

The Effects of Student Self-Assessment & Goal-Setting upon Deeper Learning

Jonathon Van Spronsen

Vancouver Island University

Spring 2016

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ABSTRACT

A study was done of seventeen Pre-Calculus 11 students at John Barsby Community School in Nanaimo, British Columbia, Canada, to determine the effectiveness of student self-assessment and goal-setting upon learning. Three methods of data retrieval were used: questionnaires filled out by the students, asking them to set short-term goals and describe their level of comfort in mathematics; informal conversations with individual students and groups of students to determine their level of self-assessment; and observations of students written in bullet-point form. Given the difficulty in quantifying such an abstract concept as "increases in learning", the limitation of the timeframe of the project, the small sample size, and various other limiting factors, the research was ultimately inconclusive. It is the opinion of the writer that further investigation into the effectiveness of student self-assessment is warranted.

INTRODUCTION

Among the greatest challenges an educator faces is the problem of assessment: how is it possible to effectively know and understand what the student knows and understands, so that the educator can help the student know and understand what the educator wants them to know and understand? In other words, what is the best way to assess student knowledge in order that the teacher will know how to aid students in their struggles and recognise the depth of knowledge they do possess? One idea that has been increasing in popularity recently in contemporary education is that of *student self-assessment*: students attempt to determine and describe their own progress and express it in a way that can be reviewed by their educator.

The advantages of integrating student self-assessment into a learning environment are multifold. First, student self-assessment enables both student and teacher to establish a baseline from which the student's education may be customised. Although students are not always aware of the full breadth and depth of their knowledge, they will almost certainly be aware of more of their skills and knowledge than the educator; different forms of questions can help students to access knowledge about themselves that they may not have previously considered relevant. Once this self-awareness is expressed in some way that the educator may interpret (such as a short written quiz or a metacognitive reflection journal), that evidence, in combination with conversations with the instructor, can lead to a greater mutual awareness of how education can then be tailored to encourage the student's strengths and be designed and adjusted with respect to the student's current learning gaps.

Second, self-assessment provides a means for students to be able to gauge their own progress regularly. This is advantageous because many students have the tendency to assume

that the summative evaluations of their work they get from teachers, such as letter grades and test scores, are the only ways to evaluate progress. If a struggling student does not achieve a grade that is perceived (by the student or others) to be satisfactory, it is possible that the student may have taken very few opportunities to acknowledge the improvements made over the course of the term (Andrade & Valtcheva, 2009, p. 12). Thus, the constant reinforcement of perceived failure without acknowledgement of progress could potentially lead to decreases in self-confidence. In contrast, being asked to self-assess regularly increases the probability that a student will be more aware of knowledge gained (assuming an effective self-assessment method is chosen), and perhaps that may result in greater recognition of strengths and accomplishments on the part of the student (Dupeyrat, Escribe, Huet, & Régner, 2011, p. 242).

Given the significant advantages that student self-assessment could potentially bring to a classroom, I decided to see if it would be an effective strategy in a math class. For the sake of ease, I decided to narrow the scope of the project from self-assessment of the student's entire education to simply setting goals and using self-assessment to measure progress.

LITERATURE/THEORETICAL FRAMEWORK

The difference in learning when students self-assess is quite astonishing. A recent study of secondary math students in Nigeria found that students' self-efficacy and learning autonomy were enhanced after implementing a self-assessment regimen (Adediwura, 2012, p. 4492). The questionnaire handed out at the beginning of the study asked students about their academic habits and current evaluation of their self-efficacy (Adediwura, 2012, p. 4500), and so, given the similarities between the Nigerian study and mine—attempt to determine the effects of self-

assessment upon students in a secondary math environment—I modelled the questions in my questionnaire after the questions I found in the Nigerian study.

A study of French secondary math students with nearly identical objectives and methodologies as the Nigerian study—except that the students were divided into three groups based on their previous academic achievements in math—found that self-assessment only resulted in achievement increases from students who rated themselves on the initial questionnaire with high levels of confidence despite low grades (in other words, the students who overestimated their math skills) (Dupeyrat, Escribe, Huet, & Régner, 2011, p. 250). Another study, this one of math and spelling students from several schools in Brazil, found similar results to the French study, with one surprising secondary result also being discovered: while positive self-assessment has a strong statistical correlation with academic performance, mathematics anxiety and other psychosocial disorders were found to have none (Hasse, et al., 2012, p. 1). This seemingly contradictory finding can be at least partly explained if it is supposed that self-assessment helps to reduce the effects of anxiety or psychosocial disorders (though this hypothesis, to my knowledge, has yet to be proven). It seems as though self-assessment is truly a powerful tool to unlock the potential of students' learning.

While not as directly related to the other studies, a particular math self-assessment project undertaken in the United States in 2004 is also of relevance. Elementary-aged students were asked to estimate their own timing and accuracy on a math drill sheet that was about to be distributed; they were also asked to write reflections on their process of studying mathematics. It was determined that those two tasks enabled the rote memorisation of math facts to become more meaningful and relevant to the students (Brookhart, Andolina, Zuza, & Furman, 2004, p. 6).

The American project is especially noteworthy because of the similarities with this research project: both are studies of math students in public schools, undertaken by student-teachers and supervisors, in an attempt to determine whether learning was improved by the use of self-assessment practises and the introduction of reflective goal-setting (Brookhart, Andolina, Zuza, & Furman, 2004, p. 1).

ACTION-BASED RESEARCH OUTLINE

This research project was undertaken by the writer (a student-teacher on practicum) and involved seventeen students in a Pre-Calculus 11 class at John Barsby Community School in Nanaimo, British Columbia, Canada. The purpose of the project was to determine whether students were able to self-assess effectively in the context of goal setting, and whether or not that self-assessment positively contributed to their learning.

Pre-Calculus 11 is one of three math choices for public-school students in British Columbia; the other two, Apprenticeship & Workplace Math and Foundations of Math, are considered to be significantly easier. Thus, it is generally assumed that the students who are taking Pre-Calculus 11 are motivated by challenge, hoping to pursue a technical or scientific career, and/or enjoy studying advanced mathematics. However, at least two of the students were taking Pre-Calculus 11 because the schedule for Apprenticeship & Workplace Math conflicted with that of another course (Foundations of Math is not offered at this school.) Thus, the students appear to have various levels of aptitude for, and interest in, mathematics.

This research project had many limitations, some of which may have impacted the reliability of the study. They include the following:

- *Small sample size.* Working with a class of only seventeen students in only one school increases the variability of the data.
- *Short scope of time.* The research project took place over two weeks, with only nine classes, two of which were entirely taken up by quiz times.
- *Inexperience of the researcher.* Since this is the researcher's first action-research project, there are all sorts of mistakes that could have been made due to inexperience.

ACTION-BASED RESEARCH PROJECT PROCESS/METHODOLOGY

Initially, it seemed that monitoring the students' quiz grades for signs of increase would have been a good metric with which to measure academic improvement, but it soon was determined that it would not be, due not only to the short period of time allotted for the research project, but also due to the fact that in that two-week period, two very disparate units were being discussed in the class, with almost no conceptual overlap, making progress difficult to verify definitively. Also, more generally, summative evaluations such as grades do not directly measure progress at all, but rather adherence to standards that are global and not personalised, so they would not have been directly relevant towards the estimation of student improvement and goal achievement. Consequently, instead of grade increases, it was decided that progress would be measured by student responses.

The first method of student response used was a questionnaire called the "Goals & Outlook" form (the questionnaire in its entirety is attached as Appendix A). The questionnaire was simple and comprised four questions:

1. *Students were asked to evaluate how comfort they were with their math skills, on a scale from 1 (very uncomfortable) to 5 (quite comfortable).* This question was asked in order to establish a baseline; if students' comfort level with math increased over the course of the two-week period, it would be assumed that their understanding had been increased in some way.
2. *Students were asked how confident they were that they would succeed in the rest of the course.* This question was asked for a similar reason as the first question: to determine whether students felt their comfort with math had increased. The reason it was asked was to allow for some redundancy to make the data more credible.
3. *Students were asked to set a goal for the two following weeks that pertained to this course.* As one of the fundamental components of this action-research project, this question was designed to help the students pinpoint their goals for the class so that they could evaluate their own progress.
4. *Students were asked how they would achieve the goal they had set.* This question, though not directly pertaining to the outcomes of the research project, was asked in order to help the students think deeply about the goal they had set. It was surmised that the process of reflection on their goals would make it more likely that the students would remember them and know how to work towards accomplishing them, especially given the short timeframe.

Originally, the idea would be to collect the questionnaires as to have specific quantitative data with which trends could be noticed. However, it was deemed more important to the success of the project that the "Goals & Outlook" questionnaires remain with the students, so that they

would be constantly reminded of the goals they set and the methods by which the students intended on achieving their goals. Also, it was assumed that students may have set different goals—goals that would have been less personally motivated by the student, and ultimately less meaningful—if they knew a teacher would be reviewing them for quality or judging whether or not those goals had been accomplished. For those reasons, it was decided that the questionnaires would be filled out in consultation and conversation with the students, and that any data gathered from them would be informally collated and approximated without the questionnaires being collected.

In addition to the questionnaires, questions were also asked verbally on several occasions, to both individual students and groups of students, in order to prompt further self-assessment. These questions took various forms: sometimes they were as simple as checks for understanding coupled with a request for justification; other times, the questions were more direct and asked students to describe how they felt they had progressed in the course during the two-week period.

Finally, notes (in bullet-point form) were taken each day throughout the duration of the research project, outlining the events of the day and the ways student self-assessment may have taken place (these are attached as Appendix B). These notes were taken in order to have a written record of the findings of the research project (some of the notes directly related to the research project itself; others were taken in order to benefit the future educational practise of the researcher).

THE STORY OF MY ACTION-BASED RESEARCH PROJECT

Several factors led to my choice of student self-assessment as my research project topic. Originally, my research proposal was quite different: I had intended to research *multimodal assessment* (using multiple forms of assessment to accommodate various learning styles and incorporate student choice) and its effects upon the grades of students in secondary French language classes. However, I was forced to abandon that project when I learned that none of my course assignments would be taking place in French language classes. The enormity of the workload required to bring multimodal assessment into three separate math courses at once, when I had never attempted it before, was enough to dissuade me from trying the same approach in the math classes I would teach. However, I knew I wanted to keep the theme of assessment prominent in my research.

I decided to return in my memory to when I took secondary math. In my adolescence I attended a private high school where students evaluated most of their own homework according to score keys that were available to everyone in the class; only tests were instructor-graded. That system not only made for far less work for the instructor, but also, most students gained a greater awareness of progress, clarification for where they needed help, and a sense of increased autonomy from taking on a role typically given only to instructors. Because I personally benefited from this model, I felt it would be interesting to try to incorporate more self-assessment techniques into math classes. Thus my action-research project began.

Given the tight timeframe I had before my practicum, I determined that it would be too difficult to redesign the entire teaching and homework model for the class I would be working with. Instead, I focused on what I perceived to be another advantage of my high school's model

of education that also pertains to student self-assessment: teaching students to set small, short-term goals so that it is easier for them to monitor their learning progress. To accomplish this in my classroom, I created a self-assessment questionnaire that I would distribute to the students so that they would take the time to evaluate their progress over a two-week period. As part of the questionnaire, I asked students what they felt their progress in math was so far and how they felt they were progressing; I also spoke to the students informally throughout my practicum, either individually or in groups, asking for their appraisal of their own progress and specific evidence for that conclusion. My intention was to be able to help students recognise their own achievements, while also increasing my awareness of what the needs of the class were.

Unbeknownst to me at the time, my future sponsor-teacher, whose classes I would be teaching during my practicum, was already incorporating self-assessment into the class in a way that was far more robust than the method I was proposing. His self-assessment form was twice as long as mine and asked questions that seemed to gather far more useful information. Both of our questionnaires asked the students to set short-term goals and outline some strategies they could use to accomplish those goals, but his questionnaire took into account various different types of goals, whereas mine did not. After I handed out my questionnaires, he and I had a conversation about the different types of goals students can set for themselves. He grouped student goals into two categories: *performance-oriented goals* and *habit-oriented goals*. According to his definitions, *performance-oriented goals* are goals that result in some sort of measurable reward at the end, such as a specific grade on a report card, a placement on the Principal's List, or the winning of a medal. He defined *habit-oriented goals* as goals that introduce healthy habits (or perhaps reduce unhealthy habits) for the intention of improvement,

such as hiring a tutor, asking more questions in class, or visiting the teacher when extra help time is available. Although the rewards of habit-oriented goals are often more abstract, he posited that habit-oriented goals tend to be easier for students to accomplish because they are usually more specific and are easier to track (students have a better idea of knowing whether or not they are achieving their goals); therefore, he felt more encouraged when students set habit-oriented goals than when they set performance-oriented goals (he told me that he would sometimes even ask students specifically to ensure that at least one of their goals was habit-oriented). I very much appreciated my sponsor-teacher's opinions on the subject, and felt like I personally agreed with most of them.

This led to my questioning of whether I had adequately prepared the students to fill in the questionnaire in the first place. Earlier, as I was watching the students write their goals, even then I had had the distinct impression that most of the goals the students were setting were too lofty and vague to develop indicators of success for, despite my suggestion to make the goals quantifiable. Hence, after my conversation with my sponsor-teacher, I was convinced that the questionnaire's data would be less reliable than I had originally hoped. For this reason, I decided not to give out the same questionnaire later and rely more extensively on verbal feedback from the students instead.

The verbal feedback I received was very interesting, since it seemed to be less intimidating for most of the students to answer a question than to invent a goal. Thus, the goal of the research project transmuted slightly to include self-assessment of several kinds, and the specificity required for a reasonable scientific conclusion was no longer feasible for this project.

FURTHER REFLECTION AND CONTINUING QUESTIONS

Interestingly, five of the seventeen students in this Pre-Calculus 11 class are English Language Learners (ELL) from other nations (China, South Korea, Japan, and Brazil). Although language challenges were not extensively considered before the project began, they ultimately were a significant factor, since the purpose of the research project was to be able to gauge student self-assessment skills, which is difficult when there is a communications barrier. One of the students commented that the most difficulty he had in the course was understanding the English. Considering the fact that he was able to consistently answer questions correctly, rephrase questions I asked him, and perform well on quizzes, I assume that perhaps he understood more than he thought, but his criticism is valid nevertheless.

Given this student's confusion, I am questioning the success of the project. Because the purpose of the project was to determine whether student self-assessment increases learning, and at least one of the students did not understand the purpose of the project, there are some lingering doubts as to the efficacy of the experiment. However, this does not completely eliminate the possibility of student self-assessment positively influencing student learning; rather, it simply reiterates to me that this research project may have been inadequately designed. Thus, I would prefer to conduct this project again with more forethought and the benefit of experience to guide the methodology.

CONCLUSION

International research clearly indicates that the introduction of self-assessment into a mathematics classroom does improve student learning overall. However, the results for this

action-research project were inconclusive at best. Because no clear criteria were defined by which learning improvement would be measured, there was no way to determine whether or not the self-assessment practises were ultimately effective. Additionally, very little data were actually gathered, and the imprecise method of data gathering, the lack of regularity or follow-up (no second questionnaire), the limited timeframe, and the small size of the student sample all contributed to the lack of reliability in any data that would have been found.

In summary, though it unclear whether the research project was effective in enhancing student learning, my personal learning has been enhanced. I believe that the idea of the study has tremendous merit, and I hope to continue to modify the methodology of implementing self-assessment in my teaching practise so that it will be meaningful and effective in helping students achieve new understandings.

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APPENDICESAPPENDIX A: Self-Assessment Questionnaire ("Goals & Outlook Form")

Circle the number that corresponds to your opinion of each statement.

I feel comfortable with my knowledge of math so far.

1	2	3	4	5
Strongly disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat Agree	Strongly Agree

I feel confident that I will do well in the rest of the course.

1	2	3	4	5
Strongly disagree	Somewhat Disagree	Neither agree nor disagree	Somewhat Agree	Strongly Agree

Answer the following questions.

What is your goal for the next two weeks in math?

How will you achieve that goal?

APPENDIX B: Action-Research Notes

February 9

- handed out questionnaire
 - student reactions positive
 - students weren't used to self-analysis
- from what I observed, students ranked themselves at approx. 3/5 despite a class average of 10/12 on the quiz the previous week
- students were slow to volunteer at first, even for simple tasks like copying what I said on the board
- students seemed to feel a bit better towards the end of the class when they were able to trust me more

February 10

- today was a review day
- students weren't very vocal except for a few (3-5 out of 10)
- students struggled with the more complex questions
- asked students privately one-on-one how they were doing; responses were varied

February 11

- worked with TTOC; students loved him
- taught calculus students about limits, even though it was technically the TTOC's job; first time teaching a split class on my own
- students missed some concepts the day previous so we did a review

February 12

- Another TTOC
- quiz day:
 - calculus students did excellently, 2/3 got 100%
 - pre-calc 11 students (quiz I designed) did okay, averaging about 70%; there were some common themes to the wrong answers so I know what to cover again
- both math 10 classes' students did poorly overall because the quiz had questions more complicated than their homework questions; get the feeling the 10's will feel defeated on Monday when they see their marks

February 15

- grade 10's told sponsor-teacher they weren't ready for a quiz that had no multiple-choice questions
- grade 10's were encouraged to think for themselves, ask questions, take risks, and justify their answers
- grade 10's were asked if they wanted a better mark on their next quiz; vast majority raised their hands; sponsor-teacher got them to suggest ways that could happen

February 16

- sponsor-teacher gave me a sample self-assessment form he has used with students in the past

February 17

- practicum supervisor visited; said he was impressed at my ability to relate to ELL students

February 18

- sponsor-teacher asked students to give themselves a grade for their homework that they think they deserve
- some students need to improve their self-assessment skills because they underestimate their own capabilities
- asked grade 11's how comfortable they felt today; one student who said she felt uncomfortable, and didn't do well last quiz, actually solved one of the most difficult examples I put on the whiteboard today
- one student who said the school "sucks" learned a new concept and worked independently today!

February 19

- sponsor-teacher told me that he found performance goals weren't as important as practical goals; he said last year he asked students to create a goal for the term that couldn't be a performance goal
- he told me he gets students to set their own homework grades but doesn't consider them in their final mark; the purpose is to get the students assessing their own progress
- students got average marks on quiz (70s); no fails, no aces; highest mark in class went to student who was quiet and was steadily improving throughout the term