

1-2010

Comparison of Pretenured and Tenured Engineering Professors'

Monica F. Cox

Purdue University - Main Campus, mfc@purdue.edu

Alene Harris

Vanderbilt University, alene.harris@vanderbilt.edu

Recommended Citation

Cox, Monica F. and Harris, Alene (2010) "Comparison of Pretenured and Tenured Engineering Professors'," *International Journal for the Scholarship of Teaching and Learning*: Vol. 4: No. 1, Article 9.

Available at: <https://doi.org/10.20429/ijstl.2010.040109>

Comparison of Pretenured and Tenured Engineering Professors'

Abstract

Analyzing 36,000 strings of instructional data from fifteen faculty teaching twenty-eight courses over five semesters, the authors conducted a research study exploring differences in the pedagogical practices of pretenured and tenured faculty teaching innovative courses designed around the principles of the “How People Learn” (HPL) framework and of pretenured and tenured faculty teaching traditional, lecture-based courses. Consistent with previous research that reports that time is needed for pretenured faculty to become proficient teachers and with research that identifies lecture to be the primary teaching strategy used by engineering faculty, the current study provides additional insight into the types of pedagogical practices most prevalent among the four types of faculty. Lectures incorporating HPL elements were used to a greater extent by pretenured faculty teaching HPL courses and by tenured faculty in traditional courses more than their tenured and pretenured counterparts, respectively. Pretenured faculty who taught courses that were designed to reflect HPL pedagogical practices incorporated more HPL elements and illustrations in their lectures and supplemented their lecture with comments that were and were not HPL-oriented than tenured faculty teaching HPL-oriented courses.

Keywords

Classroom assessment, Pedagogy, Engineering classrooms

Comparison of Pretenured and Tenured Engineering Professors' Pedagogical Practices within Undergraduate Bioengineering Courses

Monica Cox

Purdue University
West Lafayette, Indiana, USA
mfc@purdue.edu

Alene Harris Vanderbilt

University Nashville,
Tennessee, USA
alene.harris@vanderbilt.edu

Abstract

Analyzing 36,000 strings of instructional data from fifteen faculty teaching twenty-eight courses over five semesters, the authors conducted a research study exploring differences in the pedagogical practices of pretenured and tenured faculty teaching innovative courses designed around the principles of the "How People Learn" (HPL) framework and of pretenured and tenured faculty teaching traditional, lecture-based courses. Consistent with previous research that reports that time is needed for pretenured faculty to become proficient teachers and with research that identifies lecture to be the primary teaching strategy used by engineering faculty, the current study provides additional insight into the types of pedagogical practices most prevalent among the four types of faculty. Lectures incorporating HPL elements were used to a greater extent by pretenured faculty teaching HPL courses and by tenured faculty in traditional courses more than their tenured and pretenured counterparts, respectively. Pretenured faculty who taught courses that were designed to reflect HPL pedagogical practices incorporated more HPL elements and illustrations in their lectures and supplemented their lecture with comments that were and were not HPL-oriented than tenured faculty teaching HPL-oriented courses.

Keywords: classroom assessment, pedagogy, engineering classrooms

Introduction

Several researchers have examined the experiences of faculty beginning their teaching careers. Austin (2002) notes that even before becoming faculty, graduate students interested in pursuing teaching careers see that there are dichotomies between teaching well and being recognized or rewarded as a faculty member for teaching efforts. Once early career faculty begin their jobs, they are overwhelmed by the amount of time that they must spend preparing for their teaching responsibilities, developing new courses, and balancing their teaching with their research and service responsibilities (Sorcinelli & Billings, 1992). To balance these responsibilities, many faculty rely on senior faculty for advice (Sorcinelli, 1994) and seek mentoring assistance to help them to develop as teachers (Mullen & Forbes, 2000). Other studies during a similar time frame have examined university teaching practices and found faculty members, both early career and tenured, to be primarily lecture based (Donald, 2002).

Consistent with faculty experiences across multiple disciplines, engineering faculty experience similar challenges with teaching. It is known widely that engineering faculty are more likely to engage in lecture in their classrooms than in other, more active pedagogical practices such as collaborative learning (Donald, 2002). Reasons for this reliance on lecture often include an absence of formal pedagogical training for faculty during their graduate school experiences and limited amounts of time for faculty to enroll in professional development courses about pedagogy once they obtain faculty positions. Without this introduction of pedagogical practices within the doctoral process, many engineering faculty must learn to teach "on-the-job" and without formal mentoring.

An empirical study exploring the specific pedagogical practices employed by engineering faculty teaching engineering content (1) in traditional, lecture-based courses traditional and (2) in courses that were created using collaborative principles of the "How People Learn" (HPL) framework (Bransford, Brown, & Cocking, 1999) found that regardless of class type, faculty were most often likely to implement lecture in their courses (Cox & Cordray, 2008). Building upon these findings, the current study explores the pedagogical experiences of early career, or pretenured faculty (i.e., faculty at a research university who hold tenure-track or adjunct appointments), and tenured faculty teaching both types of courses. To distinguish pedagogical differences between pretenured and tenured faculty teaching these courses, observers collected data using the Classroom Interaction Observation (CIO) portion of the VaNTH Observation System (VOS) (Harris & Cox, 2003), a direct observation tool capturing real-time information about HPL-oriented classroom occurrences in bioengineering classrooms. More specifically, the CIO provides information in the form of code strings that capture (1) who is initiating an activity, (2) to whom the activity is being initiated, (3) what activity is occurring, (4) the HPL framework elements (knowledge-centered, learner-centered, assessment-centered, and/or community-centered) that are present during an interaction, and (5) any media being used (Figure 1). Thus, each code string captures *who/to whom/did what/involving what HPL elements/and with what media*. (A more detailed description of the CIO can be found in Harris and Cox (2003).) Observers code between 50 and 75 code strings within a five-minute segment, and they repeat these segments at approximately five-minute intervals.

Figure 1. VaNTH Observation System Classroom Interaction Observation (CIO) codes (Harris & Cox, 2003).

WHO	TO WHOM	WHAT	HOW	MEDIA
Professor	Professor	1 factual question	Knowledge-centered	B oard
Everyone	Everyone	2 higher order question	Learner-centered	O verhead
First student	First student	3 response	Assessment-centered	C omputer
Same student	Same student	4 instruction	Community-centered	S imulation
Small group	Small group	5 social comment	C lass	D emonstration
Large Group	Large Group	6 activity-related comment	O rganization	V ideo
Media	Media	7 acknowledge or praise		R esponse system
Visitor	Visitor	8 guide		N one
		9 correction		
		0 no response		
		A active monitoring		
		P passive Monitoring		

If a professor teaching in an HPL-oriented class asks a small group of students a higher order question about a diagram displayed on the overhead, the corresponding CIO code

string would be "P-g-2-K/L/A-O" such that "P" represents the professor who is initiating the question (*who*), "F" represents the student to whom the professor is asking the question (*to whom*), and "2" represents the higher order question that was asked (*what*). HPL dimensions represented are knowledge-centered (K), learner-centered (L), and assessment-centered (A) (*how*). The use of the overhead is represented by "O" (*media*).

Using CIO data for ten pretenured and five tenured faculty over the course of five semesters, the authors conducted a research study exploring detailed pedagogical practices of fifteen faculty (some faculty taught multiple courses and in multiple semesters). Focusing on lecture and on multiple pedagogical practices that have been found to impact positively the experiences of engineering students (Cordray, Harris, & Gilbert, 2007), researchers sought to answer the following questions: (1) What "How People Learn"-oriented and traditional instructional practices are most prevalent across observed classrooms of pretenured and tenured faculty teaching purposefully designed HPL engineering courses?, and (2) What "How People Learn"-oriented and traditional instructional practices are most prevalent across observed classrooms of pretenured and tenured faculty teaching traditional engineering courses? Answers to these questions can offer insight into understanding pedagogical implications for each group and into developing strategies for pretenured and tenured faculty that can help them engage in diverse pedagogical experiences, particularly those that introduce faculty to the scholarship of teaching at various stages of their academic careers (Boyer, 1990).

Methods

Participants

The analyses within this study use data collected from the HPL Index mentioned in a subsequent section of the paper. Observers completed 182 classroom observations over five semesters and across 28 bioengineering courses (seventeen HPL-oriented and eleven traditional). These courses, taught between spring 2002 and spring 2004 and representing sophomore-, junior-, and senior-level instruction, lasted between 50 minutes and two hours in length and were purposefully designed as either HPL-oriented or traditional, lecture-based courses (Table 1). Since researchers thought it would be more difficult for tenured faculty to change their teaching practices, more pretenured faculty were asked to teach in an HPL manner. All pretenured and tenured faculty who were approached to teach in an HPL-oriented agreed to do so. Of these faculty, only one pretenured faculty and one tenured faculty member experienced pedagogical challenges implementing HPL-oriented materials. These challenges were minor, however.

Table 1. Number of pretenured and tenured faculty observed over five semesters.

SEMESTER	TRADITIONAL COURSE		HPL-ORIENTED COURSE	
	TENURED	PRETENURED	TENURED	PRETENURED
1 (S 02)	0	1	1	2
2 (F 02)	1	2	0	4
3 (S 03)	1	1	1	1
4 (F 03)	1	2	1	2
5 (S 04)	1	1	2	3
TOTALS	4	7	5	12
TOTALS	11		17	

Measures

Over 36,000 code strings for all professors were analyzed using a HPL Index, which parses each five-segment code string from the CIO portion of the VaNTH Observation System (VOS) into categories representing *classroom organization*, *traditional (lecture-based) instruction*, and *HPL-oriented instruction* (Harris & Cox, 2003; Cox & Cordray, 2008). As these categories are mutually exclusive, the sum of code strings from the three categories represents a complete class session. *Classroom organization* code strings represent activities related to the administration of a course. *Traditional instruction* code strings focus on lecture-related teacher behaviors, and *HPL-oriented instruction* code strings relate to teacher behaviors reflecting the four "centers" of the HPL framework (Table 2). Detailed descriptions and examples of each subcategory can be found in Cox and Cordray (2008) and Cox (2009).

Table 2. Descriptions of classroom organization, traditional instruction, and HPL-oriented code string subcategories.

Classroom Organization	Traditional Instruction Subcategories	HPL-oriented Instruction Subcategories
Any activity that involves the administration of the course, such as <ul style="list-style-type: none"> • collecting papers • distributing materials • giving directions on how to submit an assignment 	Specific subcategories of <ul style="list-style-type: none"> • instruction by media • question and response • lecture* • academic-related comments* • academic praise or acknowledgement* • correction* • no response* 	Specific subcategories of <ul style="list-style-type: none"> • higher-order questioning by instructor • higher-order questioning by student • academic guidance by instructor • lecture* • academic comments* • academic praise or acknowledgement* • monitoring • question and response • correction • use of a personal response system • no response*

* Note that although some of the HPL and traditional instruction subcategories have similar labels (e.g., lecture), they differ by the extent to which they do or do not incorporate *knowledge-*, *learner-*, *assessment-*, and *community-centered* elements of the HPL framework in a classroom activity. For example, HPL lecture (an HPL instruction subcategory) incorporates multiple dimensions of the HPL framework, and traditional lecture (a traditional instruction subcategory) does not integrate these dimensions.

Procedures

To understand the pedagogical practices of pretenured and tenured bioengineering faculty teaching either HPL-oriented or traditional courses, researchers have chosen to focus this paper on analyzed code strings representing only HPL or traditional instruction. After using the HPL Index to categorize over 36,000 code strings across the observed courses, researchers parsed data by faculty type (pretenured or tenured) and by course type (HPL or traditional). Researchers ran independent samples t-tests and computed the mean occurrences and t-test results (1) for pretenured and tenured faculty teaching HPL designed courses and (2) for pretenured and tenured faculty teaching traditionally designed courses. Researchers ran a Levene's test for equality of variances, and at a family $p < 0.05$, a Bonferroni correction of $p < 0.03$ determined statistical significance of HPL Index

subcategories. Statistically significant differences at this level are displayed in Table 3 and Table 4. Mean percentages of instruction are displayed in Figures 2 and 3.

Pretenured and tenured faculty teaching HPL-oriented courses

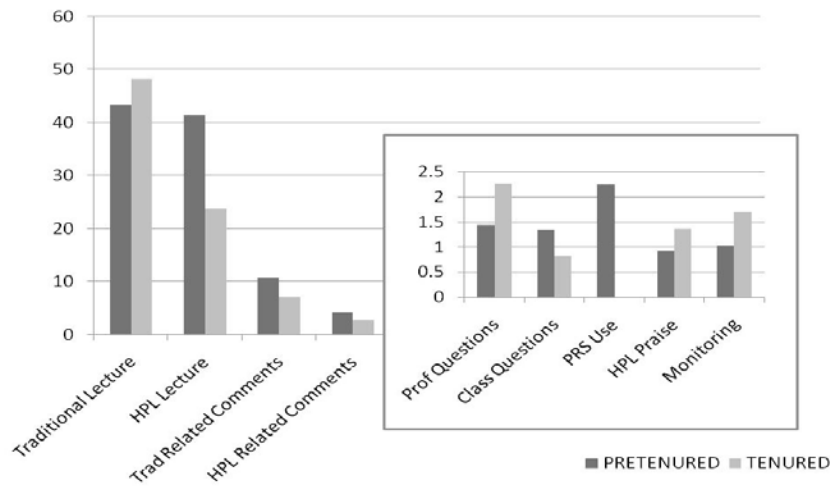
Faculty, both pretenured and tenured, who agreed to teach HPL-oriented classes were formally introduced to HPL innovations through mini-seminars several weeks prior to the beginning of a semester and provided assistance in developing HPL-oriented modules to the degree requested. Data on those classrooms prior to introduction to HPL documented traditional lecture as the primary instructional format. A question of interest to researchers was what pedagogical differences might be found between pretenured and tenured faculty teaching these innovative courses and endeavoring to incorporate HPL elements. By analyzing the thousands of code strings associated with both types of faculty, researchers sought to determine how an engineering faculty member, with limited pedagogical training, would engage with innovative HPL pedagogical practices within their disciplines, and how this engagement differs based on the level of teaching experience.

Table 3 and Figure 2 show nine instructional subcategories **in HPL-oriented classes** in which there were statistically significant differences between pretenured and tenured bioengineering faculty. (Note that subcategories with low percentages of observed instances are presented as an inset within Figure 2 for easy of viewing.)

Table 3. Areas of statistically significant differences between pretenured and tenured bioengineering faculty teaching HPL-oriented classes.

	INSTRUCTIONAL SUBCATEGORY (TYPE)	HIGHER FOR TENURED FACULTY	HIGHER FOR PRETENURED FACULTY
1	Professor-initiated Questions (HPL)	$t(20023.68) = -4.457$ $p = 0.000$	
2	Personal Response System Use (HPL)	$t(12809.91) = -16.576$ $p = 0.000$	
3	HPL-oriented Praise (HPL)	$t(19789.946) = -3.004$ $p = 0.003$	
4	Monitoring (HPL)	$t(20216.81) = -4.284$ $p = 0.000$	
5	Traditional Lecture (Traditional)	$t(17829.086) = -6.871$ $p = 0.000$	
6	Class-initiated Questions (HPL)		$t(14698.823) = 3.584$, $p = 0.000$
7	Traditional Academic-related Comments (Traditional)		$t(15406.29) = 5.065$, $p = 0.000$
8	HPL-oriented Academic-related Comments (HPL)		$t(15390.47) = 5.065$ $p = 0.000$
9	HPL-oriented Lecture (HPL)		$t(19789.95) = -3.004$ $p = 0.003$

Figure 2. Percentage of observed instances of instruction among pretenured and tenured faculty teaching HPL-oriented courses.



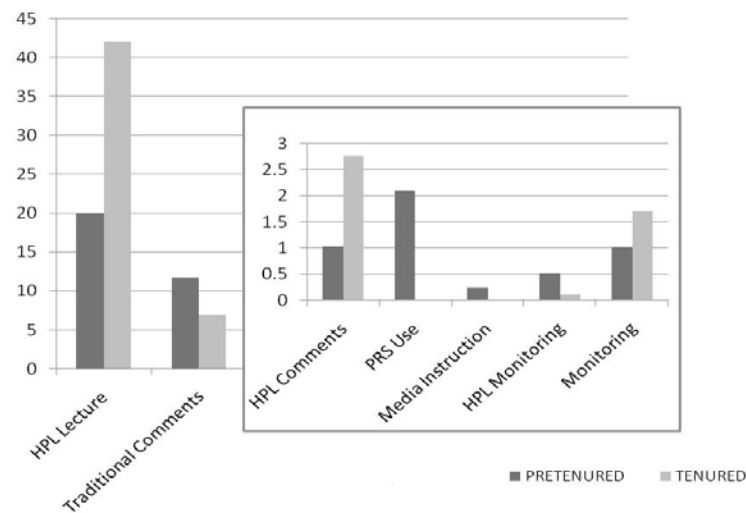
Pretenured and tenured faculty teaching traditional courses

Table 4 and Figure 3 show six instructional subcategories **in traditional classes** in which there were statistically significant differences between pretenured and tenured bioengineering faculty. (Note that subcategories with low percentages are presented as an inset within Figure 3 for easy of viewing.)

Table 4. Areas of statistically significant differences between pretenured and tenured bioengineering faculty teaching traditional classes.

	INSTRUCTIONAL SUBCATEGORY (TYPE)	HIGHER FOR TENURED FACULTY	HIGHER FOR PRETENURED FACULTY
1	HPL-oriented Comments (HPL)	t(5481.73) = -6.439 p = 0.000	
2	HPL-oriented Lecture (HPL)	t(5917.09) = -6.295 p = 0.000	
3	Instruction by Media (Traditional)		t(11265.00) = 5.298 p = 0.000
4	Personal Response System Use (HPL)		t(11265.00) = 15.559 p = 0.000
5	Monitoring (HPL)		t(14710.56) = 4.711 p = 0.000
6	Traditional Academic-related Comments (Traditional)		t(9584.442) = 9.763 p = 0.000

Figure 3. Percentage of observed instances of instruction among pretenured and tenured faculty teaching traditional courses.



Discussion

Research identifies lecture to be the primary teaching strategy used by engineering faculty (Donald, 2002). For the four types of faculty (i.e., pretenured teaching HPL-oriented courses, tenured teaching HPL-oriented courses, pretenured teaching traditional courses, and tenured teaching traditional courses), both HPL-oriented lecture and traditional lecture were most prevalent. However, lectures incorporating HPL elements were used to a greater extent by pretenured faculty teaching HPL courses and by tenured faculty in traditional courses more than their tenured and pretenured counterparts, respectively. This implies that over time, even without a use of formal HPL materials, the tenured faculty in the study were applying HPL-oriented pedagogical practices and knowledge. Whether this was a result of “contamination” from conversations with fellow faculty members teaching HPL-oriented courses, the result of developing HPL-oriented strategies as a result of past trial-and-error teaching, or from an innate sense of the teaching efficacy of HPL elements is unknown. Although pretenured and tenured faculty both engaged in HPL-oriented instruction, this type of instruction differed. For example, regardless of whether they taught in HPL-oriented or traditional manners, pretenured faculty teaching courses in a traditional manner were more likely to incorporate activities that engaged students in in-class questioning, comments, and HPL-oriented instruction than their tenured counterparts.

The ability to incorporate HPL elements in lecture was demonstrated more often by pretenured faculty teaching formal HPL courses than by tenured faculty teaching formal HPL courses. More specifically, pretenured faculty who taught courses that were designed to reflect HPL pedagogical practices incorporated more HPL elements and illustrations in their lectures and supplemented their lecture with comments that were and were not HPL-

oriented than tenured faculty teaching HPL-oriented courses. This implies that by engaging in innovative pedagogical materials, pretenured faculty can become confident more quickly in incorporating diverse pedagogical practices in their courses.

The current research is significant for several reasons. First, although researchers report that student collaboration, faculty-student interactions, faculty guidance to correct answers, and the presence of higher-order questioning increase students' learning and engagement within engineering classrooms, it has been difficult to link these specific classroom behaviors to good teaching performance (Schuster and Zingheim, 1992). The HPL Index used in this study, however, provides specific information for faculty about the extent to which they are engaging in these targeted activities, and these targeted activities have repeatedly demonstrated superior student learning (Cordray, Harris, & Gilbert, 2007). Second, in response to faculty's requests for feedback about their job performance and their teaching skills early in their academic careers (Sorcinelli, 1988; Olsen & Sorcinelli, 1992; Menges, 1999), analysis of coded data strings using the HPL Index provides a way to give consistent quantitative feedback to faculty about their pedagogical patterns within the classroom in the form of pedagogical profiles framed within the context of the widely-recognized HPL framework. These profiles may be beneficial to tenured faculty who would like feedback about their teaching and might be used by tenured faculty to give feedback to junior faculty, who have reported a desire to have such feedback from their senior colleagues (Olsen & Sorcinelli, 1992). Also, such a profile indicating the presence of good teaching practices could be used by pretenured faculty as evidence of effective teaching.

Finally, this study is important since it provides feedback to faculty in engineering, which is a high consensus academic discipline in which faculty have been found to demonstrate an affinity for research and to spend less time in teacher preparation than their non-engineering counterparts (Braxton & Hargens, 1996; Neumann, 2001). One reason for this attraction to research may be engineering faculty's affinity for their engineering discipline, not their affinity for educational pedagogy (Ruscio, 1987). Despite their lack of pedagogical training, however, engineering faculty are expected to demonstrate elements of effective teaching by transferring their knowledge of engineering to students who will become future engineers and active, lifelong learners (McKinney, 2004). For this reason, tools providing detailed information about faculty's engagement with specific HPL-oriented and traditional instructional categories are needed.

Unlike Olsen and Sorcinelli's (1992) study that explored the longitudinal experiences of faculty, the current study provides snapshots of faculty's experiences with the identified HPL-oriented and traditional instructional subcategories. Although outside the scope of this study, future studies might explore the semester-by-semester experiences of groups of faculty in an effort to note changes over time. In addition, qualitative data exploring details about faculty's experiences could be explored to enhance the stories of individual faculty included in the current study.

Conclusions

In the same way that becoming an expert researcher is deliberate, becoming an expert teacher also is deliberate. Given the time limitations of many faculty to learn how to become proficient teachers, the current study presents a quantitative, formal tool for giving faculty directed pedagogical feedback when they are learning how to integrate multiple pedagogies in their classrooms. Although additional studies will be needed to explore the long-term impacts of faculty's use of innovative pedagogical practices, this research assists in the

initiation of conversations between pretenured and tenured faculty about ways to diversify their teaching practices and to impact positively student outcomes.

This work was supported primarily by the Engineering Research Centers program of the National Science Foundation under annual grant EEC-9876363.

References

- Austin, A. E. (2002). Preparing the next generation of faculty: Graduate school as socialization to the academic career. *The Journal of Higher Education*, 73, 1, 94-122.
- Boyer, E. (1990). *Scholarship reconsidered: Priorities for the professoriate*. Princeton, NJ: The Carnegie Foundation for the Advancement of Teaching.
- Bransford, J.D., Brown, A.L., & Cocking, R.R. (1999). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academy Press.
- Braxton, J.M., & Hargens, L.L. (1996). Variation among academic disciplines: Analytical frameworks and research. In *Higher education: Handbook of theory and research*, 11. New York: Agathon Press.
- Cordray, D., Harris, T.R., & Gilbert, J. (2007). "What works" in engineering education? A meta-analysis of VaNTH ERC biomedical engineering modules. Proceedings of the American Society for Engineering Education, Honolulu, HI.
- Cox, M. F., & Cordray, D. S. (2008). Assessing pedagogy in bioengineering classrooms: Quantifying elements of the "How People Learn" model using the VaNTH Observation System (VOS). *Journal of Engineering Education*, 97(4), 413-431.
- Donald, J. G. (2002) *Learning to think: Disciplinary perspectives*. San Francisco: Jossey Bass.
- Harris, A. H., & Cox, M. F. (2003). Developing an observation system to capture instructional differences in engineering classrooms. *Journal of Engineering Education*, 92(4), 329-336.
- McKinney, K. (2004). The scholarship of teaching and learning: Past lessons, current challenges and future visions. *To Improve the Academy*, 22, 3-19.
- Menges, R.J. et al. (1999). *Faculty in new jobs*. San Francisco: Jossey-Bass.
- Mullen, C.A., & Forbes, S.A. (2000). Untenured faculty: Issues of transition, adjustment and mentorship. *Mentoring & Tutoring*, 8, 1, 31-46.
- Neumann, R. (2001). Disciplinary differences and university teaching. *Studies in Higher Education*, 26, 2, 135-146.
- Olsen, D., & Sorcinelli, M. D. (1992). The pretenure years: A longitudinal perspective. *New Directions for Teaching and Learning*, 50, 15-25.
- Ruscio, K.P. (1987). Many sectors, many professions. In *The academic profession*. (Burton R. Clark, Editor), 331-368.
- Schuster, J.R., & Zingheim, P.K. (1992). *The new pay: Linking employee and organizational performance*. New York: Lexington Books.
- Sorcinelli, M.D. (1988). Satisfactions and concerns of new university teachers. *To Improve the Academy*, 7, 121-133.

Sorcinelli, M. D., & Billings, D. A. (1993). *The career development of pretenure faculty: An institutional study*. Paper presented at the Annual meeting of the American Educational Research Association.

Sorcinelli, M.D. (1994). Effective approaches to new faculty development. *Journal of Counseling & Development*, 72, 5, 74-79.