5-22-2013

Teaching Undergraduates How to Analyze

Ryan Andrew Nivens
East Tennessee State University, nivens@etsu.edu

Rosalind Raymond Gann
East Tennessee State University, gannr@etsu.edu

Citation Information

Nivens, Ryan Andrew; and Gann, Rosalind Raymond. 2013. Teaching Undergraduates How to Analyze. Paper presentation. *Proceedings of the Joint Meeting of the Academic Business World International Conference & International Conference on Learning and Administration in Higher Education*, Nashville, TN. 631-639. http://iclahe.org/Proceedings/2013/Proceedings-2013.pdf

Teaching Undergraduates How to Analyze

Title: *Teaching Undergraduates how to Analyze*

Ryan Andrew Nivens
Assistant Professor
Department of Curriculum and Instruction
East Tennessee State University
Johnson City, TN 37614
Nivens@etsu.edu

Rosalind Raymond Gann
Associate Professor
Department of Curriculum and Instruction
East Tennessee State University
Johnson City, TN 37614
GannR@mail.etsu.edu

Abstract: Analysis is typically the first of the higher functions listed in taxonomies of higher order thinking. Academics consider these upper categories extremely worthwhile, but they are hard to teach and we are apt to ignore them. Today higher education is being criticized for "dumbing down" curriculum or lowering standards. To rectify this, many policies at the state or national level are requiring higher education institutions to change. In K-12 education, Race to the Top and Common Core requirements are placing new demands on K-12 teacher preparation, which include evaluation of the analysis skills of pre-service teachers. But professors do not always view their disciplines as the proper place for teaching analytical skills. Others become frustrated when trying to teach analysis. But if we do not teach these skills, our teacher candidates will be poorly prepared for successful teaching, a problem which will cascade throughout our society, rendering our citizens less educated. In this paper, we describe our efforts to teach analysis in two courses from widely differing subject areas, literacy and mathematics education. We are now requiring pre-service teachers to analyze simulated or actual samples of student work. We have developed a sequenced process of analysis education that we designate with the acronym CODE. It includes Compilation of information, Organization of data, Determination of patterns, and Explanation of understanding. We believe this technique can be generalized to many courses in where students' ability to analyze poses a problem.

Introduction

The ability to analyze is a vital aspect of the academic endeavor. Students at all levels struggle with analysis, but because analysis is difficult to teach, instructors and professors sometimes lower the bar on what is expected, viewing the teaching of analytical thinking as outside their scope of responsibility, or perhaps beyond any teacher's reach. In this paper, we discuss how we foster analytic thinking in a mathematics course and in reading education. Across the nation, educational reform is being required at all levels. The Common Core Standards for language arts and mathematics education stress the acquisition of analytic thinking (National Governors Association, 2010). Sometimes the changes are enthusiastically embraced; always they must be addressed and incorporated into new curricula. In Tennessee, a reform of teacher education has mandated a series of new requirements for teachers. The initiative is a result of several policies, notably Race to the Top, a product of competition between state departments for Federal funds requiring alignment with a Federal agenda. Race to the Top is concerned with K-12 education, but it is having a profound impact on higher education coming in the form of the Ready2Teach initiative, which is directly changing the education of prospective teachers at all six Tennessee Board of Regent's (TBR) universities (TBR, 2010). TBR is the nation's sixth largest university system; thus the impact of the Ready2Teach initiative is immense.

Ready2Teach requires that teacher education programs be redesigned and individual courses be rewritten in line with its policies. Prospective teachers must now be taught about student learning using Stanford's SCOPE framework (see Figure 1). In this paper, we use the term 'student' to designate pupils in grades K-12, while the pre-service teachers with whom we work are called teacher candidates. We describe how we have adjusted our courses to support several subcategories in the SCOPE framework, specifically, *Assessments to Monitor Student Learning*, and *Analysis of Student Learning.* We officially began to pilot these adjustments to our courses in 2012, and as we analyzed our own goals in teaching, we have identified some learning characteristics of our teacher candidates which, we believe, transcend our classes and program. While able to build rapport with K-12 students, our candidates are typically weak in analysis of educational problems when they arrive in our classes. We illustrate how we foster analysis in two very different courses. We believe the same process might be applied to any teacher education program or other course in higher education where analysis is valued. We support our ideas with anecdotal data and conclude with our ideas on why the skill of analysis is initially so weak.

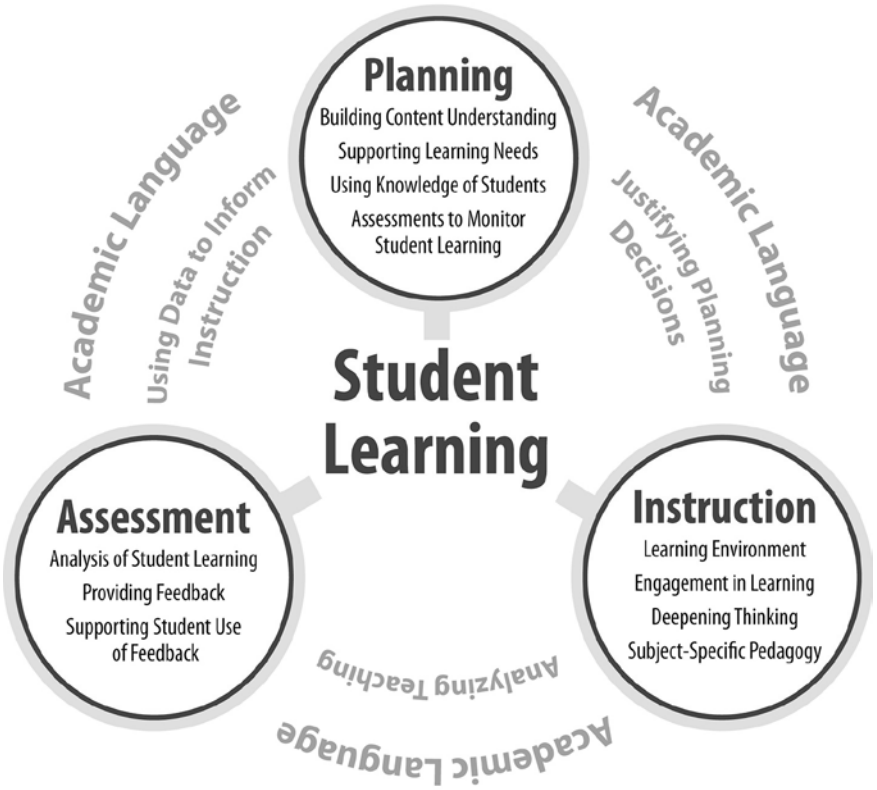


Figure 1. Stanford framework from the SCOPE project

Implementation in Higher Education, Math Methods Example

The skill of analysis is required in many areas of our Interdisciplinary Studies in Education program, which prepares students to teach in grades K-6. One focus of our teaching is strategic analysis of student work.

Using a problem-based learning approach (Duch, Groh, & Allen, 2001; Levin, 2001), pre-service teachers hear a brief story about a struggling third grade student and are then presented with a sample of this student's work. Teacher candidates are given a week to study this case material. Following this, there is group analysis and discussion. Teacher candidates must prepare a 2-3 page analysis of student work, with this suggested structure: 1) Identification of misconception or errors, 2) Supporting evidence and 3) connection to other aspects of student work or relevant peer-reviewed literature.

At first, teacher candidates struggle with identification of student misconceptions. Typically, they react to incorrectly executed addition or subtraction by stating, "This student forgets to borrow or carry her ones." To scaffold the teacher candidates in their presentation of analysis, we instruct them to go beyond description. We require analysis. Most teacher candidates have not been required to conceptualize at this level, especially in the context of mathematics. They must move beyond description and produce such analyses as, "This student lacks knowledge of place

value. When she adds 9 + 6, she gets 15, but then writes both digits of the 15 in the tens column, even though there are still hundreds digits to add following this computation." The difference between these two statements is that the first identifies a procedural error, while the second identifies the mathematical knowledge, or lack thereof, causing the error.

Teacher candidates are required to provide examples from the student work in support of their analyses. They might say, "Her misconception of place value is evident in problem #2, when she attempts to add 197 + 66." Frequently, our teacher candidates can describe an error, but are unclear where they have seen it. Their writing sometimes lacks context, for our candidates sometimes assume the only audience for their writing is the professor who provided student samples and is fully familiar with them. Our goal, by contrast, is teaching them to write about math performance for other educators.

The requirement that they make connections to other aspects of the assignment or professional literature is the most difficult for the teacher candidates. Rarely have they read literature on analyzing student work, and finding links to other courses and internship experiences is difficult. In this assignment teacher candidates are expected to cite relevant literature; in the earlier example they might say something like, "Ashlock (2010) describes many errors in student computation and in particular illustrates student work that displays errors in place value that result in unreasonable computations." As they learn to analyze obstacles to learning, teacher candidates also make connections to peer-reviewed literature documenting difficulties encountered by English Language Learners (ELLs) and students with special needs. The aim is helping the teacher candidate realize that analysis of student work is not a simple matter of saying what students "get right" and "get wrong" nor even of describing the error; rather, we seek a paradigm shift where errors are viewed as a means of assessing what a student is confused about and needs to learn next.

Implementation in Higher Education, Reading Course Example

This way of looking at errors in math is similar to the miscue analysis we employ in literacy education (Johns, 2012). Assessment and Enhancement of Reading is an upper level course whose goal is making teacher candidates aware of reading as a developmental process. Our teacher candidates educational experience has taught them a discourse (Gee, 1999) where student output is graded, production is viewed as either right or wrong, and the role of the teacher is praising students, or else reprimanding them for not trying. We call this the discourse of scoring. It has limited utility in math education; nor is it particularly useful in teaching children to read. Our course seeks to move teacher candidates into a developmental discourse which examines what children already know about reading, analyzes what might be getting in their way, and suggests strategies for further mastery (Johns, 2012).

In one assignment, we require teacher candidates to administer the Johns Basic Reading Inventory to an elementary school child who reads at approximately grade level and to use the information thus gained to develop a developmentally appropriate reading activity. The assessment yields rich data on a young reader's errors, which in developmental discourse, we term "miscues" (Goodman, 1996). The assessment itself consists of graded word lists, reading

passages and comprehension questions. It is easily administered, and when analyzed properly, it offers a window into the child's reading process, where it is possible to learn what a boy or girl does when encountering unfamiliar text (Aarnoutse, et al., 1999). By examining the word lists, we discover if they use or confuse graphically similar words such as 'ball' and 'doll'; whether they reverse letters and read 'saw' for 'was'; whether they decode the first part of the word and guess at the rest so that 'horse' is rendered 'house,' 'library' as 'liberty,' 'industry' as 'instruct,' and 'invention' is read as 'invitation.' The reading passages yield even richer data. We learn, first of all, if children expect what they read to make sense. If they do not, sentences such as "The puppy was a black poodle" might be rendered, "The puppy was a big puddle" and not self-corrected. On the Johns Inventory, miscues are coded as reversals, omissions, substitutions, insertions and non-words. Self-corrections using context and substitutions of contextually acceptable words are not deemed significant. The inventory sorts errors in comprehension, coding them as factual, thematic, inferential, and vocabulary based (Johns, 2012).

While teacher candidates have little difficulty administering the inventory, they find its analysis challenging. They resort to the discourse of scoring which they have learned since grade school. For example, when a child's decoding strategies break down on encountering unfamiliar words, a teacher candidate might write, "She did a great job on the fourth grade list and got all the words right, but when she got to the fifth grade list, she got sloppy and got 12 of them wrong." When a child renders a sentence, "The sun looks much larger than the stars you can see in the night sky" as "The sun looks bigger than stars you see up in the sky," we do not view it as a significant problem (Johns, 2012). Concerned about accuracy, our teacher candidates are apt to comment that the child needs to "slow down more so she'll get the words right."

To promote the discourse shift we are looking for, students are asked to organize their data as shown in Table 1.

Table 1. Samples of text and student miscues.

Text says	Student's Miscue
Puncture	Picture
Ornamental	Oatmeal
Complex	Complete
Contraction	Contraption
Distort	Distant

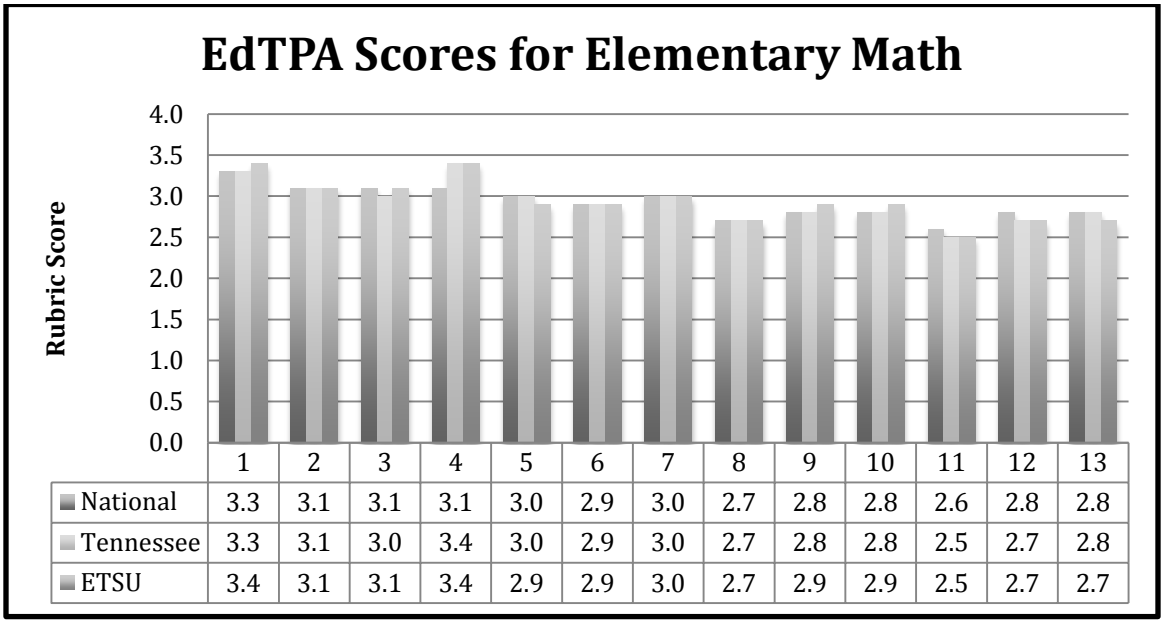
In the above example, we want teacher candidates to notice that the student decodes the initial letter accurately in all cases and apparently guesses the rest. While the words substituted bear no semantic similarity to the text, they are usually of similar length and shape. The words "distant" and "distort," for example, are graphically similar. We want teacher candidates to realize that a student making such substitutions is overusing graphic and phonetic cues and makes inadequate use of context. The student may be unaware that text is supposed to make sense. In such instances, the teacher candidate must make the child aware of this as use of context is taught.

Typically, teacher candidates have trouble recognizing whether students utilize context as they read. They may have trouble discriminating between types of errors, though they are quick to correct them. Candidates have difficulty identifying the pattern of student errors and often tell us no pattern exists. For this reason, we require them to bring miscue data to class, where we examine it together. Initially, they are apt to frame data using the discourse of scoring, with which they have grown up (Gee, 1999). But as they recognize the utility of developmental discourse for planning instruction, our teacher candidates start using it in their assignments. A few resist. This, ironically, is where the instructor shifts to the discourse of scoring, and candidates are reminded of the requirements. Allowances are made for the unfamiliarity of the target discourse, and if on later assignments, our candidates show they have mastered developmental reading discourse, we adjust their grades accordingly. For while the scoring is useful in evaluating terminal achievement, we and our students are better served by a discourse of analysis and development when we teach.

Evidence of Effectiveness

To teach in an age of accountability means we must supply evidence that our methods are proving effective. Administrators and other evaluators will require empirical proof that instructional strategies work. Until recently, there were no systems in place within our department to monitor the effectiveness of teacher candidate analytical skills external to our own grading. With a new assessment in place for our graduating seniors, we now have a category that evaluates our teacher candidates' skill in analysis. The edTPA is now required for all our teacher candidates who seek to graduate and receive a license to teach in grades K-6. In the 13 categories scored in this assessment, #10 specifically addresses analysis of student work. Table 2 shows our scores in item #10 exceed state and national averages. Our program scores higher than the national average in four categories. While this evidence is not conclusive, it suggests an elevated level of development in the area of analysis.

Table 2. Scores for the edTPA



	1	2	3	4	5	6	7	8	9	10	11	12	13
National	3.3	3.1	3.1	3.1	3.0	2.9	3.0	2.7	2.8	2.8	2.6	2.8	2.8
Tennessee	3.3	3.1	3.0	3.4	3.0	2.9	3.0	2.7	2.8	2.8	2.5	2.7	2.8
ETSU	3.4	3.1	3.1	3.4	2.9	2.9	3.0	2.7	2.9	2.9	2.5	2.7	2.7

Elementary Math edTPA legend: Planning 1-4; Instructing 5-6; Assessing 7- 9; Analyzing-10; Academic Language-11-13

Generalizing the Process to Any Course

In examining our instructional practices, we identified four components essential to teaching candidates how to analyze. We have developed the acronym CODE to describe the process in which we engage.

1. **Compile data.** Analysis, to be legitimate, is data driven. We instruct teacher candidates in discipline specific techniques of acquiring information to analyze. In early assignments, the instructor may provide this data as scaffolding.
2. **Organize.** An analysis should result in the recognition of patterns. One is likely to see these only when data are organized. Candidates are therefore shown how to form lists and tables of the student data they inquire.
3. **Determine.** We model inspection of organized data, showing our teacher candidates how we identify patterns. These are sometimes readily apparent, but more often pattern recognition is a recursive process, where we continually check our hunches as we continually examine data.
4. **Explain.** We ask our teacher candidates to explain the patterns they identify and pinpoint the reasons for what they see. We require them to connect these explanations to discipline specific concepts.

We believe that this method transcends teacher education and is widely applicable to situations where college students learn to analyze data.

Conclusion

Analysis is essential in any field, and we expect our teacher candidates to utilize it. However, college students often struggle with analysis. Some instructors and professors are tempted to reduce expectations, viewing the teaching of analytical thinking as someone else's job. Others behave as if it is impossible to teach. In this paper, we have provided examples of how analytical thinking and the associated written description of this process can be conducted.

We have discussed analysis in a mathematics course and a course in reading education and introduced a sequenced process for teaching analysis, one we call CODE. We believe analysis is both context specific and teachable. Our teacher candidates must learn the analytic skills relevant to the subjects they will teach so they can transmit this ability to their students. Standards and expectations in higher education coursework must not be lowered, but rather, instructors and professors need to analyze courses and determine what scaffolding is necessary so that students can be taught to think analytically and report their analysis using appropriate terminology.

References

Aarnoutse, C., Van Leeuwe, J., Voeten, M., & Oud, H. (2001). Development of decoding, reading comprehension, vocabulary and spelling during the elementary school years. *Reading and Writing: An Interdisciplinary Journal, 14*(1) Retrieved from https://login.ezproxy.etsu.edu:3443/login?url=http://search.proquest.com/docview/62365993?accountid=10771

Ashlock, Robert. (2010). *Error patterns in computation: Using error patterns to help each student learn.* Boston: Allyn & Bacon. ISBN 0-13-500910-3.

Duch, B. J., Groh, S. E., & Allen, D. E. (2001). *The power of problem-based learning.* Sterling, VA: Stylus.

Gee, J.P. (1999). *An introduction to discourse analysis*. New York, N.Y.: Routledge.

Goodman, Kenneth (1996). *Understanding reading*. Portsmouth, N.H.: Heinemann.

Johns, J. (2012). *Basic reading inventory*. Dubuque, IA: Kendall Hutt.

Levin, B. B. (2001) *Energizing teacher education and professional development with problem-based learning.* Alexandria, VA: Association for Supervision and Curriculum Development.

National Governors Association Center for Best Practices, Council of Chief State School Officers (2010). *Common core state standards initiative*. Washington, DC: http://www.corestandards.org/

Tennessee Board of Regents (2010). *Ready2Teach overview*. Retrieved from http://www.ready2teach.org/ready2teach-overview