logging section" (NS) were encouraged to review the feedback they received on assignments but were not given reflections to complete. Other than the use of the reflection logs, the activities and instruction in the two sections were identical.

Table 1 (p. 26) outlines the structure and content of the reflection log sheets. The items listed in questions 3 and 4 of the reflection log were unique to each assignment. For example, the assignment that included the problem in Figure 2 focused on exponential functions as models and comparing linear and exponential models. The reflection log for this assignment therefore included skills and knowledge such as "finding a linear equation from two data points," "explaining why an exponential function $y = a \bullet b^x$ will never have a zero output," and "documenting my work completely" (see Appendix 1 for a completed reflection log).

In order to give students ample opportunities to reflect over the course of the semester, but also to adjust to the nature and expectations of the course, the reflection logs were introduced 2 weeks into the semester. The teacher explained that although some students may already review their graded work, this activity would provide all students with a structure for doing so; she framed the activity as an opportunity to improve their ability to learn from homework feedback. The logs became part of the practice of the class; students received a new log with returned assignments and they turned in logs with the next assignment. However, in order to help students view the logs as a learning opportunity rather than an assessment, logs were not graded, and the quality of log completion was not evaluated. Students did not receive feedback on the logs, as they were kept for analysis.

College students do not necessarily view homework as a positive experience.

Data Sources

To document students' participation in the practice of homework reflection, the following data were collected: the completed reflection logs, measures of students' performance in the course, an effective-learning self-assessment completed at the start of the semester, and an end-of-semester survey that included the same self-assessment. The end of semester survey (LS) also included students' perspectives on the reflection activity.

The effective learning self-assessment included items from the math department's criteria for learning outcome 5, the effective learning outcome. Thus the self-assessment included items such as "understanding factors that help you learn," "meets deadlines," and "follows directions." The self-assessment also included items tailored to the reflection logs, such as "reviews graded work to learn from feedback." For each item, students were asked to rate themselves as "excellent," "satisfactory," or "not there yet."

Analytical Approaches

To understand students' participation in the reflection process, and to determine any relevant differences between the two classes, our analysis centered on three questions:

1. How did students in the LS class utilize the logs as a structure for reflection?
2. How did students in the LS class make meaning out of the reflection process?
3. Were there differences between the LS and NS classes in terms of course performance and their growth as effective learners?

The methods of data analysis are summarized in Table 2 (p. 26). To address the first and second questions, qualitative methods (Miles & Huberman, 1994) were employed. Each student was considered as a case of reflection participation and we searched for patterns across cases. Each student's reflection sheets, survey responses, teacher observations, and quantitative measures of course performance (e.g., course grades) were used as case documents. To specifically address the first question, the first author inventoried the set of each student's logs to determine the extent to which the student participated (i.e., the number of logs completed) and analyzed whether or not the student did the logs completely and correctly. For example, a log was coded as incomplete if any questions were left blank. A log was coded as incorrect if the student did not complete a self-rating for every item listed. Further, students' responses to question 5 on the logs were used to develop categories or

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Exponential modeling:

At the park, you park your car 100 yards from the soccer field. After solving a problem in your intermediate algebra class, you decide to do an experiment. You walk halfway to the field, and then stop. You decide to repeat this process until you are only a few inches from the field.

- Explain why (mathematically) you would never reach the field.
- What is the equation that models this situation?
- What do the constants in the equation tell you about the situation?

***Figure 2.* Sample questions from a written assignment that require students to communicate conceptual understanding of exponential functions.**

Table 1

Reflection Log Dimensions

Dimension	Description and Rationale
Score (Log Sheet Questions 1 and 2)	Students log their score, their score as a percent (Q1), and a rating of their level of satisfaction with this score (Q2). Students in this course are expected to develop the skill of keeping track of their own performance. Too often students are unaware of how they are being graded, and so the goal of this dimension was for students to determine for themselves their general level of accomplishment on a given assignment.
Skills/ideas achieved or to be improved (Questions 3 and 4)	Each log listed the major skills and concepts students were expected to learn from and demonstrate on the assignment. The lists included mathematical skills, such as solving particular equations, as well as effective learning skills, such as checking work. The skills list was given twice on the log so that students could identify each skill/idea as something they had achieved (Q3) or needed to improve (Q4). Students were expected to review the written feedback on their assignments and use the feedback to complete the log sheet. Feedback included: indications of work being correct or incorrect and the nature of mistakes; comments on learning outcomes, such as effectively communicating ideas or use of a problem-solving process.
Accounting for performance (Question 5)	Students were asked to write about what they had done to be successful or not as successful as they hoped on an assignment. The goal of this dimension was to help students develop agency in connecting their performance to their homework practices, including work habits and resources.

Table 2

Summary of Analytical Approaches

Research Questions	Data Sources	Data Analysis
How did students in the LS class utilize the logs as a structure for reflection?	Completed reflection logs	• Inventory of logs to determine frequency of participation • Review of each student's logs to determine if logs were done correctly and completely • Coding of student responses to question 5 on logs in order to identify themes in how students accounted for success or lack of success
What meaning did students in the LS class make out of the reflection process?	Pre- and postsurveys	Coding of student responses to pre- and postsurvey survey questions in order to identify themes. Questions included: • Why reflection was assigned • Why students participated • Why students did not participate
Were there differences between the LS and NS classes in terms of course performance and their growth as effective learners?	Course and exam grades; self-assessments; surveys	Coding of student responses to survey questions in order to identify themes. Questions included: • Whether or not and how work habits had changed over the semester • Why students would or would not do homework if it were not graded Quantitative analysis: *t*-tests to determine differences in mean levels of performance between the classes; chi-square analysis to determine changes in each classes distribution on self-assessment categories.

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themes. Starting with the broad categories of (a) accounting for success and (b) accounting for lack of success, each student's logs were reviewed for all responses to question 5. A grounded approach (Glaser & Strauss, 1967; Strauss, 1987) was used for this coding to develop a set of themes grounded in the perspectives of the students. A summary list of key words or ideas was created for each student and then all of the students' lists were considered together to identify larger themes or patterns across cases. For example, when students' summary lists included items such as "finding both solutions on a graph," or "knowing why a log function can't have a negative input," these items were gathered into a larger category of "specific mathematical content." Similar themes were developed around the kinds of resources students wrote about, as well as the course learning outcomes they referenced in accounting for both success and lack of it.

The same process was used to code students' responses to survey questions related to the second research question. Students' responses to the question of why the reflections were assigned were coded to identify themes for their understanding of the purpose of the reflections and to determine if students with more or less participation had different understandings. Students' responses to the questions of why they did or did not participate in the reflections were coded similarly.

One goal of this analysis was to differentiate between students who merely understood the value or purpose of reflection and those who took ownership of its value (cf. Landers, 2013b; Wenger, 1998). A student was considered to be taking ownership of a particular meaning of the reflection activity only if he or she described the meaning and his or her participation matched the given meaning. For example, if a student could explain that the reflection logs were useful for self-assessment and participated in ways that supported self-assessment (e.g., correctly and completely filled out the reflection logs), then the student was considered as having taken ownership of the value of this activity for self-assessment. If another student described the value of the activity similarly, but then rarely or never exhibited participation, then this student was considered as not having taken ownership of this particular meaning of the activity. The initial log inventory revealed three levels of participation (described in Results), and so the analysis for Research Questions 1 and 2 included looking for differences across the participation groups.

Analysis for the third research question included both quantitative and qualitative comparisons of the LS and NS classes. Qualitative comparisons included coding of responses to survey questions about changes in work habits during the semester and whether or not students would do homework if it were not graded. Responses to the

work-habits question were coded for (a) whether or not the students reported changing work habits and (b) how they accounted for the changes. Responses to the question about homework not being graded were coded for (a) whether or not students indicated they would do the work and (b) categories of justifications. Quantitative analyses were used to compare the two classes on measures of course performance and to compare the class participants' growth as effective learners, using the self-assessments given at the beginning and end of the semester. To compare performance, *t*-tests were used to determine differences in means on exams and course grades. To compare the classes for effective learning growth, chi square analysis was used to determine if the distributions of students in the three categories of self-assessment (excellent, satisfactory, and "not there yet") shifted from the beginning of the semester to the end. The analysis was completed for each item on the self-assessment.

Results

With little prompting, the majority of the LS class (over 71%) participated in the reflections. Nevertheless, analyses revealed differences in how students engaged with the reflection log sheets and how they negotiated the meaning of the activity. These patterns within the LS class are summarized in response to the first and second research questions, and then the differences between the LS and NS sections (Research Question 3) are addressed.

Research Question 1 (reflection participation)

LS students were categorized according to three different levels of participation, summarized in Table 3. The students in the nonparticipation group did not submit sufficient reflection materials for analysis, so analyses of reflection practices focused on the first two groups (frequent participation and decreased participation). Students from all groups completed surveys, thus analyses of students' understandings of reflection come from all groups. Overall, students who participated in reflection received higher grades in the course (see Table 4).

Comparative case analyses revealed differences in exactly how students engaged with reflection. The students with frequent participation routinely answered all of the questions on the reflection sheets, except that they sometimes did not rate themselves for every skill listed. In contrast, the students with decreased participation often submitted incomplete or incorrect logs. For example, some students did not complete all the self-ratings in questions 3 and 4 of the logs, or they would circle/highlight a given skill *both* as achieved and as needing improvement.

There were also differences in how students responded to question 5 on the reflection sheets, which asked them to "explain what you did that led you to be successful on this assignment, or what led you to not be as successful as you may have wanted." The frequent participation students used this prompt to document their self-assessment as they reflected on their assignments. Six of these ten students routinely described their strengths and weaknesses, and three students focused almost exclusively on critiquing their work. The tenth student in this category was less specific in his responses, though he focused on the need to improve his communication and general study skills. To account for their success, these students discussed using their resources, such as getting help in the lab, or using their classwork. They also referenced specific math content and several of the learning outcomes for the course (e.g., problem solving, communication). They referenced these same topics when discussing areas for improvement, especially specific math content, the problem solving outcome, and the communication outcome. Further, students who frequently participated utilized the reflection logs to write about, and even negotiate, other aspects of their work, including critiquing the quality of help they received in the lab and questioning how their work had been graded. In contrast, only two students from the decreased participation group exhibited this same level of self-assessment. In accounting for their success, students in the decreased participation group rarely referenced specific math content or the learning outcomes, instead focusing primarily on the resources they used. In describing areas for improvement, their focus was also on resources, describing resources that they should have used. And these students did not use the reflection logs to discuss other aspects of their work. Table 5 shows examples of students' responses to question 5.

Students who frequently participated utilized the reflection logs to write about, and even negotiate, other aspects of their work.

Research Question 2 (meanings of reflection)

Regardless of their level of participation, survey responses indicated that all students understood the purpose of the reflection activity as self-assessment (see Table 6 for representative student responses). The coding of students' responses to the question of why they engaged in the reflection activity yielded two main themes: self-assessment and teacher compliance. Of the 10 students who frequently participated, 6 gave self-assessment as

Table 3

Categories of Reflection Participation

Category	*N*	Description
Frequent participation	10	These students completed most or all of the logs consistently throughout the semester. These students completed 14[a] -20 logs each (70% or higher).
Decreased participation	10	These students started out completing logs, then decreased in frequency, or stopped turning them in. These students completed 6-13 logs each (30-65%).
Nonparticipation	8	These students completed 0, 1, or 2[b] logs each (0-10%).

Note. [a] Included in this group is one student who initially did not complete logs, but then began to do so midway through the semester. She completed a total of 14 logs. [b] There were no students who completed 3 – 5 logs.

Table 4

Reflection Participation and Final Course Grades

	Grade Received				
Category	A	B	C	D	F
Frequent participation	3	4	3		
Decreased participation		3	6	1	
Nonparticipation		1	4	2	1

their reason, although one of these students also indicated teacher compliance. Two of the ten students explained that they participated for teacher compliance because they already reflected on their own. The last two indicated teacher compliance as well as other reasons: giving the teacher information and earning better scores. (This last reason is related to self-improvement, though not clearly linked to self-assessment.) Of the 10 students with decreased participation, 8 took the survey, and 4 of these students gave self-assessment as their reason for participation. Two students indicated self-assessment and teacher compliance, and two did not give responses that explained their reasons. Thus, most of the students in the frequent participation group and half of the students in the decreased participation group were classified as taking ownership of the value of reflection for self-assessment, in alignment with how the teacher introduced the practice. Additionally, these students negotiated the idea of participation for teacher compliance. For example, one student who completed all of the logs described his participation: "I have done all the reflections. I did them because they were assigned as homework, but I did not get much out of them. I just wanted to make sure they were turned in. When I got my work returned, that is when I would learn from my mistakes, not by looking at the reflection sheet and trying to put it into words."

Students with decreased participation or no participation provided little information about why they stopped or did not participate, even though the survey directly prompted them to discuss this issue. Only three students responded: one explained that he forgot to do the reflections because he was focused on getting assignments done; one explained that she did not do reflections because she did not do the assignments in the first place; the third student described how his motivation for school in general had decreased.

The end-of-semester survey also asked students in the LS class how likely they were to reflect in this same way on their own in future classes. In the frequent participation group, 9 of 10 students indicated they would continue reflecting; however, four of these stated that they would not reflect at the same level of written work and detail. As one student explained: "most likely [I won't] go over it as I did this semester, but if I actually have to do it, I would. But I don't think I would go over it like I did this semester unless I had to, so it was a good thing to have to do." The students in the frequent participation therefore took ownership of the reflection by critiquing the way the reflection was structured. In contrast, students in the decreased participation and nonparticipation groups gave mixed responses about future reflection: Some indicated they were not likely to do so (2 in each group), whereas others said they would (4 in each group), though it was ambiguous if they were referring to the reflection log process or to reflection in general.

In contradiction to their actual practices, some students with decreased or no participation indicated that they found the reflections to be useful. This indicated that they did not fully take ownership over the activity (cf. Landers, 2013a). Two of these cases are summarized in Table 7 (p. 29), and this issue is examined further in the discussion section.

Research Question 3 (comparison of sections)

We conducted t-tests to assess whether there were differences in the mean level of performance between the LS and NS groups. (Scores of 0 were not included. These scores represent students who stopped attending class near the end of the semester but did not drop officially. They did not take the final exam.) Comparisons of the two classes revealed no statistically significant differences in final exam scores, $t(48) = 2.011$, $p = 0.387$ (two-tailed) or final course grades, $t(52) = 1.421$, $p = 0.161$ (two-tailed). However, the end-of-semester surveys and self-assessments revealed differences in students' perspectives on homework and self-assessment of several effective learning characteristics. In both the beginning and end-of-semester surveys, students rated themselves as "excellent," "satisfactory," or "not there yet" on a set of 16 effective learning characteristics. The surveys were analyzed using chi-squared to compare the LS and NS sections, specifically to document shifts in each class of the distributions of ratings. Relevant findings are summarized in Table 8 (p. 30), rows 3 – 5. For instance, LS students indicated that they were more likely to revise their work and saw homework as a learning opportunity, not just a means of attaining a grade.

There were also differences in the sections in terms of their perspectives on homework (see Table 8, row 1, p. 30); however, there were no clear differences in the students' perspectives on how their work habits had changed during the course of the semester. In fact, in both classes, 75% of the students who completed the end-of-semester survey indicated that they had improved their study habits. Further, qualitative analysis revealed that both groups of students reported the same types of improvements: spending more time on work, being more focused, improving time management, and more frequently asking for help.

Table 5

Sample Responses to Reflection Sheet Question 5

Student Category	Sample Responses to Question 5 (accounting for success or lack)
Frequent participation	Using my previous work as an example helped me with this assignment. I could have done better if I was done with [the skills software] for the exponent properties.
Frequent participation	Overall I think I understood the problems really well, which led to some success. I do tend to rush through things even when I try not to so I leave things out or inadvertently write the wrong thing down. For #8 I did the equation on my calculator and explained the answer but forgot to put in the process for my solution.
Decreased participation	I tried doing this assignment by myself, and I got a decent grade, but I should get help next time. I try to do each problem as if it was the first question. I take my time, and then go over it.
Decreased participation	I did not explain the meaning of things. I went to the math lab and worked on my assignment with two other people in my class but I still didn't understand some things.

Table 6

Examples of Students' Descriptions of the Purpose of the Reflection Activity

Student's Participation	Sample Responses to Survey Question
Frequent participation	To understand what helped you be successful on each assignment, and what you were not successful on. Areas where you could improve.
Decreased participation	Maybe for us to see what we need to improve on when we get graded work back and to do better on the next assignment.
Nonparticipation	I think we have been asked to do this because it gives us an opportunity to evaluate ourselves and to see a visual of our performance in the class.

Discussion

Although most of the students in the LS class understood the purpose of reflecting, the students who regularly participated took ownership of the value of reflecting in ways that their classmates did not. These students aligned their claims about the value of the reflection with their actions, but as described previously, they also showed more understanding of the artifact itself and how to complete it. They went beyond the skills listed on each log, regularly describing their specific strengths and weaknesses related to the course content and learning outcomes. Several of these students also used the artifact as a means to negotiate other aspects of the classes' collective work (cf. Wenger, 1998), such as how their assignments were graded and the quality of help they received in the math lab. Although it is not evident why this is so, it is perhaps the case that these students have felt more empowered to negotiate, or even to critique aspects of their experience, than their classmates.

Our concern was to understand students' participation in practice and their meaning making; yet the findings also point to issues of identity, a concept deeply connected to social practice and meaning making (Wenger, 1998). Specifically, at issue is how students are positioned and how they position themselves in practice (Holland et al., 1998). Through this lens, it becomes clear that the reflection activity positioned those who participated as "successful" and those who did not participate as "not successful." This is also true for the practice of homework in general, and most other school-related practices. In this context, the students who already included reflection in their repertoire of practice, and those who were willing and able to expand their repertoire to include reflection, were positioned as successful and compliant with the teacher's expectations. This positioning may have contributed to their willingness to negotiate.

Other students were positioned as less successful. This may explain survey responses from some of the students in the decreased participation and nonparticipation groups indicating that the reflections were very useful, even though they did not actually engage in the reflection activity

Table 7

Homework Nonparticipation and Examples of Reflection Perspectives

Reflection Participation	Description of Homework Practices	Response to Survey Question
Nonparticipation	Completed all assignments but routinely missed deadlines. Only completed two reflections.	I feel like the reflections was my favorite assignment because I was able to write out how I was feeling at the moment and it really helped me become a better student.
Decreased participation	Completed most, but not all, course assignments. Completed seven reflections, but filled out the form incorrectly. Only reflected on assignments on which he was highly successful.	They do help, I know what my strengths and weaknesses by doing the reflection sheets therefore I know where I need to get help.

as they described. It is likely that these students sought to position themselves as good students. Many of the students in the decreased participation group met course expectations in other ways, and reflecting on why they had not participated in this aspect of the course may have led them to identify themselves differently. Nevertheless, not all of these students did actually meet the course expectations; they may have just responded in ways that they thought would please the teacher. Social desirability, the tendency to distort self-reports in a favorable direction, is a pervasive and well-documented phenomenon (e.g., Furnham, 1986). Given that the students knew the value their instructor put upon reflection, it would be easy for them to cast their responses in a favorable light. Finally, since the logs were not returned, it is possible that some students may not have remembered exactly how many logs they completed when they took the survey.

The LS students who regularly completed their reflections performed considerably better in the course than the LS students who did not. However, this data does not necessarily suggest that participating in the reflection activity directly affected course performance. The results are confounded by the fact that if a student did not complete an assignment, he or she could not complete the reflection log sheet for that assignment. Not turning in an assignment directly affected (lowered) a course grade. It is more reasonable to conclude that students who already had productive out-of-class practices (e.g., successfully completing assignments, studying for tests) were more willing to expand their repertoire of practice to include the structured reflection activity. Again, these were students who were already positioned and/or positioning themselves as good students.

Some students with decreased or no participation indicated that they found the reflections to be useful.

With ownership of value comes effective participation in homework practices (Landers, 2013a). Here, the LS students who regularly completed their reflections also used the reflections differently than the decreased participation students. The regular completers correctly answered the questions and they used the reflections to self-assess areas for growth. In contrast, the decreased participation students filled out more incorrect and incomplete reflections and did not self-assess as effectively. It is possible that despite their survey responses, these students may not have found the activity to be very useful, and, as a result, they decreased participation.

With respect to the comparison, there are several ways to understand why there were no significant differences in course performance between the LS and NS classes. First, given that the reflections were only a single component of the course, it is difficult to determine whether it should have had a significant impact on performance measures. Second, a number of students did not fully engage in this practice, which would likely affect the role of reflection in their learning. Finally, the reflection activity was only designed to help students develop their skills and habits in reflecting on their work, and not necessarily to enhance other aspects of effective learning, such as time management or completing assignments.

Table 8

Summary of Comparisons Between Classes

Dimension for Comparison	Summary of Analysis
The larger purpose of homework	At the end of the semester, 23/24 LS students surveyed indicated that they would do homework if it were not graded, and their reasons centered on their desire to learn. Only 14/20 NS students surveyed indicated that they would do homework if it were not graded, and their reasons focused equally on learning and on test preparation. This difference was significant (Observed Wald $x^2 = 2.3328$, $p = 0.0268$[a]).
Frequency of reflecting on and revising homework	At the end of the semester the majority of students (>75%) in both classes indicated that they regularly read and reflected on homework comments. However, more than half of the LS students indicated that they regularly revised their work; only 27% of the NS students indicated they revised.
Level of accomplishment in reviewing graded work to learn from feedback	The distribution of LS students shifted towards the "excellent" rating and the distribution at the end of the semester was significantly different from the beginning ($x^2 = 7.111$, $p = 0.0207$). The change was not significant in the NS class ($x^2 = 0.2396$, $p = 0.8871$).
Level of knowledge of how math is related to one's academic goals	The distribution of LS students shifted towards excellence and the distribution at the end of the semester was significantly different from the beginning ($x^2 = 12.108$, $p < 0.01$). The change was not significant in the NS class ($x^2 = 1.9872$, $p = 0.3702$).
Level of understanding factors that help one learn	The distribution of LS students shifted towards excellence and the distribution at the end of the semester was significantly different from the beginning ($x^2 = 15.367$, $p < 0.01$). The change was not significant in the NS class ($x^2 = 3.055$, $p = 0.217$).

Note. [a] We used Barnard's test rather than chi-squared, because the 2×2 contingency matrix contained a cell with a value of 1.

Limitations

The present study had a number of limitations. As a part of the data collection process, student reflections were collected but not returned to students. As a result, students could not review their reflections and also did not receive feedback on them. This has been remedied for future iterations of the design, in which logs are reviewed, scanned, and then returned to students. Another issue is that the first author acted as a teacher and researcher. Although the instructor explained the purpose of the surveys and there were no right or wrong answers, students still may have responded in ways that they believed would be perceived as socially desirable by their instructor. In general, self-reported information from research participants is less reliable than information from direct observation.

Implications for Research and Practice

The current study provided insight for further development of the reflection activity. In order to effectively engage in a practice, students must be able to negotiate and take ownership of the meaning of the practice. Accordingly, in further implementations of this activity, the logs have been reformatted to clarify how to complete the skills ratings and respond to other questions. For example, reorganizing the self-ratings in a table rather than in bulleted lists has resulted in more students understanding that they need to rate themselves on every skill listed. Also, in-class activities provide a space for more explicit negotiation of the form of the logs, the skills/concepts to be assessed, and rubrics to be used for self-assessment. Ideally these changes will provide

greater opportunities for students to develop the *guild knowledge* (i.e., evaluative knowledge used to determine quality of work) needed for effective self-assessment (Sadler, 1989), a skill they must take with them into college-level math courses. Review of students' completed logs also provides opportunities for negotiation and clarification. Finally, as effective self-assessment includes reflecting on work, judging its quality, and revising it (cf. Andrade, 2008), this reflection activity could be improved by explicitly emphasizing the revision of assignments. Rather than deeming future assignments or summative assessments as students' opportunities to develop or demonstrate their knowledge, revising selected assignments might provide better opportunities to master the skills and concepts on which they have already worked and reflected. Future research will aim to document how improving the reflection process will provide students with such opportunities, towards increased and effective participation, as well as a stronger connection to course performance. This research should also examine opportunities for identity development within the practice and the connection to effective participation and learning.

Conclusion

This study demonstrates that, with little prompting, students were able to incorporate reflection into their mathematics homework practices and that the students who regularly participated in the reflection activity took it seriously as a means of self-assessment and as a tool for negotiating the meaning of their work. This is an important finding in the context of community college developmental mathematics, a setting in which students are often positioned as deficient in skills and motivation. Instead, the students who participated in the reflection activity not only demonstrated and developed their self-assessment skills, but they were more likely to position themselves as owners of the process. This study therefore adds to the homework literature by examining and revealing the nature of a particular aspect of students' homework practices: how students incorporate reflection into their practice and develop themselves as effective learners through this participation.

The study also connects homework research to the formative assessment literature, given that self-assessment is considered a core component of formative assessment (Black & Wiliam, 2009). Although homework is often mentioned as a site for formative assessment, it has not been a focus of this body of work. In contexts like the current one, students must have opportunities to learn from feedback as they do in traditionally writing-intensive courses such as English. Sadler (1989) emphasizes that effective use of formative assessment in instruction should ultimately help learners transition from external feedback to self-monitoring and assessment. With respect to the concept of participation in practice, this is about students taking ownership of the value of reflection. This study serves as a starting point for understanding how reflection can be incorporated in developmental mathematics courses, towards developing students' abilities to self-assess and to use this information for improved performance in mathematics.

Formative assessment in instruction should ultimately help learners transition from external feedback to self-monitoring and assessment.

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Appendix: Sample Reflection Log

Assignment 10 reflection log sheet (turn in with assignment 12) Name:

Directions: read over your work and feedback you received on **assignment 10 (U2A1 lab)** Then complete this form

1 The score I received on this assignment was 35 which is 70 percent

2 How satisfied are you with your work on this assignment? Circle or highlight one.

Very satisfied Satisfied Somewhat satisfied Somewhat dissatisfied Very dissatisfied I don't care

3 What did you do well on this assignment? Circle or highlight all that apply

- Finding a linear equation from two data points
- Converting units
- Explaining why an exponential function $y = a \cdot b^x$ will never have a zero output
- Identifying the constants in an equation
- Documenting my work completely
- Finding an exponential equation from two data points
- Rounding decimals
- Finding an exponential equation from a verbal description of a situation
- Explaining the meaning of the two constants in an exponential equation in terms of the situation being modeled
- Completing all problems on an assignment

4 What did you miss or not do well on this assignment? Circle or highlight all that apply

- Finding a linear equation from two data points
- Converting units
- Explaining why an exponential function $y = a \cdot b^x$ will never have a zero output
- Identifying the constants in an equation
- Documenting my work completely
- Finding an exponential equation from two data points
- Rounding decimals
- Finding an exponential equation from a verbal description of a situation
- Explaining the meaning of the two constants in an exponential equation in terms of the situation being modeled
- Completing all problems on an assignment

5 Explain what you *did that led* you to be successful on this assignment, or what led you to not be as successful as you may have wanted

This week, my biggest issue was documenting my work completely. I figured out the work, but forgot to write my equations. I need to make sure I am completely documenting my work. Overall, I am satisfied with how well I did, but I need to be careful when I write my answers.

Developments

Keeping Students on Track

Although faculty and administrators at two-year colleges have been concerned with retaining students through credentialing or transfer for decades, the recent focus on "college completion" has added a new twist. Many states have begun to connect student retention or completion rates to funding for colleges. Retention has thereby become an even higher priority for colleges.

A varied as well as recurring body of "solutions" to increase retention have been forwarded and implemented across the 30-plus-year career of Rob Jenkins. For example, as a faculty member at multiple community colleges, he claims to have experienced changes back and forth between faculty-based student advising and professional advising numerous times. "Obviously, we haven't yet discovered the magic formula, or else we wouldn't still be talking about this" (Jenkins, 2015, para. 3).

However, based on research studies showing that the quality of students' classroom experiences is an important factor for student persistence and success, Jenkins shares some high-impact actions that faculty members can implement in their classes. Rather than a full program or curriculum change, Jenkins' recommendations for enhancing student-instructor interactions carry across settings and content. Such actions help achieve "what the student-retention expert Sherry Miller Brown calls 'academic integration'" (Jenkins, 2015, para. 5) and are particularly helpful for at-risk students such as those who are nontraditional and in developmental education programs. Jenkins' suggestions include

Be a teacher, not a gatekeeper. By approaching teaching as a partner with students in the learning process, students are more likely to persevere through difficulties; the gatekeeper "sink or swim" approach has resulted in greater student attrition from his classes.

Be flexible. Students at open-access institutions are often part-time students with additional responsibilities for jobs, healthcare, children, parents, and other daily life issues demanding a large portion of their attention. Accommodating extenuating circumstances for a student in the midst of a personal crisis can make the difference between losing and retaining a student.

But don't be a pushover. Setting boundaries and clear guidelines is also important. An appropriate balance of flexibility and structure is key: "Being too flexible can create just as many problems as being completely inflexible" (Jenkins, 2015, para. 15).

Be accessible—and approachable. Physical availability (keeping office hours at varied times, staying after class to meet with students, and providing contact information) is an accepted and widely practiced component of student support. Education professionals should be cognizant of their approachability as well; interacting with students informally can help lessen any intimidation factor.

Make the material relevant. An engaged student is more prone to succeed, and connecting class content as directly as possible to students' "real life" and future can significantly increase engagement.

Take some personal responsibility. Although students bear the burden of responsibility for their academic effort and behaviors, reaching out to a struggling student can assist his or her recognition of an issue/barrier to success and also boost that student's personal responsibility.

Jenkins' acknowledges that every recommended intervention does not result in student success, and passing a particular course does not necessarily lead to finishing college or earning a degree. However, his course completion rates have increased almost 15% in the 4 years he has been implementing these class-level strategies. He points out "that in order for students to complete college, they first have to pass individual courses....And that's something we as faculty members do have some control over" (Jenkins, 2015, para. 27).

The preceding is summarized from Jenkins, R. (2015, May 18). Retention in the trenches: What can you do in your own classroom to keep students on track? *The Chronicle of Higher Education*. Retrieved from http://chronicle.com/article/Retention-in-the-Trenches/230211/

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