DOCUMENT RESUME

ED 444 433 HE 033 170

AUTHOR	Ulmer, M. B.
TITLE	Self-Grading: A Simple Strategy for Formative Assessment in Activity-Based Instruction.
PUB DATE	2000-06-00
NOTE	9p.; Paper based on a presentation at the Conference of the American Association for Higher Education (Charlotte, NC, June 2000).
PUB TYPE	Opinion Papers (120) -- Reports - Descriptive (141) -- Speeches/Meeting Papers (150)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	College Mathematics; College Students; *Course Content; Course Descriptions; Course Objectives; *Critical Thinking; Curriculum Development; Formative Evaluation; Grading; Higher Education; Learning Activities; Liberal Arts; *Mathematics Instruction; Personal Narratives; *Problem Based Learning; Problem Solving; *Self Evaluation (Individuals); Student Evaluation; *Teaching Methods

ABSTRACT

This paper discusses the author's personal experiences in developing and implementing a problem-based college mathematics course for liberal arts majors. This project was initiated in response to the realization that most students are dependent on "patterning" learning algorithms and have no expectation that self-initiated thinking is a characteristic of learning. The problem-based version of college mathematics presented here uses no required text; instead a packet of activities and project assignments accompanies material designed to add structure to the course. The paper addresses concerns about increased faculty workload in teaching for critical thinking and the additional time required for formative assessment. Using examples from the author's own experience in the classroom, it compares advantages and disadvantages of instructor-graded formative assessment with the suggested self-grading technique. The latter allows the instructor: (1) to see the learner's initial response, (2) to see what information the learner has gained from the discussion session, (3) to measure the learner's level of comprehension, and (4) to review only one set of papers in order to make small adjustments in the learner's understanding. A graphing activity and a self-assessment rubric are appended. (CH)

ERIC

Reproductions supplied by EDRS are the best that can be made
from the original document.

ED 444 433

SCOPE OF INTEREST NOTICE
The ERIC Facility has assigned this document for processing to: HE
In our judgment, this document is also of interest to the Clearinghouses noted to the right. Indexing should reflect their special points of view. TM

Self-Grading: A Simple Strategy for Formative Assessment in Activity-Based Instruction

M.B. Ulmer, University of South Carolina Spartanburg
Spartanburg, SC 29303 , USA

This paper is edited from the dialog of a presentation made to the Assessment 2000 conference of the American Association for Higher Education in Charlotte, NC, in June 2000.

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY
M. Ulmer
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
1

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
☒ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

BEST COPY AVAILABLE

333170

ERIC

SCOPE OF INTEREST NOTICE
The ERIC Facility has assigned this document for processing to: HE
In our judgment, this document is also of interest to the Clearinghouses noted to the right. Indexing should reflect their special points of view. TM

Self-Grading: A Simple Strategy for Formative Assessment in Activity-Based Instruction

M.B. Ulmer, University of South Carolina Spartanburg
Spartanburg, SC 29303 , USA

This paper is edited from the dialog of a presentation made to the Assessment 2000 conference of the American Association for Higher Education in Charlotte, NC, in June 2000.

Abstract. Experience indicates that a major impediment to problem-based learning in mathematics is the excessive time one must spend in formative assessment activities. A technique employed to be more efficient in formative assessment of critical thinking in problem-based learning can significantly decrease the time and work demand on the instructor, while providing timely and authentic feedback to the learner.

As educators we continually ask ourselves

- How do we know our students are learning?
- How do we know they are thinking critically?
- How can we follow their patterns of thought?

But more important are the questions:

- How do THEY know they are learning?
- How do THEY know they are thinking critically?
- How can THEY reflect on their patterns of thought?

Background. For nearly a quarter century I taught, discussed, assigned, assessed, graded – in some order or another. I hoped and expected that students would read and reflect on all those comments and thought-provoking questions I so meticulously wrote on their homework and tests. As I learned to give more authentic assignments, I realized that much of what we (I) had taken for learning was really *patterning*. If I can be allowed to oversimplify the best student's expectation it would be, "Give me an example of how to think and do and I'll think and do like you." Students seldom evidenced their own ideas except during our Socratic questioning sessions – sessions in which formative peer- and self-assessment were part and parcel.

In the years '91-'93 I had two sets of experiences that changed the way I teach. First I tried piloting a middle grades statistics book in a semester-long course for eighth graders. The only way I found to reach these students was through active learning and projects. Only later did I learn to call it problem-based learning (PBL). These students won the American Statistical Association's national project competition.

The second experience was teaching in a three-year program called the Partnership for Excellence in which we modeled progressive techniques for in-service teachers. We attempted activity-based learning, guided discovery, cooperative learning - every promising technique we could find or think up… and we used technology wherever possible. What seemed to work best were the activity-based strategies.

Informed by these two experiences, some of us on the mathematics faculty at the University of South Carolina Spartanburg (USCS) fashioned a problem-based version of our College Mathematics course for liberal arts majors. We began teaching the PBL course in 1995.

ERIC
Full Text Provided by ERIC
TM031570

The problem. Our work began as a response to the realization that most of the students entering our math classes were and are products of pedagogical styles that depend on learning algorithms, i.e. *patterning*, in order to be successful. (Ulmer, 1994) They bring with them no expectation that self-initiated thinking should be a characteristic of learning. There may be several reasons for this, including

- Textbook dependence. One finding of the Third International Mathematics and Science Study was the inclination of US grade school teachers to spend disproportionate class time using textbooks compared to such countries as Japan and Germany. Mathematics instruction in those countries was found to be more successful than in US schools.(Peak, 1996)
- Out-of-context instruction. Mathematics instruction has, for some decades, been governed by a curriculum in which topics were included on the basis of their consistency with other topics. Applicability, a criterion deemed important by most students, has seldom been a consideration for those writing high school and college math books. (When have you factored a quadratic polynomial, rationalized a denominator, or used the FOIL method as part of solving a real problem? Problems I encountered in my earlier work as a laboratory statistician and in more recent work as an operations research and mathematics consultant bore little resemblance to those in the textbooks from which I taught.)
- Repeated curriculum. Since the seventh grade textbook had the same topics as the eighth grade textbook, which was much like the ninth grade textbook... There is the *pattern* again!
- ...and many other reasons you may be able to articulate.

So the problem-based version of College Mathematics at USCS uses no required textbook. Instead, a packet of activities and project assignments accompanies a forty-two-page booklet designed to add structure to the course. The booklet contains too few textbook-style problems to support the faculty member who wishes to spend class time in drill, practice and patterning. Fewer problems are worked than in the text-based version of the course, but, as other educators using active learning and PBL have found, "students appear to emerge with a greater store of usable knowledge." (Moore, 1997) Our in-course and subsequent performance assessment data supports that statement. Students succeed at a much higher rate (median = 75%) in the PBL version than in the text-based version (median = 56%) and those who take statistics the next semester succeed there at a higher rate. More detailed data can be found on the web as a PDF-formatted link from the course web page: http://www.uscs.edu/~mulmer/PBI_Index.shtml

Only about half the mathematics faculty members at USCS have bought into the idea of PBL. They have reasons:

- Some do not like the prospect of abandoning texts. Our department has several very well respected textbook authors.
- Others do not wish to, or can't, give up control of the order, methods and styles of learning to the extent necessary for PBL to work. But most of all,
- PBL presupposes teaching for critical thinking, and so, requires a great deal of formative assessment. And that means a lot of time and work!

It is this last bullet that I address in that which follows.

Critical Thinking and Formative Assessment: Problem-based instruction requires the learner to rely on his or her own thinking (not patterning) in order to begin solutions to problems. The problems themselves call for thinking in order to complete activities and write associated reports. This allows us as instructors to teach for **critical thinking,** which we might loosely describe as reflective thinking, or thinking about ones own thinking in order to improve the quality of that thinking. Early formative assessment activities serve to acclimate the learner to this need for critical thinking.

As an example of my own development toward teaching for critical thinking, and the hurdles I encountered, consider one small topic from business calculus: that of distinguishing between the Absolute Rate of Change and the Relative Rate of Change. In days gone by, I might have asked students to distinguish between these concepts by stating the definitions. Some students, perhaps 30%, would succeed. Then I might have given a problem where they had to use the definitions to compute absolute and relative growth of some function for a given change in the independent variable (say, time). A few more, perhaps 40%, would succeed. Then, as benefits of contextual learning became more obvious, I actually gave the following question:

"Would the *Absolute Growth Rate* or the *Relative Growth Rate* be more important to someone who wants to buy stocks?"

To my delight, HALF THE CLASS got it right!! But that delight lasted about as long as it took you, the reader, to recognize that a higher success rate than 50% was needed on a two-response question to indicate that any learning was taking place!

So two years ago, when I got a chance to teach the course again, I began to use writing as a vehicle for promoting critical thinking. I gave the following assignment:

"In one-half page or less, explain why the *Absolute Growth Rate* or the *Relative Growth Rate* (pick one) would be more important to someone who wants to buy stocks."

Realizing that for assessment to be formative, it must be timely, I graded and returned each submission with comments and tried to incorporate a consideration of common mistakes into a Socratic session. It was extremely time consuming. But even more frustrating was the realization that it was I - not the intended learners - who was thinking critically about their work. The students simply stashed my well-chosen comments in a backpack and left for history or psychology class.

Since then I have used the self-grading technique as follows:

- Give an assignment requiring a short well-thought-out written response to a question. I call it a "ticket", indicating that it must be completed for admission to the next class.
- Once in class, have students put away all books, papers, pencils, pens, etc. - except for their responses to the assignment. Hand out colored pencils for students to use for corrections and modifications to their work.
- Solicit discussion from students about their perspectives on the assignment. Use Socratic techniques if necessary to steer the conversation. Ask all students to correct or improve their own responses as they evaluate the oral responses of their peers. Require additions or corrections to be made with the colored pencil.

- Once discussion has revealed correct or reasonable responses, provide a rubric overhead by which the student can assign his or her own grade. Take up the assignment.
- Before next class, review the students' responses and self-reported grade for accuracy and for adherence to the rubric, and make necessary adjustments in a third color of ink. Record scores.

Attached below are an example activity and its corresponding rubric. Some additional activities are found on the course web site given above.

Summary of Advantages. Using **instructor-graded** formative assessment, the instructor

- sees the learner's initial response. A great deal of time and thought goes into preparation of feedback on each response.
- must offer opportunity for rewriting in order to ensure that learners rethink the assignment, and
- must grade, or at least remark, a second set of responses.

The learner

- sees his or her initial response,
- sees the instructor's reply, and
- formulates a second response in isolation, often long after discussion has taken place.

Such a scenario can take more than a week in two-day-per week classes.

Using the **self-grading** technique, the instructor

- sees the learner's initial response,
- sees the information the learner gleaned from the discussion session,
- gets a measure of the learner's level of comprehension from his or her adherence to the rubric,
- must review only one set of papers, and then only to make small adjustments in the learner's understanding.

The learner

- sees his or her initial response,
- reflects on that response and becomes engaged,
- formulates a second response,
- sees the instructor's response to both learner responses, and
- receives timely feedback on her or his thinking and self-assessment.

The self-grading scenario can usually be accomplished in one class period. The quality and the quantity of formative assessment are greatly improved. The impetus to think critically is placed where it belongs - with the learner. And, since the time the instructor spends grading papers is significantly reduced, another barrier to successful problem-based learning is removed.

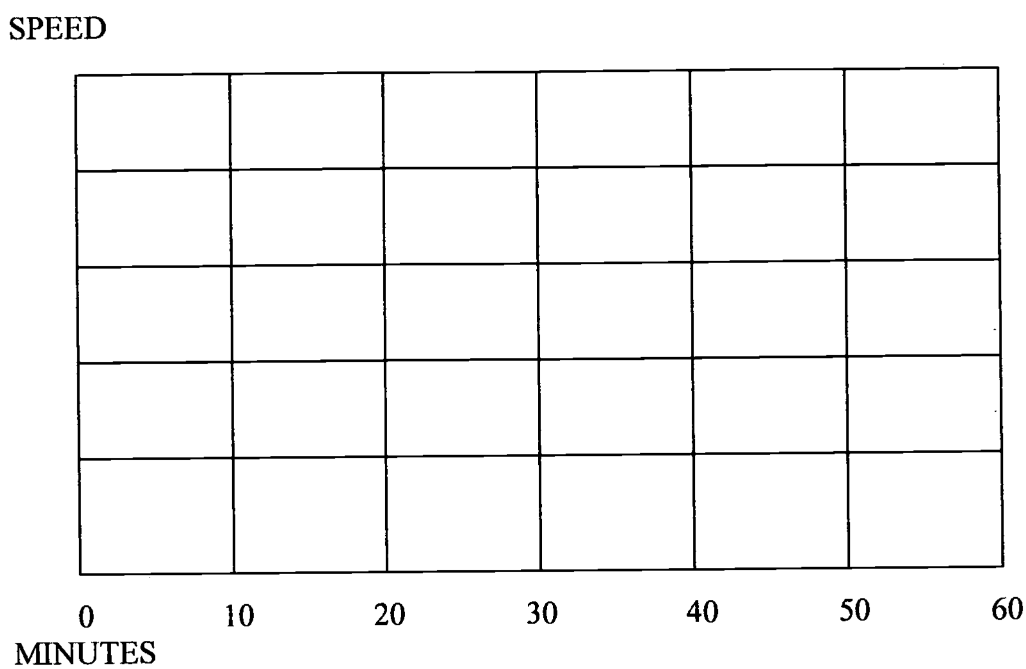
ERIC

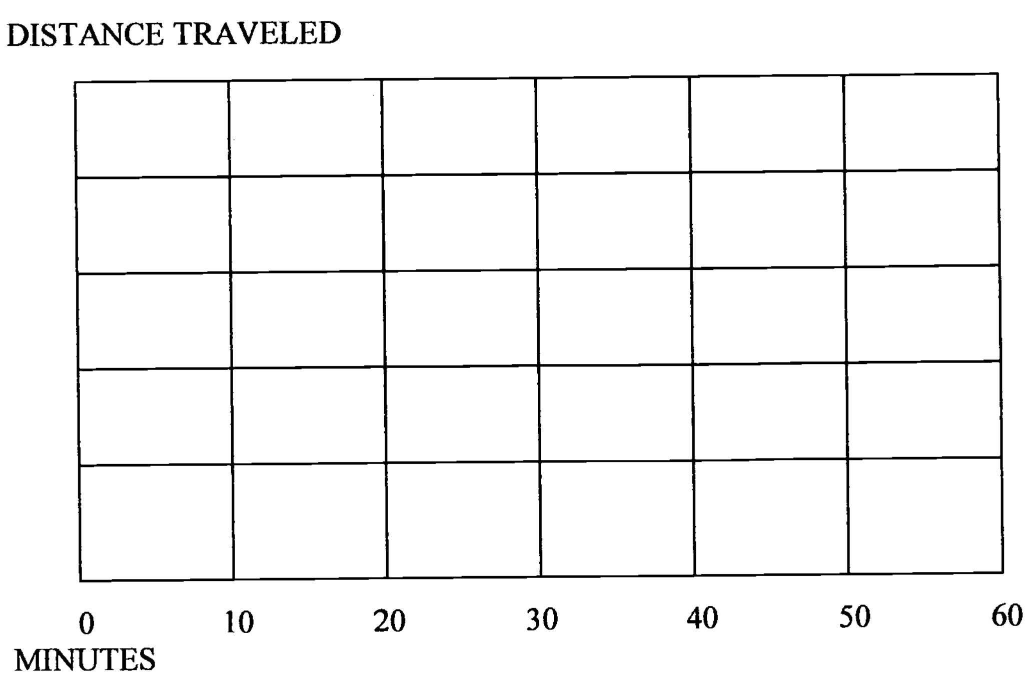
References:

1. Moore, D. S. (1997). New pedagogy and new content: the case of statistics. International Statistical Review, 65(2), 123-137.
2. Peak, L. (1996), Pursuing Excellence - A Study of U.S. Eighth-Grade Mathematics and Science Teaching, Learning, Curriculum and Achievement in International Context (USDE Publication No. NCES 97-198). Washington, D.C.: US Government Printing Office, 37.
3. Ulmer, M.B.(1994),"Using Statistics and Data Analysis to Motivate Other Mathematical Topics", Proceedings of the Fourth International Conference on Teaching Statistics, vol II, 607.

SMTH 122 - Graphing activity 1- The Runner

A runner starts her workout by jogging slowly at a steady pace for ten minutes. She then runs fast for twenty minutes, but catches up with a friend who is a slower runner. She runs with him for fifteen minutes and then, for the final five minutes, walks to cool down. On the first grid below, draw a possible graph of her speed as a function of time. On the second grid, draw a possible graph of her distance traveled as a function of time.





Self Assessment
Rubric #1 5 Points

I did not do the activity.	0 points
I tried something, but my answer is impossible.	2 points
My results are possible but highly unlikely.	3 points
My results are mostly reasonable but need improvements.	4 points
My results are good. I can find no flaws in my reasoning	5 points

ERIC

U.S. Department of Education
Office of Educational Research and Improvement (OERI)
National Library of Education (NLE)
Educational Resources Information Center (ERIC)

HE033170

REPRODUCTION RELEASE

(Specific Document)

I. DOCUMENT IDENTIFICATION:

Title: Self-Grading: A Simple Strategy for Formative Assessment in Activity-Based Instruction

Author(s): M.B. Ulmer

Corporate Source: University of South Carolina Spartanburg

Publication Date: 16 June 2000

II. REPRODUCTION RELEASE:

In order to disseminate as widely as possible timely and significant materials of interest to the educational community, documents announced in the monthly abstract journal of the ERIC system, *Resources in Education* (RIE), are usually made available to users in microfiche, reproduced paper copy, and electronic media, and sold through the ERIC Document Reproduction Service (EDRS). Credit is given to the source of each document, and, if reproduction release is granted, one of the following notices is affixed to the document.

If permission is granted to reproduce and disseminate the identified document, please CHECK ONE of the following three options and sign at the bottom of the page.

The sample sticker shown below will be affixed to all Level 1 documents	The sample sticker shown below will be affixed to all Level 2A documents	The sample sticker shown below will be affixed to all Level 2B documents
PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY ____ TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) 1	PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE, AND IN ELECTRONIC MEDIA FOR ERIC COLLECTION SUBSCRIBERS ONLY, HAS BEEN GRANTED BY ____ TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) 2A	PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN MICROFICHE ONLY HAS BEEN GRANTED BY ____ TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) 2B
Level 1	Level 2A	Level 2B
☑	☐	☐
Check here for Level 1 release, permitting reproduction and dissemination in microfiche or other ERIC archival media (e.g., electronic) *and* paper copy.	Check here for Level 2A release, permitting reproduction and dissemination in microfiche and in electronic media for ERIC archival collection subscribers only	Check here for Level 2B release, permitting reproduction and dissemination in microfiche only

Documents will be processed as indicated provided reproduction quality permits.
If permission to reproduce is granted, but no box is checked, documents will be processed at Level 1.

I hereby grant to the Educational Resources Information Center (ERIC) nonexclusive permission to reproduce and disseminate this document as indicated above. Reproduction from the ERIC microfiche or electronic media by persons other than ERIC employees and its system contractors requires permission from the copyright holder. Exception is made for non-profit reproduction by libraries and other service agencies to satisfy information needs of educators in response to discrete inquiries.

Sign here, → please

Signature: M.B. Ulmer
Printed Name/Position/Title: Associate Dean, College of Arts + Sciences
Organization/Address: 800 Univ. Way, Spartanburg, SC 29303
Telephone: (864) 503-5224
FAX: (864) 503-5709

E-Mail Address: mulmer@uscs.edu	Date: 1 Aug 00

III. DOCUMENT AVAILABILITY INFORMATION (FROM NON-ERIC SOURCE):

If permission to reproduce is not granted to ERIC, *or*, if you wish ERIC to cite the availability of the document from another source, please provide the following information regarding the availability of the document. (ERIC will not announce a document unless it is publicly available, and a dependable source can be specified. Contributors should also be aware that ERIC selection criteria are significantly more stringent for documents that cannot be made available through EDRS.)

Publisher/Distributor:
Address:
Price:

IV. REFERRAL OF ERIC TO COPYRIGHT/REPRODUCTION RIGHTS HOLDER:

If the right to grant this reproduction release is held by someone other than the addressee, please provide the appropriate name and address:

Name:
Address:

V. WHERE TO SEND THIS FORM:

Send this form to the following ERIC Clearinghouse:

However, if solicited by the ERIC Facility, or if making an unsolicited contribution to ERIC, return this form (and the document being contributed) to:

ERIC Processing and Reference Facility
4483-A Forbes Boulevard
Lanham, Maryland 20706

Telephone: 301-552-4200
Toll Free: 800-799-3742
FAX: 301-552-4700
e-mail: ericfac@inet.ed.gov
WWW: http://ericfac.piccard.csc.com

EFF-088 (Rev. 2/2000)

ERIC
Full Text Provided by ERIC