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The Impact of Merit Pay on Teaching Outcomes

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ABSTRACT

Merit pay for professors to encourage better teaching is controversial. Whether it works as expected can be examined empirically. In this study, ACT scores of incoming freshmen were a strong predictor of CPA exam pass rates. The presence of a merit pay system for professors was also significantly associated with the CPA Exam pass rates suggesting that, in this sample, merit systems were associated with better teaching outcomes.

Keywords: Merit pay, teaching, CPA exam.

Introduction and Motivation

An article in the Santa Rosa, California, *Press Democrat*, dated October 24, 2001 reads:

"Faculty at Sonoma State University staged a protest of their own on Tuesday. Frustrated by the administration's 'corporate' management style, professors held a daylong teach-in at the Student Union and central quad to draw attention to a laundry list of grievances. Speakers at the event railed against the merit system. The merit pay system, established in 1995, is a major sticking point in stalled contract negotiations with professors. The faculty association wants to scrap the system, which bases pay raises partially on reviews by both faculty and administrators. 'The system pits professors against one another and rewards those who pander to administrators,' said Rick Luttmann, the Sonoma State faculty chair (sic) and math professor."

Clearly, merit pay for professors is controversial.

Introduction

Compensation practices vary widely across colleges and universities. Periodically, the College and University Personnel Association (CUPA) surveys over 3,000 higher education institutions regarding their policies and methods for adjusting individual salaries. Methods considered in the survey included: annual general wage adjustment, automatic length of service adjustment, a merit pay plan, lump sum incentive payment,

bonus, gain-sharing, skill- and competency based pay, team incentives, and combination across-the-board and merit pay plans. The CUPA data indicates that merit systems are used by 23.7 percent of responding institutions and plans that combine across-the-board pay raises with merit pay are used by another 26.4 percent of institutions. Since the data is aggregated, there is no way of knowing which individual schools use a merit-based or partially merit-based pay system.

The rationale behind merit systems is to reward and thus encourage better performance in the key areas of teaching, research and service. Some kind of performance measure is required to operationalize such a pay plan. Typically, a professor's teaching performance is measured with student evaluations or outcomes assessment tests, such as the ETS Major Field tests. Research performance is most frequently measured with some count of a professor's publications. It has proven most problematic to find an acceptable quantitative measure of service.

In previous work, authors of this study have used CPA Exam pass rates as a proxy for teaching outcomes in accounting programs (Lindsay & Campbell, 1995). That work considered the research productivity of a school's faculty as a possible determinant of the success rate of the school's accounting graduates. Given the ongoing controversy over the usefulness of merit pay plans, we are now asking whether the presence of a merit system might be an institutional determinant of good teaching outcomes as measured for accounting programs with CPA exam pass rates.

Literature Review

Increasing restrictions on public funding and a desire on the part of university administrators for greater discretion to set faculty salaries have encouraged a move away from more traditional seniority-based compensation systems (Grant, 1998). For merit plans to be feasible, however, there must be a clear link between individual effort and performance, and that performance must be accurately measured (Heneman and Young, 1991). It has been vociferously argued that merit pay schemes are just not practical in a university setting, because the performance of individual faculty members is too difficult or specialized to measure objectively (Johnston, 1978).

In general, the purpose of merit pay is to provide an incentive or motivating force to push a worker, whether a laborer, a government employee, or a college professor, to greater productivity (Miller, 1979). Merit pay for teachers is hardly a new idea; it was first used in England in the 19th Century (Holmes, 1920).

A field study of public school deans' perspectives showed that deans do believe merit systems promote better teachers and higher quality research output, (Taylor, Lesher, Hunnicutt, Garland, & Keefe, 1991). However, this study, as well as the faculty protests at Sonoma State University, is evidence only of opinions. We suggest that, at least in the context of an accounting program, the question of the value or effectiveness of merit pay can be addressed as an empirical issue.

Of the three areas of faculty productivity -- research, teaching and service -- this study is intended to develop empirical evidence of the impact of merit pay systems on teaching. If merit pay systems have the desired impact of improving faculty performance in measured areas, then schools with merit systems would be expected to boast stronger than average faculty performance.

Hypotheses

Teaching effectiveness can be measured used student evaluations, but evaluations may be a skewed measure (DeBerg & Wilson, 1990). Undergraduate education in accounting can be evaluated, in part, based on graduates' performance on the CPA exam (Schick, 1998). While not all accounting students take the CPA exam, and the goal of an accounting education is broader than simply exam preparation, we believe that performance on professional exams can be used as a good indicator of a program's overall teaching outcomes. If a program's graduates are successful with the CPA exam, they will also be successful with other professional challenges.

The central question of this study is then stated as:

H1: Ceteris paribus, there is a statistically significant negative relationship between the CPA exam failure rates of a school and the presence or absence of a faculty merit pay plan.

The CPA exam pass rate is expressed in the hypothesis in inverse form in order to compare the proportion of students passing any part of the exam to those not passing at all rather than attempting to distinguish between students passing fewer or more sections.

Prior research indicates that there exists a significant and positive association between ACT scores and CPA exam performance, (Dunn & Hall, 1984).

This leads to the second hypothesis, which must be addressed in order to consider potentially a powerful confounding issue:

H2: Ceteris paribus, there is a statistically significant negative association between the average ACT score of a school's incoming freshmen and the school's CPA exam failure rates.

It is reasonable to expect that some schools, perhaps due to reputation, would attract academically gifted students. Such attractive schools would boast not only a strong student body but also a strong faculty.

Therefore it is likely that student CPA exam performance in such schools might be stronger. The freshman ACT score was used to represent the quality of each institution's incoming student body and its relationship with a measure of teaching, CPA exam results, was tested.

Methodology

The e-mail addresses of department chairs of 500 of the 800+ accounting programs in the United States were identified using Hasselback's Accounting Faculty Directory 2003-2004. Each of the 500 chairs was e-mailed a survey using the CUPA taxonomy of methods currently used to adjust individual salary rates. The chair's response to this survey revealed whether or not a merit plan was in place at that school. A copy of the cover letter is presented as Exhibit 1. A copy of the survey is presented as Exhibit 2.

Average ACT scores were obtained from Profiles of American Colleges, 2002 published by Barron's. If the ACT score was not reported, the California State University System's Eligibility Index Table for California High School Graduates or Residents of California was used to convert the SAT score into an ACT score.

The CPA exam performance of first-time candidates without advanced degrees by schools with five or more candidates for November of 2002 was obtained from the National Association of State Boards of Accountancy's (NASBA) publication Candidate Performance on the Uniform CPA Examination, 2003.

A regression was then run. The dependent variable is the percent of the school's first-time CPA exam candidates without advanced degrees who passed NONE of the four parts of the exam administered in fall of 2002. In the regression, the two independent variables are: an indicator variable assigned the value of 0 if the school does not have a merit program, and a value of 1 if it does; and the school's mean ACT score of incoming freshmen.

Therefore, the model to be tested is:

Percent Passing None of the Parts = b0 + b1ACT + b2Merit + e

Results and Conclusion

Sixty-one of the 500 surveys (12%) were returned. Eleven of these were not usable, leaving 50 usable surveys (10%). Only 4 types of faculty salary adjustments were reported:

COLA-used by 31 (62%) schools
STEPS-used by 8 (16%) schools
Merit-used by 34 (68%) schools
Bonus-used by 2 (4%) schools

Some schools used multiple methods. As seen in Table 1, correlation coefficients show that schools with merit programs tend not to offer 'time in grade' pay adjustments.

In the regression, the F is 4.76 and significant at the .016 level. The adjusted R square is .195. The estimated coefficient on the Merit variable is <15.108>. Since it is significant at the .047 level it just barely makes the .05 hurdle. The estimated coefficient on the ACT variable is <4.972> and significant at the .014 level. These results are consistent with both hypotheses.

Clearly, the quality of incoming freshmen is a powerful predictor of students' ultimate success on the CPA exam. These results do suggest, however, that schools using a merit pay system enjoy some enhancement of the success rate of their students. This simple test does, therefore, suggest that merit systems may indeed reward and encourage teaching performance as claimed by their many advocates.

Given the controversy over the use of merit pay and the relatively weak association between the presence of merit pay systems and positive teaching outcomes revealed in this study, additional empirical evidence should be collected and analyzed. Additional confounding factors could easily have influenced the results returned with the relatively simple models used in this study. Both faculty and administrators need to continue to examine the design and implementation of merit systems. Perhaps additional empirical work will make the continued discussion less adversarial than it was at Sonoma State University in 2001.

TABLE 1

Pearson Correlation Coefficients
Salary Adjustment Methods Used by Accounting Programs

N = 50

	COLA	STEPS	MERIT	BONUS
COLA	1.0			
STEPS	.229 (.109)	1.0		
MERIT	<.272> (.056)	<.402>** (.004)	1.0	
BONUS	.160 (.268)	<.089> (.538)	<.079> (.587)	1.0

Legend

COLA = Annual General Wage Adjustment
STEPS = Automatic Length of Service Adjustment
MERIT = Merit Pay Plan

** Coefficient is significant at the .01 level

EXHIBIT 1

1 COLLEGE OF BUSINESS ADMINISTRATION
California State University, Stanislaus
2 Department of Accounting and Finance
801 West Monte Vista Avenue • Turlock, California 95382
Phone (209) 667-3671 • Fax (209) 667-3042

December 26, 2002

Dear Department Chair:

My colleagues, Dr. Annhenrie Campbell and Dr. Kim B. Tan, and I are asking you to take a few minutes to complete the attached survey for our research study on methods used to adjust individual faculty salaries.

The survey will take you just a few minutes to complete. Please return, via e-mail, your completed questionnaire—no matter how few questions you answer.

Your responses will be pooled with others for statistical analysis. No specific individual response will be discussed or disclosed.

Your participation is completely voluntary. While you may choose to disregard this request, we hope you decide to participate in our study.

Please contact me with any questions or concerns you may have regarding this project.

Best regards,

David H. Lindsay, Ph.D., CPA
Professor of Accounting

Phone: (209) 667-3296
E-mail: Acc_Dept_Chair@csustan.edu

EXHIBIT 2

This is a survey of the methods used to arrive at individual faculty salary amounts in accounting programs. Please check all items applicable to your department's procedures in the years 1997, 2000, and 2002.

	1997	**2000**	**2002**
Annual General Wage Adjustment	[ ]	[ ]	[ ]
Automatic Length of Service Adjustment	[ ]	[ ]	[ ]
Merit Pay Plan	[ ]	[ ]	[ ]
Lump Sum Incentive Payment	[ ]	[ ]	[ ]
Combination Across-the–Board And Merit Pay Plan	[ ]	[ ]	[ ]
Bonus	[ ]	[ ]	[ ]
Gainsharing	[ ]	[ ]	[ ]
Skill- and Competency Based Pay	[ ]	[ ]	[ ]
Team Incentives	[ ]	[ ]	[ ]
Other	[ ]	[ ]	[ ]

Please forward, via e-mail, the completed survey to Acc_Dept_Chair@csustan.edu

THANK YOU FOR YOUR PARTICIPATION

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Managing a U.S. Business School Professor Shortage

Robert S. Owen
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Abstract

The business school accreditation agency, AACSB, has been predicting a future shortage of professors in U.S. business schools. Factors that have been advanced in support of a looming shortage include increased future student enrollments, mass retirements of aged professors, decreased production of fresh doctoral graduates, and the taking of faculty employment outside of academe or the U.S. Actual data, however, show that the student-age population is not going to change substantially for the foreseeable future, that boomer-aged employees are not likely to retire anytime soon, that a "decline" in the supply of new business doctor graduates is referenced from an oversupply that existed throughout the 1990s, and that loss to foreign employment is less than it was in the 1990s. If a shortage is indeed looming, the experienced "lost generation" of underemployed surpluses from the 1990s could be used to fill gaps in fresh doctoral supply.

Keywords: professor shortage, business school professor, business doctor, AACSB accreditation, enrollment forecast

Introduction

This assessment addresses various factors that many have put forth in predicting future business faculty shortages. Predicting a "supply and demand shortage" of business doctors, if without substantive supporting evidence, is socially irresponsible because of the cyclic chaos that this can and *has* caused in the academic marketplace: wildly high salary requests by job candidates, an inability of business schools to advance on the assumption of shortages and a market of candidates who are unwilling to accept reasonable salaries, followed by an oversupply of new doctors that results from the promise of future high-demand, high salary job market. AACSB (business school accrediting agency) predictions of shortages fifty years ago resulted in an oversupply of new doctorates in the 1970s. AACSB predictions of shortages in the 1980s resulted in an oversupply of new doctorates in the 1990s. The "surplus" doctorates of the nineties were either forced to take faculty positions at bottom-end schools that constrained their scholarly growth opportunities or to take positions outside of academe that destroyed all aspirations of an academic career. At graduation, the typical new business doctor is age 35, is married, and has taken a five year break out of the workforce to complete the degree (Survey of Earned Doctorates, 2007) – the lives of entire families are destroyed during an "oversupply" cycle job market.

In the hopes of diminishing yet another "oversupply" cycle, the present analysis examines factors that impact the demand (need) for doctorally-qualified business faculty. A repeat of past oversupply cycles might be avoided if realistic projections can be maintained. If there is indeed a pending shortage of business doctors, the "lost

generation" of under-employed but experienced, doctorally-qualified surpluses of the nineties could be considered as more viable alternatives to the current calls for hiring untrained, academically unqualified business practitioners and inexperienced new doctors from non-business disciplines.

Historical Timeline

In 1958, AACSB warned that there would be a shortage of 2800 business school professors by 1970 (Gordon and Anderson, 1958). However, a 1972 survey of marketing departments was conducted to answer the question of whether there was an *oversupply* of new marketing doctors. The findings suggested that during 1973 and 1974, 279 new doctorates would be competing for only 172 positions that required a doctor degree (Shawver, 1973). A 1974 survey of accounting departments also indicated that the demand for doctorates, as estimated by the responding schools, would be decreasing in the next several years (Lossett and Moustafa, 1975).

Fifty years later, AACSB is still warning of a shortage of 2400 business school professors by 2012 (AACSB, 2007). (In fifty years, the supposed shortage has decreased by 400!) Quoting AACSB sources, a *Business Week* article (Damast, 2007) claims that business schools are at a "tipping point" for future gloom, with such dire predictions that some schools will be in danger of losing AACSB accreditation due to the professor shortage. "In the past five years, the overall production of business PhDs declined . . . an entire population of business-school professors are [sic] expected to retire in the next few years, leaving a vacuum in the B-school classroom . . . the B-school world is looking to the larger academic world for help, hoping to convince a psychology professor, for example, to take a job as a marketing professor."

Yet according to Survey of Earned Doctorates (2007), conducted since 1957 and funded by several U.S. government agencies, the overall production of business doctors actually *increased* from 1065 in 2000 to 1168 in 2005 (see Table 1; note that the 2007 compilation is on data collected from 2005 graduates). A problematic issue with the suggestion of tapping the pool of new psychology doctors is that their production *decreased* from 3616 in 2000 to 3327 in 2005 (see Table 1).

Table 1: Doctor Production in Selected Fields

	1975		1980		1985		1990		1995		2000		2005	
	count	pct.	count	pct.	count	pct.	count	pct.	count	pct.	count	pct.	count	pct.
all fields	32952	100.0	31019	100.0	31295	100.0	36065	100.0	41747	100.0	41361	100.0	43554	100.0
engineering	3002	9.1	2479	8.0	3166	10.1	4894	13.6	6008	14.4	5323	12.9	6404	14.8
psychology	2751	8.3	3098	10.0	3117	10.0	3281	9.1	3429	8.2	3616	8.7	3327	7.7
education	7360	22.3	7586	24.5	6733	21.5	6509	18.0	6648	15.9	6432	15.6	6229	14.4
business	787	2.4	640	2.1	789	2.5	1036	2.9	1330	3.2	1065	2.6	1168	2.7

Source: Survey of Earned Doctorates (2005)

AACSBs prediction of mass retirements is suspect from several perspectives. The Survey of Earned Doctorates shows that there were substantially fewer business doctors produced in the 1960s and 1970s. Additionally, some of those were lost to early retirement incentives in the belt-tightening 1980s, minimizing the effects of the predicted

"mass retirements" by that generation. Furthermore, surveys by AARP (2003, 2004) found that members of the baby boomer generation, who would have obtained business doctor degrees around the mid 1990s (median age 35 according to the Survey of Earned Doctorates; see Table 2), don't plan on retiring anytime soon. On the basis of US Census data, it appears that the college age population should stay roughly flat (on average) for the next two decades.

The remainder of this assessment will expand on these sorts of issues. First, factors related to the business doctor surpluses of the 1990s will be addressed. This is followed by an assessment of business doctor demographics: trends in business doctor production, losses of business doctors to non-academic jobs and foreign placement, and issues related to the likelihood that there will be a mass exodus of ageing professors through retirement. Finally, trends in the U.S. population and the potential for future student enrollments is discussed.

Oversupply of New Business Doctors Through the 1990s

When AACSB publicizes a decrease in doctoral graduates, it is using a period of peak oversupply as the standard. The late 1980s saw an increase in doctoral student enrollments, feeding an increase to record high outputs of new doctorates in the 1990s. In the early 1980s, AACSB was cited for saying that it would take 11 years to fill business faculty vacancies (Fiske, 1981). In the middle 1980s, AACSB was reporting a faculty shortage of twenty percent, expecting it to continue into the 1990s despite an anticipated drop in student enrollments (Whalen, 1984); this shortage was attributed to business faculty salary gains of 10.4 percent in 1984 (Whalen) and 8.8 percent in 1985 (Cebrzynski, 1985). By the late 1980s, AACSB was being cited for saying that faculty vacancy rates were twenty-five percent in business disciplines (Pal and Waldauer, 1988).

AACSB publicity in the 1980s about a looming shortage of business doctors and resultant high salaries was likely a factor in the decision of some to pursue a doctoral program. Indeed, a new business doctor degree program at the University of Connecticut attracted more than 30 applicants for each available seat in the fall of 1987 (Hamilton, 1987).

This increase in enrollments in business doctoral programs in the 1980s caused an increase in the production of new business doctors in the early to middle 1990s, both in raw number and as a percentage of all doctorate production (see Table 1). The unfortunate result of the increased business doctor output of the early to middle 1990s was an oversupply of doctoral graduates at a time of decreasing business school enrollments. With falling MBA applications in the US, business schools started setting up branch programs in other countries (Gallagher, 1993). At the annual American Accounting Association meeting in 1992, 180 resumes were submitted to fill just 110 open positions. The oversupply finally began to subside in 1997 with 117 resumes submitted to fill 120 open positions (Joseph, 2004).

This oversupply of new doctors was exacerbated by a bad economy which caused a lousy academic job market for all disciplines, including business. State and federal assistance to higher education was suddenly and drastically declining during a time of decreasing enrollments. The result was almost universal university downsizing, layoffs, early retirement incentives, and hiring freezes (cf., Healy et al. 1996; Kerlin and Dunlap,

1993; Selvin 1995); the word "retrenchment" was a common response to many of us who were mailing applications to schools on our lists of both desirable job choices and undesirable job choices alike.

To make matters worse, a 1994 federal law prohibited mandatory retirement on the basis of age for tenured faculty members, resulting in a belief that older faculty members were clogging the career paths of newer Ph.D.s; faced with retrenchment needs, many universities were offering inducements for early retirement (Honan, 1994). With the dismal academic job market, affirmative action programs in the 1990s created yet more uncertainties for new doctorates, sometimes leaving even the most promising of white males unable to obtain job interviews (cf., Wilson, 1995); a survey of political science Ph.D. graduates found that while men and women found positions at about the same rate, men were more likely to be placed in temporary positions (Britnall, 1996). The weak and uncertain academic job market forced new doctorates in all disciplines to seek jobs outside of academe (cf., Wilson, 1997).

Employment Outside of Academe

Arguments are sometimes advanced that the number of new doctor graduates available for faculty employment is decreased because so many are attracted to work in private industry and because so many leave to teach outside of the U.S. As can be seen in Table 2, an even greater number of new doctor graduates are lost to "seeking employment" in the year following graduation than to foreign employment. A total of about one in five 2005 graduates were "lost" to jobs in either industry, government, or non-profit organizations. This doesn't sound like an outrageous "loss"; it would seem odd if fewer chose to take such jobs. It seems much more outrageous that one in six in 2005 was seeking employment the year following graduation during a time when there was supposed to be a huge shortage of new business doctors. This suggests that either doctor-granting schools are graduating wholly incompetent teachers and researchers or that employing schools have set such wholly unrealistic expectations that they would prefer to "train" practitioners from industry perform professor jobs.

Table 2: Profile of Doctoral Recipients

	1993	1997	2005
citizenship			
US citizen	59.7	63.5	49.5
permanent res.	6.0	6.9	4.5
temp. visa	30.7	21.9	38.4
unknown	3.6	7.8	7.6
age at doctorate	35.5	35.7	35.6
yrs. since bacc. to doct.	11.9	12.4	12.3
postdoctoral plans			
definite postdoc study	0.9	2.6	3.0
definite employment	71.1	64.5	77.7

seeking employment or study	18.6	20.7	16.6
other/unknown	7.6	12.1	2.7
definite employment			
educational institution			76.5
industry/business			13.0
government			3.8
nonprofit			1.9
other/unknown			1.1
foreign employment after doct.	16.6	12.7	14.2

Source: Survey of Earned Doctorates (1995, 1999, 2007) from Table A-3a in each report. These particular years were chosen due simply to the availability of older years' documents. "Definite employment" subcategories for 2005 cannot be directly compared to the earlier years.

The Impact of Retirements

The prediction of a faculty shortage is based in large part on an assumption that there is some kind of aged-professor bulge that will suddenly burst into retirement all at once. Some forecast mass retirements by business school professors who were hired in the 1960s and 1970s or that baby boomer-aged faculty (born between 1946 and 1964) will all retire at the same time within the next few years (e.g., Hammond, 2005; Mangan, 2001; Schevitz, 2000). As for the professors who graduated in the 1960s, there were far fewer business doctors graduated at that time than in more recent times. Additionally, the early retirement incentives of the 1990s retrenchments most certainly has already thinned these ranks even further. (E.g., one member of the present author's dissertation committee accepted an early retirement incentive at age 55 in 1995, but continues to teach as an adjunct at small schools.) It is hard to imagine that the retirement of these old folks will make any greater difference in the natural progression of retirements that has come and gone and will come and go for decades.

Considering the Survey of Earned Doctorates finding that obtaining a Ph.D. in business disciplines takes, on average, five years and that the typical graduate is age 35, it is logical to expect that new graduates are drained financially, hungry to pay off student loans, and only just starting long-term retirement savings. A boomer born in 1955 would most typically have graduated and taken a first academic job at age 35 in 1990. With the tenure system that pervades academe, many of those would have since experienced at least one life-disrupting move and the need to start over yet again. The idea that these boomers are in a financial position to retire fifteen years after graduation, or perhaps just nine years after starting the second tenure-track job, is unrealistic.

Additionally, the boomer generation seems to be embracing a "sixty is the new forty" perspective in its attitudes toward health, longevity, and retirement: studies by AARP (which at one time stood for the American Association of Retired People) have

been finding that the baby boom generation does not hold the same attitudes as earlier generations with regard to retirement. AARP (2003) found that 68 percent of baby boomers who have not yet retired report that they plan to work into their retirement years or never retire, and almost half indicate that they envision working into their 70s or beyond (compare with similar results of AARP, 2004). A typical boomer born in 1955 might continue working until at least 2025. This hardly seems like a looming threat.

The Increase in the Number of AACSB Accredited Schools

AACSB's push to accredit more business schools no doubt has an effect on the number of doctorally qualified faculty that are needed. The 1971-72 AACSB directory listed 153 accredited schools (Shawver, 1973). An archived AACSB website accessed at Archive.org states that as of April 1997, there were 330 accredited programs in the US, four in Canada, and one in France. Its current (November 2007) website claims that as of July 2007, there were 457 accredited programs in the US and another 94 outside of the US. That is, the present pool of AACSB accredited schools is 164 percent of what it was just ten years earlier.

This dramatic increase in the number of accredited schools means that there will be more demand for doctorally qualified faculty. Since it is smaller, non-research schools that have been added since the 1992 change in AACSB standards, it also means that many (perhaps most) of these schools need to lower teaching loads, requiring even more faculty than had been necessary prior to thoughts of accreditation. Additionally, the requirement for greater numbers of doctorally qualified faculty means that there will be greater demand for faculty who are able to remain academically qualified. "Academically qualified" is proven in two ways: either by the conduct of continuing research in the most recent five year window, or by being a fresh doctor graduate who is automatically considered academically qualified for five years. As a result, the latter – unproven fresh grads right out of school – will be the "hot commodities" in the market, not the more experienced teachers who have already proven that they are, on average, merely average researchers.

With the growth of business as an undergraduate major and the expansion of business programs in the 1970s, the new business programs at smaller schools were unable to attract faculty with doctor degrees; with a short supply of business doctors, nobody wanted to teach at a smaller school (Shawver, 1973). The increased interest in accreditation across the years, however, has required that those schools seek faculty with doctor degrees, thereby causing an increasing demand. AACSB requirements, however, were a cause for schools' increased needs for faculty with doctor degrees (cf., Lossett and Moustafa, 1975).

Two undesirable outcomes result from AACSBs continuing efforts to grow more accredited schools: an artificial increase in demand for doctor degrees and a very real increase in mediocrity. White et al. (2005) note that while the quantity of new doctors increases with AACSB accreditation issues, the result *must be* decreased quality standards if the quantity available does not rise. The proportion of doctorally qualified and research faculty in the newer AACSB standards has (in fact) been lowered. Some would argue that increases in AACSB accreditation and the resulting (perceived or real) lowering of AACSB standards has caused good teaching schools to change their focus to

become peddlers of third-rate articles (cf., Wright and Larwood, 1998). This has in turn caused a need for an increasing number of third-rate journals (perhaps themselves sponsored by third rate schools) that nobody ever sees. Publicity for the increased demand for business doctors, whether the demand is artificial or real, has perhaps also been a cause for the increased interest in substandard business doctor degrees (cf., Owen, 2007).

While there is increased demand for business doctors due to increased efforts by AACSB to accredit business schools, there is quite possibly a decrease in the quality of business education. There will still be the higher tier, larger, research oriented colleges and universities, and there will still be bottom tier business schools located in lower tier, smaller teaching oriented colleges and university. But the AACSB "seal of approval" has resulted in mediocre business schools that promote themselves to be "in the same league as Harvard," when instead they are once-good teaching schools that have changed their focus toward cranking out junk publications in junk outlets. If an administration wants to cut budgets, middle tier and smaller schools could now be forced by university administrations to cut the number of doctorally qualified faculty to be replaced by full-time "participating" adjuncts due to the weakened AACSB standards (cf., Mangan, 2003). There is no net gain to society or to any educational purpose when these are the outcomes of AACSB's pursuit of greater numbers of accredited schools.

Student Enrollments

In addition to an assumption that a bulge of older professors is about to suddenly retire, an assumption is often made that college and business school enrollments will continue to climb as they had in the late 1990s. College enrollments in the U.S. have indeed been climbing for decades (National Center for Education Statistics, 2007), but the population has not, over the long run, been growing. As can be graphically seen in Figure 1, the size of the population after the boomer generation has remained relatively flat right up to newborns. The only way that college enrollments can continue to grow is if a greater proportion of the population attends college – but there is a finite limit as to how far growth can continue before reaching asymptote.

Additionally, the growth of business majors as a proportion of all college enrollments relies on employability, and that, too, has a finite asymptote. Consider, for example, that 2007 experienced a record year for layoffs in finance (Rosenbush, 2007). That could very well translate into dramatically fewer finance majors in the future. MBA applications have been declining, with some top schools reporting single year drops of around 25% in 2004, causing schools to compete harder to fill classes (BusinessWeek, 2007).

Figure 1. U.S. Population.

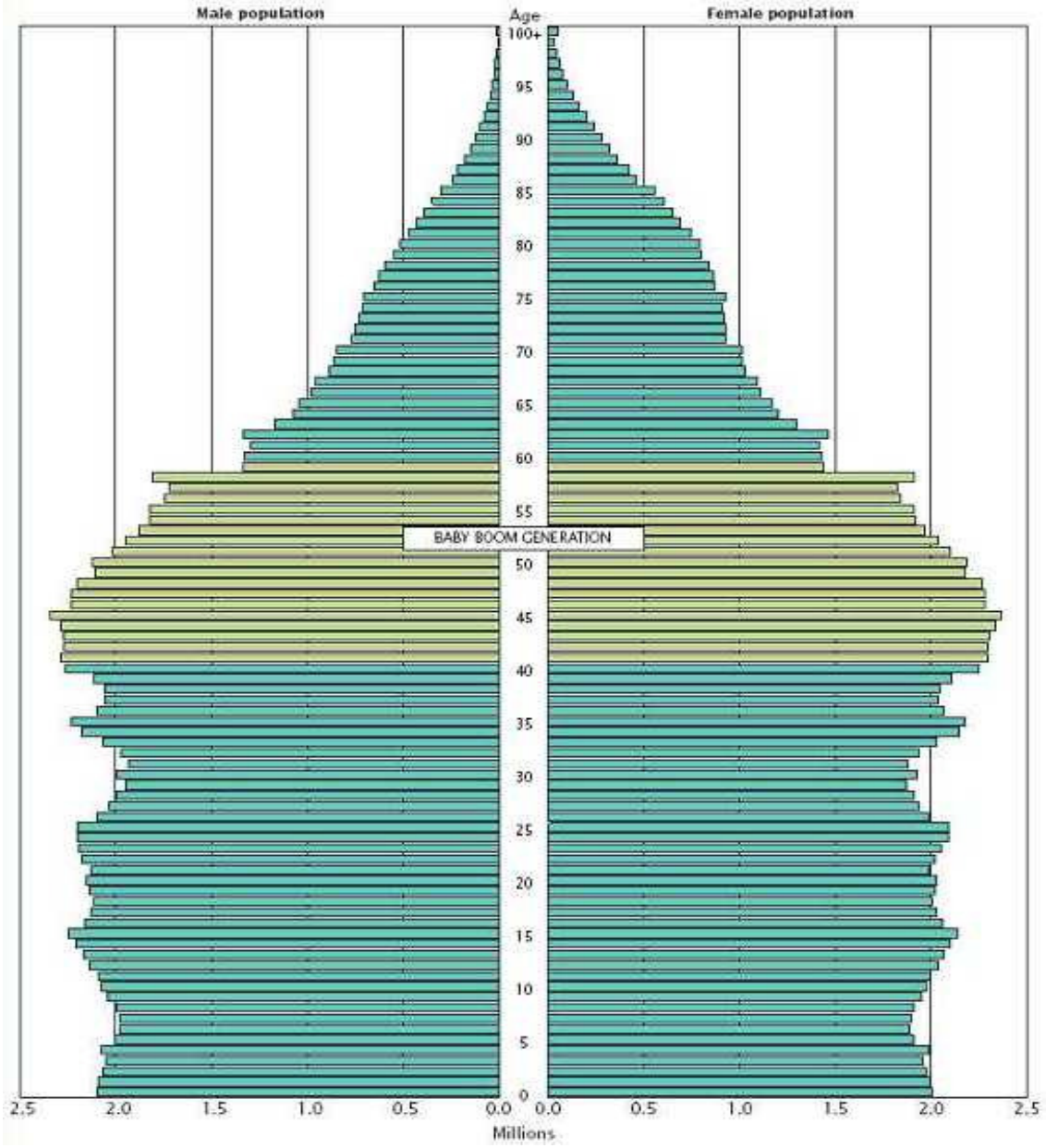

Figure copied from (uncopyrighted) US Census Bureau (2005).

Conclusions

AACSB has for decades claimed that there has been, is, and will be a faculty shortage in business. Assumptions that are made include declining business doctor production, mass retirements by a bulge of aged professors, and increasing student enrollments. Instead, there was an oversupply of business doctors for consumption in the 1990s, and the current claim of declining production is based on the early to mid nineties record peak that resulted in that oversupply. Aged professors are not likely to retire at

any higher rate than in the past; instead, they very well might retire at a slower rate than in the past. U.S. population trends suggest that the U.S. population of college-aged students should remain relatively steady for the foreseeable future.

If there are any shortages in fresh doctors to hire, one important resource never seems to receive mention: the lost generation of those who completed doctorates in the early to mid nineties. Many of that generation of graduates would have been forced to take jobs at unaccredited "teaching" schools. While their scholarly output has been severely constrained by these positions, they started in these positions with rigorous research training and now, ten or fifteen years later, they have substantial teaching and service experience. Current talk of "training" business practitioners to "fill the gaps" in a doctoral shortage makes no sense given that a misplaced generation of rigorously trained nineties graduates is still around. Many of this lost generation have maintained reasonable research production despite continuous four-prep-semester teaching loads, twelve month teaching schedules, and few research resources. Members of that lost generation who have consistently maintained a few publications per year could possibly be expected to out-produce research-school counterparts who have been no more productive while in opportunity-rich environments.

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Student Teachers' Knowledge of the Individuals with Disabilities Education Act

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Abstract

Are student teachers in the southern region knowledgeable about teaching students with special needs? The purpose of this study was to describe agricultural education student teachers' knowledge of the Individuals with Disabilities Education Act, disabling conditions, and special education laws. The population was student teachers (*N* = 335) from the American Association of Agricultural Education southern region. Respondents participated in a student teaching experience during the 2005 spring semester. Overall, 74.5% felt prepared to teach special needs students in agricultural education classrooms and laboratories. However, this feeling of preparedness was primarily centered on developing an individual education plan. Mean scores for the total correct response to the knowledge assessment was 57%. Respondents were marginally knowledgeable about five special education criterion (providing least restrictive environment; providing appropriate and challenging curriculum for all; understanding special education laws; deaf- or hearing-impaired; and emotional/behavior disorder). Student teachers may be ill-prepared to meet the challenges of accommodating special needs students in agricultural education classrooms and laboratories. Agriculture teachers who are unaware of special education laws and/or issues that may impact their local programs should request in-service workshops, materials, and/or network with teachers who have experience in teaching special needs populations.

Keywords: Individuals with Disabilities Education Act, Student Teachers

Introduction

Education law regarding individual rights has existed since Brown v. Board of Education (1954). Brown v. Board of Education set forth the case for civil rights and expanded the rights of all. Huefner (2000) stated "in the aftermath of the desegregated decision in Brown, the individual rights guaranteed under the Bill of Rights and the Fourteenth Amendment to the U.S. Constitution were held to apply to students and teachers in school situations" (p. 4). However, it took almost two decades before laws were passed that provided assistance in meeting the needs of handicapped and special needs students in schools.

Over 100 years of research has shown that teachers are ill-prepared to meet the needs of special education students in general education classrooms (Daane, Beire-Smith

& Latham, 2000; Kleinhammer-Tramill, 2003; Lombard, Miller, & Hazelkorn, 1998; Lombardi & Hunka, 2001; Rojewski & Pallard, 1993; Schumm & Vaughn, 1995; Scruggs & Mastropieri, 1996; Sindelar, 1995; Singh, 2001; Trump & Hange, 1996; Welch, 1996; Wishart & Manning, 1996).

A longitudinal study conducted by Scruggs and Mastropieri (1996) reported that after 28 trials of investigating general educators' perceptions of inclusion between 1958 and 1995, only 29.2% of the general educators felt that they had adequate knowledge and skill to implement inclusive services in the general education classroom. Schumm and Vaughn (1995) studied 775 general educators' perceptions, knowledge, and skills in meeting the needs of disabled students in general education classrooms. They found that "many teachers were not prepared to plan and make adaptations for students with disabilities. Many acknowledged that their teacher preparation programs did not include intensive instruction on how to teach students with disabilities" (p. 172).

Thirteen disabling conditions are recognized by the Individuals with Disabilities Education Act (IDEA). They include: autism, deaf-blindness, deafness, emotional disturbance, hearing impairments, mental retardation, multiple disabilities, orthopedic impairments, other health impairment, specific learning disabilities, speech or language impairments, traumatic brain injuries, visual impairments, and other health impairments. The following brief descriptions of each disabling condition provide better understanding of each condition.

- Autism is "a developmental disability significantly affecting verbal and nonverbal communication and social interaction" [Code of Federal Regulations, Title 34, Section 300.7(c)(1)(i)]. Students with autism may show characteristics of repetitive procedural tasks, erratic movements, resistance to environmental change or changes in daily routines.
- Deaf-Blindness includes "concomitant hearing and visual impairments, the combination of which causes such severe communication and other developmental and educational needs that they cannot be accommodated in special education programs solely for children with deafness or children with blindness" [Code of Federal Regulations, Title 34, Section 300.7(c)(2)].
- Deafness is referred to as "a hearing impairment that is so severe that the child is impaired in processing linguistic information through hearing, with or without amplification that adversely affects a child's educational performance" [Code of Federal Regulations, Title 34, Section 300.7(c)(3)].
- Emotional Disturbance can be explained as: (1) "an inability to learn that cannot be explained by intellectual, sensory, or health factors; (2) an inability to build or maintain satisfactory interpersonal relationships with peers and teachers; (3) Inappropriate types of behavior or feelings under normal circumstances; (4) a general pervasive mood of anxiety or unhappiness or depression; and (5) a tendency to develop physical symptoms or fears associated with personal or school problems" [Code of Federal Regulations, Title 34, Section 300.7(c)(4)].
- Hearing impairments are "an impairment in hearing, whether permanent or fluctuating, that adversely affects a child's educational performance but that is not included under the definition of deafness" [Code of Federal Regulations, Title 34, Section 300.7(c)(5)].

- Mental Retardation characteristics are described as "significantly sub average general intellectual functioning, existing concurrently with deficits in adaptive behavior and manifested during the developmental period that adversely affects a child's educational performance" [Code of Federal Regulations, Title 34, Section 300.7(c)(6)].
- Multiple disabilities are a combination of "concomitant impairments (such as mental retardation—blindness, mental retardation—orthopedic impairment, etc.), the combination of which causes such severe educational needs that they cannot be accommodated in special education programs solely for one of the impairments. The term does not include deaf-blindness" [Code of Federal Regulations, Title 34, Section 300.7(c)(7)].
- Orthopedic impairments include "severe orthopedic impairment that adversely affects a child's educational performance. The term includes impairments caused by congenital anomaly (e.g., clubfoot, absence of some member, etc.), impairments caused by disease (e.g., poliomyelitis, bone tuberculosis, etc.), and impairments from other causes (e.g., cerebral palsy, amputations, and fractures or burns that cause contractures)" [Code of Federal Regulations, Title 34, Section 300.7(c)(8)].
- Other health impairments can be classified by "limited strength, vitality or alertness, including a heightened sensitivity to environmental stimuli, that results in limited alertness with respect to the educational environment that is due to chronic or acute health problems such as asthma, attention deficit disorder or attention deficit hyperactivity disorder, diabetes, epilepsy, a heart condition, hemophilia, lead poisoning, leukemia, nephritis, rheumatic fever, or sickle cell anemia, and adversely affects a child's educational performance" [Code of Federal Regulations, Title 34, Section 300.7(c)(9)].
- A specific learning disability will contain "a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, that may manifest itself in an imperfect ability to listen, think, speak, read, write, spell, or do mathematical calculations, including such conditions as perceptual disabilities, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia. The term does not include learning problems that are primarily the result of visual, hearing or more disabilities, of mental retardation, of emotional disturbance, or of environmental, cultural, or economic disadvantage" [Code of Federal Regulations, Title 34, Section 300.7(c)(10)].
- Speech or language impairments are classified as "a communication disorder, such as stuttering, impaired articulation, language impairment, or a voice impairment, that adversely affects a child's educational performance" [Code of Federal Regulations, Title 34, Section 300.7(c)(11)].
- Traumatic brain injury is "an acquired injury to the brain caused by an external physical force, resulting in total or partial functional disability or psychosocial impairment, or both, that adversely affects a child's educational performance. The term applies to open or closed head injuries resulting in impairments in one or more areas, such as cognition, language, memory, attention, reasoning, abstract thinking, judgment, problem solving, sensory, perceptual, and motor abilities, psychosocial behavior, psychosocial functions, information processing, and

speech. The term does not apply to brain injuries that are congenital or degenerative or to brain injuries induced by birth trauma" [Code of Federal Regulations, Title 34, Section 300.7(c)(12)].

- Visual impairment is defined as "impairment in vision that, even with correction, adversely affects a child's educational performance. The term includes both partial sight and blindness" [Code of Federal Regulations, Title 34, Section 300.7(c)(13)].

As a leading organization for educators, Interstate New Teacher Assessment and Support Consortium ([INTASC], 2000), has provided educational standards for all beginning classroom teachers about the knowledge, skills, and dispositions needed to effectively teach students with special needs in general education classrooms. INTASC believes that "model core standards for licensing teachers represent those principles which should be present in all teaching, regardless of the preparation and professional development" (p. 2). INTASC created five competencies for all beginning teachers working with disabled students, regardless of subject taught.

The INTASC task force standards for a common core of teaching knowledge and skills should be acquired by all new teachers. The standards were developed in response to five major propositions that guide the National Board's standard-setting and assessment work, including:

(1) Teachers are committed to students and their learning;
(2) Teachers know the subjects they teach and how to teach those subjects to diverse learners;
(3) Teachers are responsible for managing and monitoring student learning;
(4) Teachers think systematically about their practice and learn from experience; and
(5) Teachers are members of learning communities. The teacher knows about areas of exceptionality in learning, including learning disabilities, visual and perceptual difficulties, and special physical or mental challenges. (p. 2)

The National Council for Accreditation of Teacher Education (NCATE) provides standards for all teacher certification programs (NCATE, 2002). NCATE-accredited universities experience programmatic reviews every five years. The standard (NCATE) for teaching students with special needs states:

> The unit designs, implements, and evaluates curriculum and experiences for candidates to acquire and apply the knowledge, skills, and dispositions necessary to help all students learn. These experiences include working with diverse higher education and school faculty, diverse candidates, and diverse students in P-12 schools. (p. 2)

NCATE standards emphasize the word *all* in every standard, indicating that each standard requires the teacher certification program to meet the needs of the general education students and special education students in every classroom.

The American Association for Agricultural Education (AAAE) National Standards for Teacher Education in Agriculture states that all agricultural education programs should provide for teacher candidates to acquire and develop the pedagogical and professional understandings and skills needed to work with all students (AAAE,

2001). A pedagogical and professional understanding of teaching and serving students with exceptionalities is included in these standards. Given the prevalence of standards throughout the education profession, what do current student teachers in the AAAE southern region know about the Individuals with Disabilities Education Act, disabling conditions, and special education laws?

The purpose of this study was to evaluate agricultural education student teachers' knowledge of the Individuals with Disabilities Education Act, disabling conditions, and special education laws. The objectives of this study were to:

1. Describe pre-service agricultural education teachers in the AAAE southern region during the 2005 spring semester.
2. Describe agricultural education student teachers' knowledge of disabling conditions and special education laws for meeting the needs of special education students in agricultural education classrooms and laboratories.

Methods

Selected methods used in reporting the results in this paper were part of a larger project entitled, "Agricultural education student teachers' confidence and knowledge: Teaching special needs students." Similarities in research design and demographics reported in this paper exist in another publication (Author, 2005), but are described fully in the following.

The population ($N = 335$) for this descriptive census study was student teachers in the southern region of the American Association of Agricultural Education. Student teachers were participating in their teaching experiences for teacher certification during the 2005 spring semester during this study. The AAAE southern region includes 13 states and 40 academic institutions offering teacher certification in agricultural education. Eleven states were represented in this study: Arkansas, Florida, Georgia, Kentucky, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, and Virginia.

Of the 40 agricultural education programs in the AAAE southern region, 32 had one or more student teachers enrolled during the 2005 spring semester. Twenty-six universities chose to participate in this study. Each student teacher coordinator was contacted by telephone to explain the project. Student teacher coordinators provided student teachers' e-mail addresses for the study. Three agricultural education program directors stated they were not allowed to release students' e-mail addresses, but agreed to send the survey e-mail notice so their student teachers could access the online instrument. Valid student teachers' e-mail addresses for 70% ($n = 235$) of the population of interest were received, however all ($N = 335$) student teachers were contacted in this study (three agricultural education program directors forwarded the survey notice from their own e-mail accounts).

The knowledge portion of the research instrument sought to determine respondents' understanding of teaching special needs students in agricultural education classrooms and laboratories. Knowledge questions (multiple choice, four responses; and/or Likert-type, True/False) referred to the following recognized disabilities from the Individuals with Disabilities Act: learning disabled; mildly mentally handicapped; attention deficit disorder; deaf- or hearing-impaired; blind- or visually-impaired; emotional/behavior disorder; and physically impaired. Additional questions focused on

participants' knowledge about special education law, providing the least restrictive environment, participating in Individual Education Program (IEP) development, and providing an appropriate and challenging curriculum for all students.

The knowledge portion was adapted from a test bank accompanying *Exceptional lives: Special education in today's schools* (Turnbull, Turnbull, Shank, & Smith, 2004). An expert panel of 12 special education teachers selected appropriate questions for the IDEA recognized disabilities and special education laws. The knowledge portion contained 33 questions; three questions for each disabling condition and/or special education law. The Kuder-Richardson Formula 20 (Ary, Jacobs, & Razavieh, 1996) was calculated for the knowledge portion, resulting in an overall reliability of .62. Overall knowledge scores for each special needs condition and/or law were interpreted using total mean values as: Unknowledgeable = 0.00-1.50; Marginally Knowledgeable = 1.51-2.50; Very Knowledgeable = 2.51-3.00.

Survey instrumentation and online design were created with Hypertext Markup Language. Data were collected in a secured Microsoft Access database and later transferred to SPSS for data analysis. The online method was chosen for questionnaire delivery based on its ability to achieve fast response rates at minimal expense (Ladner, Wingenbach, & Raven, 2002), and for its suitability with college-level students (Kypri, Gallagher, & Cashell-Smith, 2004). To encourage favorable response rates, respondents were offered a lottery incentive ($100 gift certificate from Amazon.com). Student teachers who completed the survey and who consented (voluntarily provided valid e-mail addresses in the survey) to the incentive were entered into the lottery drawing. Dillman (2000) questioned the value of an economic exchange incentive "in which money serves as a precise measure of the worth of one's actions" (p. 14), however Singer (2000) and Porter and Whitcomb (2003) found lottery-type incentives increased response rates.

Data were collected during the 2005 spring semester. The online survey was activated February 1, 2005; weekly e-mail reminders were sent to non-respondents for six weeks. After six attempts, instruments were mailed to each university for non-responders to complete during their end-of-semester meetings. The total response rate was 83.28%. Five instruments were deemed unusable, reducing the total response rate to 81.79%.

Data were analyzed using the Statistical Package for the Social Sciences (SPSS) Version 12. Descriptive statistics were used to report the results.

Results

Valid responses ($N = 274$) were received from student teachers at 26 universities, with the majority (90.1%) responding from Texas ($n = 138$), Oklahoma ($n = 29$), Kentucky ($n = 28$), Georgia ($n = 22$), North Carolina ($n = 20$), and Florida ($n = 10$) (Table 1). Respondents were described as female (53%), Caucasian (93%), and slightly more than 23 years old. Most student teachers had or were receiving their Bachelors degree ($n = 247$); 14 students had their Masters degree. The majority ($n = 159$) had taken courses in special education issues. Over one-half (55.8%) had spent time with a special needs person outside an academic setting. Twenty-six (9.5%) student teachers had an Individual Education Program while enrolled in high school. Overall, 74.5% of the student teachers felt prepared to teach special needs students in agricultural education classrooms and laboratories.

Table 1
Demographics of Respondents (N = 274)

Variable	Category	*f*[a]	%
States	Texas	138	50.4
	Oklahoma	29	10.6
	Kentucky	28	10.2
	Georgia	22	8.0
	North Carolina	20	7.3
	Florida	10	3.6
	Tennessee	8	2.9
	Virginia	8	2.9
	Arkansas	7	2.6
	South Carolina	2	.7
	Mississippi	2	.7
Gender	Female	144	52.6
	Male	128	46.7
Race	Caucasian	256	93.4
	Hispanic	12	4.4
	African American	2	.7
	Multi-racial	1	.4
Education	BS	217	79.2
	BS + 10 hours	30	10.9
	MS	14	5.1
	MS + 10 hours	3	1.1
If a special needs course was taken in college, was it:	Required	154	56.2
	None taken	93	33.9
	An elective	5	1.8
Have you spent time with a special needs' person outside an academic setting?	Yes	153	55.8
	No	113	41.2
Did you have an IEP in secondary education?	No	231	84.3
	Yes	26	9.5
Do you feel prepared to teach special needs students?	Yes	204	74.5
	No	61	22.3

Note. [a]Frequenices may not equal 274 because of missing data.

Student teachers were given a knowledge test containing 33 questions (three questions for each disabling condition and/or each special education criteria). Overall, student teachers answered slightly more than one-half (M = 18.64, SD = 3.95) of all questions correctly, for a total correct response rate of 56.49% (Table 2). Given a standard grading rubric of 60% or better to pass an exam, student teachers would have had to correctly answer 20 of the 33 knowledge questions. Less than one-half (43.1%) of all respondents correctly answered 20 or more questions in the knowledge portion of this study. An additional 36.9% (n = 101) of the respondents scored less than 50% correct.

Analyses of student teachers' knowledge scores by specific criterion for special education disability or law revealed the respondent group was very knowledgeable about IEP development

Table 2
Descriptive Statistics for Knowledge of Special Education Disabilities and Special Education Law (N = 274)

Criteria	*M*[a]	*SD*	*f*[b]	% of Total
Individual education program development	2.53	.73	179	65.3
Providing least restrictive environment	2.42	.74	153	55.8
Providing appropriate and challenging curriculum for all	2.32	.84	145	52.9
Understanding special education laws	1.97	.80	73	26.6
Deaf- or hearing-impaired	1.61	.79	31	11.3
Emotional/behavior disorder	1.58	.83	36	13.1
Blind- or visually-impaired	1.45	.88	28	10.2
Learning disabled	1.29	.83	21	7.7
Attention deficit disorder	1.24	.80	14	5.1
Physically impaired	1.20	.76	9	3.3
Mildly mentally handicapped	1.03	.75	9	3.3
Total Knowledge[c]	18.64	3.95		

Note. [a]Summed criterion scores could range from 0-3; interpretations were based on the ranges: *very knowledgeable* = 2.51-3.00; *marginally knowledgeable* = 1.51-2.50; *unknowledgeable* = 0.00-1.50. [b]Frequencies of those who scored 100% correct for the criterion. [c]Total knowledge scores ranged from 5-29 correct for 33 questions.

(*M* = 2.53, *SD* = .73). They were marginally knowledgeable (*M* = 1.51-2.50) about five criterion (providing least restrictive environment; providing appropriate and challenging curriculum for all; understanding special education laws; deaf- or hearing-impaired; and emotional/behavior disorder). However, they were unknowledgeable (*M* = 0.00-1.50) in five other areas (blind- or visually-impaired; learning disabled, attention deficit disorder, physically impaired, and mildly mentally handicapped) (Table 2).

Conclusions

The laws and amendments discussed in this paper provide the basis for a much needed, and required by law, addition to agricultural teacher education programs. The results show ample evidence that future agricultural science teachers have "limited" or no knowledge of the disabling conditions impacting special needs students. If the educator is unprepared to teach the special needs student, then the next course of action by a parent or guardian may be to remedy these inequities through legal methods. Judicial proceedings cost school districts and state educational agencies both in money and time.

Today's emphasis on inclusion signifies the importance for agricultural educators to be aware of special education issues. Furthermore, teachers must recognize the expectations placed on them in order to accommodate special needs students. Information

about special education law and strategies to meet the needs of special education students should be included in all teacher certification curricula. For teachers who are unaware of special education laws and/or issues that may impact their local programs, specific requests should be made for in-service workshops, materials, or networking possibilities with teacher education programs and/or those who are experienced in teaching special needs students. A "good faith" effort is akin to the ounce of prevention; neither pound of cure, nor "ignorance of the law" is a justifiable defense.

The average mean score for the knowledge assessment was 57%. The knowledge exam was graded as a regular classroom exam would be graded with equal weights for each question. A mean score of 57% would be a failing average. Only 45 student teachers (16.4%) would have earned a "C" or better, while only four students would have achieved a "B" grade; no student teachers would have earned an "A" on the knowledge portion. Granted, this topic is highly specialized and does not impact all agricultural teachers equally, however that does prohibit future agriculture teachers from learning more about special education issues.

Additional study into the specific special needs courses that 159 respondents indicated taking as part of their teacher education curricula may shed light on the necessity of truly understanding this important topic. The results indicated that topics in IEP development, providing a least restrictive environment, appropriate and challenging curriculum for all, or understanding special education laws were the basis of respondents' knowledge. It is not apparent that, although 75% of the student teachers felt prepared to teach special needs students, they had any idea about the disabling conditions facing special needs students. Did their special needs courses provide in-depth understanding of the disabling conditions facing some students? If so, how much attention was devoted to the study of those conditions?

Data showed that student teachers had marginal knowledge about special education laws. Elbert and Baggett (2003) suggested that agricultural education teachers in Pennsylvania needed more knowledge of special education law, such as providing the least restrictive environment and in designing individual education programs. It is important though to remember that Ebert and Baggett surveyed veteran teachers, while this study focused on student teachers. Other studies involving veteran teachers have shown similar results (Schumm & Vaughn, 1995). Student teachers have not experienced extended time in teaching special needs students. Cotton (2000) found that veteran vocational teachers wanted additional training regarding least restrictive environment and providing an appropriate curriculum for all students in their classrooms. The findings in this paper concur with Cotton's.

A knowledge assessment for special education issues is needed in all areas of education, regardless of teacher certification title. Questions for this study were generated from a test bank accompanying *Exceptional lives: Special education in today's schools* by Turnbull, Turnbull, Shank, and Smith (2004). Reliability of .62 for the knowledge portion can be improved in future studies. Future instrumentation should be created through factor analysis to identify appropriate questions for creating a truly reliable instrument to assess teachers' knowledge of disabling conditions and special education laws.

Based on the findings, the authors recommend replicating this study with populations outside the AAAE southern region. Additionally, an instructional unit about

disabling conditions and special education laws for use in agricultural teacher preparation courses should be created. Pre- and post-test analyses could determine changes in knowledge after teachers complete the instructional unit. It is recommended that continued testing occur for student teachers' knowledge of special education issues to determine if understanding of disabling conditions and special education laws increases with time. Teacher educators must update their knowledge bases of special needs students so they can provide in-service training for current teachers at state agricultural education teacher conferences. Finally, leadership within the AAAE is needed to design an educational law workshop on special education, including liabilities in areas of negligence, which may affect all agricultural educators, classrooms, and laboratory activities. Such a workshop could be offered at regional and/or national conferences, or in conjunction with the National FFA Convention.

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Publishing Rates of Graduated Education Ph.D. and Ed.D. Students: A Longitudinal Study of University of California Schools

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ABSTRACT

This study investigated the publishing rates for Ed.D. and education Ph.D. graduates from 1999 to 2003 in the University of California school system, as a function of graduation year and degree type. Random sampling resulted in 409 archival records and multi-journal databases were searched for publications by the authors of those 409 dissertations, published within +/-2 years of graduation. There were no significant differences among graduating years. The data revealed that 36.7% of the Ph.D. graduates published at least one article compared to 13.7% of the Ed.D. graduates. This was a moderate effect and significant (V = .234, p = .001, α = .05).

Key Words: PhD, EdD, Publishing Rates, University of California,

OBJECTIVES

This study investigated the publishing rates for Ed.D. and education Ph.D. graduates from 1999 to 2003 in the University of California school system as a function of degree type. Random sampling resulted in 409 archival records from a dissertation database. A set of multi-journal databases were searched for publications by the authors of those 409 records, published within plus-or-minus (+/-2) years of their graduation. This study provided the first opportunity to compare the publishing rates of Ed.D. and Ph.D. degrees in the same large school system.

The doctor of education (Ed.D.) degree is more broadly focused and applied, as compared to the doctor of philosophy (Ph.D.) degree, which is more research oriented. Mason (1998) declared that "evaluative research data from doctoral students and graduates of Ed.D. and Ph.D. programs in education have been scarce to non-existent in the current literature" (p. 3). This statement is still true and this study compares the publishing rates of both types of degrees in the same school system.

The alpha level for this study was set at the α = .05. Data were initially tabulated using standard summary statistics and evaluated using chi-square and Carson's V.

BACKGROUND

Authors and the subjects of their writing become part of history. Written and verbal stories are the basis of knowledge that is passed from one generation to the next, but only written knowledge has the longevity to consistently transcend multiple generations. The transfer of knowledge is the reason that authors publish their work. The ProQuest *Dissertations and Theses* database has an average of over 51,000 doctoral dissertations have been produced every year from 1994 to 2006. Dissertations have many characteristics such as integrity and objectivity, and "high-quality research should be

characterized by publication" (Mauch & Birch, 1998, p. 15) so it is available to the people who can use it. Although the research described in a dissertation should be publishable, there has been limited research focused on the scholarly publishing rates of doctoral students. Scholarly publishing is important, for doctoral students attempting to enter the academic profession, because "published research leads to promotions and tenure. Higher salaries come with publications … [and] many good things happen to those who publish" (Blackburn & Lawrence, 1995, p. 116). An earlier National Science Foundation study of 10,000 doctorate holders identified the three major components of job satisfaction to be 1) salary, 2) relationship of job to graduate study, and 3) publishing – however, the authors point out that publishing is on the job satisfaction list only because it relates to salary (Solman & Hurwicz, 1978). It is important for students to publish because "early publication, including publication before the doctorate, predicts future production rate and total production" (Blackburn & Lawrence, 1995, pp. 79-80).

RESEARCH QUESTION 1

What are the overall publishing rates of doctoral students in education over a five year period? The data analysis for Research Question 1 used standard summary statistics and chi-square analysis of the data led to the rejection or non-rejection of the null hypothesis for this research question. The null hypothesis 1 (H_o1) is: The observed difference in publishing rates between graduates from year to year is the result of chance variations with the random sampling process. The alternate hypotheses (H_a1) is that the observed difference in publishing rates between graduates from year to year is not the result of chance variations.

RESEARCH QUESTION 2

Do publishing rates vary by degree type (Ed.D. or Ph.D.)? The data analysis for Research Question 2 used standard summary statistics and chi-square analysis of the data led to the rejection or non-rejection of the null hypothesis for this research question. The null hypothesis 2 (H_o2) is: The observed difference in publishing rates between graduates with Ed.D.s and Ph.D.s is the result of chance variations with the random sampling process. The alternate hypotheses (H_a2) is that the observed difference in publishing rates between graduates with Ed.D.s and Ph.D.s is not the result of chance variations.

METHODS

The general flow of the research started by identifying the Ed.D. and Ph.D. graduates in a database, recording dissertation information (first row of Figure 1), searching for published articles and recording publishing information (second row of Figure 1). The recorded information was coded onto a master matrix and subjected to statistical analysis (third row of Figure 1). The specific procedural steps and a detailed flowchart can be found in Mallette (2006).

Several authors have used a similar approach of initially identifying the population of doctoral graduates and then quantifying research productivity by searching databases for published articles (Gerbasi, Anderson, Gerbasi, & Coultis, 2002; Green,

Kvarfordt, & Hayden, 1999; Hutchinson & Zivney, 1995; Lee, 2000; McGinnis, Allison, & Long, 1982; Salmi, Gana, & Mouillet, 2001).

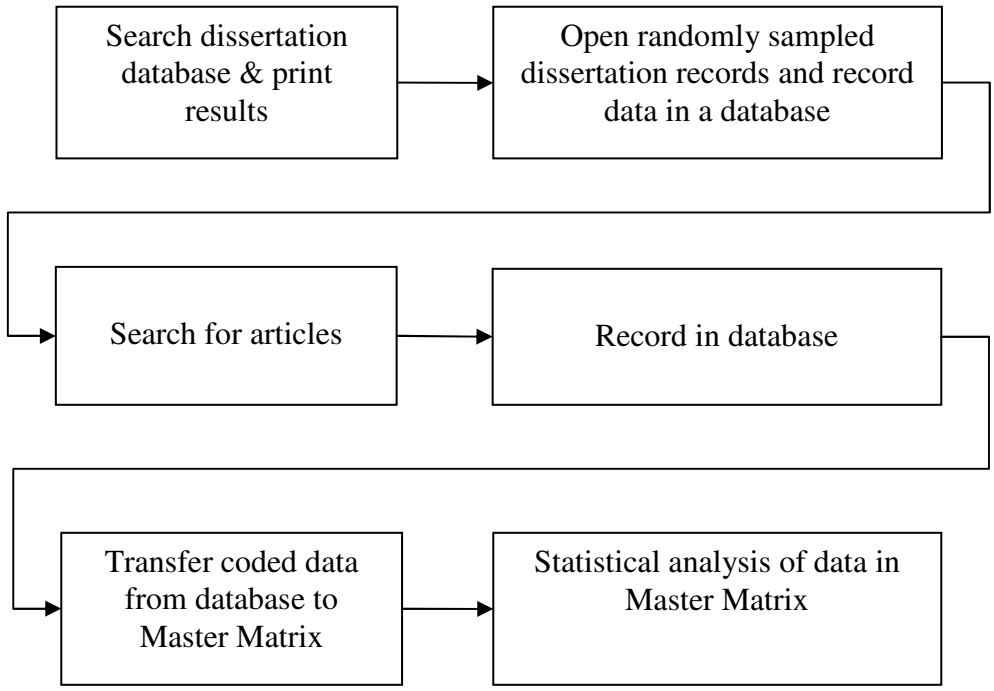

Figure 1. Overview of Research Flow.

POPULATION

The population to be studied is doctoral students of education in the UC school system. Within this population there are two populations of students that were studied: Ed.D. and Ph.D. graduates. The first population is the group of all Ed.D. graduates in the UC system from 1999 through 2003. The population (N) was 185 in those five years. The second population is the group of all Ph.D. graduates in education (as defined by the word *education* in either their abstract or citation), in the UC system, from 1999 to 2003. The population (N) for the Ph.D. group was 873. These populations were randomly sampled according to the "table for determining sample size from a given population" (Krejcie & Morgan, 1970, p. 608).

DESCRIPTIVE STATISTICS OF THE SAMPLE

Table 1 displays the descriptive statistics for the sample. For the five study years, the number of graduates per year in the sample ranged from 74 to 86. There were twice the number of Ph.D. graduates (68.0%) compared to Ed.D. graduates (32.0%) in the study. Students were most commonly female (63.8%) and most (64.3%) of the graduates came from either UCLA (39.1%) or UC Berkeley (25.2%). During the five-year period, 29.3% of the graduates published at least one article (M = 0.64, SD = 1.49).

SUMMARY OF THE SAMPLE

There were two samples studied in this research. They were sampled from the populations of (a) Ed.D. and (b) Ph.D. graduates in education from the University of California system from 1999 to 2003.

Ed.D. Population and Sample

There were 185 Ed.D. graduates from UC schools from 1999 to 2003 and 131 were sampled. There were Ed.D. graduates from four campus locations. They were UC Berkeley (8), UC Davis (32), UC Irvine (11), and UC Los Angeles (80). The other campus locations did not have Ed.D. graduates.

There were 29 Ed.D. graduates sampled from 1999, 22 from 2000, 30 from 2001, 27 from 2002, and 23 from 2003. The majority (54%) of Ed.D. students were female. There were 57 male students, 71 female students, and 3 students with neutral names that could not be identified from the acknowledgments, dedication, or vita in the dissertation. The information on the Ed.D. sample described above is summarized in Tables 2 and 3 by year and campus location.

Ph.D. Population and Sample

There were 873 Ph.D. graduates from UC schools from 1999 to 2003 and 278 were sampled. There were Ph.D. graduates from nine campus locations. There were 95 from UC Berkeley, 21 from UC Davis, eight from UC Irvine, 80 from UC Los Angeles, 16 from UC Riverside, 15 from UC San Diego, four from UC San Francisco, 36 from UC Santa Barbara, and three from UC Santa Cruz. It should be noted that five of the dissertations from UC Berkeley were listed as being conferred with UC San Francisco. These five dissertations were listed with the first listed school (UC Berkeley). The UC Merced campus locations did not have any graduates because it had not opened during the study range of this dissertation. There were 55

Table 1
Demographics of the Sample (N = 409), n is Number of Graduates in the Sample

		n	%
Graduation Year			
	1999	84	20.5
	2000	81	19.8
	2001	86	21.0
	2002	84	20.5
	2003	74	18.1
Campus			
	Berkeley	103	25.2
	Davis	53	13.0
	Irvine	19	4.6
	Los Angeles	160	39.1
	Riverside	16	3.9
	San Diego	15	3.7
	San Francisco	4	1.0
	Santa Barbara	36	8.8
	Santa Cruz	3	0.7
Degree			
	Ed.D	131	32.0
	Ph.D.	278	68.0
Student Gender			
	Male	134	32.8
	Female	261	63.8
	Unknown	14	3.4
Total Publications in Five Years[a]			
	0	289	70.7
	1	58	14.2
	2	35	8.6
	3	10	2.3
	4 to 17	17	4.2

[a] $M = 0.64$, $SD = 1.49$, N = 409

Table 2
Number of Graduates in the Ed.D. and Ph.D. Samples by Graduating Year

Year of Graduation	Ed.D.	Ph.D.	Combined
1999	29	55	84
2000	22	59	81
2001	30	56	86
2002	27	57	84
2003	23	51	74
Total	131	278	409

Table 3
Number of Graduates in the Ed.D. and Ph.D. Samples by Campus Location

Campus of Graduates	Ed.D.	Ph.D.	Combined
UC Berkeley [a]	8	95	103
UC Davis	32	21	53
UC Irvine	11	8	19
UC Los Angeles	80	80	160
UC Riverside	0	16	16
UC San Diego	0	15	15
UC San Francisco [a]	0	4	4
UC Santa Barbara	0	36	36
UC Santa Cruz	0	3	3
Total	131	278	409

[a] It should be noted that five of the dissertations from UC Berkeley were listed as being conferred with UC San Francisco. These five dissertations were listed with the first listed school (UC Berkeley).

Ph.D. graduates sampled from 1999, 59 from 2000, 56 from 2001, 57 from 2002, and 51 from 2003. The majority (68%) of Ph.D. students were female. There were 77 male students, 190 female students, and 11 students with neutral names that could not be identified from the acknowledgments, dedication, or vita in the dissertation.

RESULTS FOR RESEARCH QUESTION 1

Research Question 1 asked: What are the overall publishing rates of doctoral students in education over a five year period? The null hypothesis 1 (H_o1) stated that *the observed difference in publishing rates between graduates from year to year is the result of chance variations with the random sampling process.* Table 4 displays the chi-square test comparison (the alpha level for this study was set at $\alpha = .05$) for whether the graduates published at least once based on graduation year. The percentage of graduates who published over the years varied between a low of 24.3% to a high of 32.1% but these differences were not statistically significant ($p = .83$). This finding supports the non-rejection of the null hypothesis.

The analysis of publishing rate by year (relative to the graduation year) is reported in Table 5 and contrasted with earlier studies. The results in this study show an increasing trend through all years, similar to the other studies, except for a decrease in the last year.

There were 261 publications identified in this five year study and 120 published graduates. This yields an overall publishing rate of 0.435 publications per graduate per year. This study found that 29.3% of graduated UC doctoral students in education published peer reviewed articles within plus two or minus two (+/-2) years of their graduation year. The next paragraphs discuss early publishers and high publishers.

Early Publishers – Definition

"Early publishers" (Zivney & Bertin, 1992, p. 312) are defined as those who published before graduation.

Early Publishers – Results

This study identified 41 (10% of the 409 graduate sample size) of the 120 graduates who eventually published to be early publishers. Of these 41 early publishers, about half (19) never published again and 22 continued publishing and published from one to 13 publications in their graduation year and the two succeeding years.

High Publishers – Definition

Horner, Rushton, and Vernon (1986) defined low publishers to have 0.2 publications per year or less, medium publishers have between 0.2 and 1.0 publications per year, and high publishers have 1.0 or more publications per year. That would equate to five or more publications during the five-year study period of this dissertation.

High Publishers – Results

There were 11 high publishers (2.7% of the 409 graduate sample size) that published five to 17 articles in the five year study range. Eleven of the 41 early publishers became high publishers and all high publishers were also early publishers. The majority (30; 73%) of the early publishers did not become high publishers.

Table 4
Publishing Rates During the Five-Year Period for Graduation Year. Chi-Square Tests of Significance (N = 409), n is Number of Graduates in the Sample

		No Publications		Published	
		n = 289		*n* = 120	
		n	%	*n*	%
Graduation Year [a]					
	1999	58	69.0	26	31.0
	2000	55	67.9	26	32.1
	2001	62	72.1	24	27.9
	2002	58	69.0	26	31.0
	2003	56	75.7	18	24.3

[a] χ^2 (4, N = 409) = 1.49, p = .83

Table 5
Publications per Publishing Graduate in Specific Years Relative to the Graduation Year (Publications per Graduate per Year)

Years After Graduation	Zivney & Bertin (1992)	Hutchinson & Zivney (1995)	Anwar (2004)	Mallette (2006) (Ed.D.)	Mallette (2006) (Ph.D.)
-2	0.04	[a]	0.07	0.05	0.12
-1	0.05	0.24[a]	0.03	0.05	0.25
0	0.12	0.20	0.07	0.17	0.30
+1	0.22	0.36	0.51	0.44	0.39
+2	0.41	0.49	0.51	0.28	0.35

[a]All years prior to graduation were put into one category.

RESULTS FOR RESEARCH QUESTION 2

Research Question 2 asked: Do publishing rates vary by degree type (Ed.D. or Ph.D.)? The null hypothesis 2 (H_o2) stated that *the observed difference in publishing rates between graduates with Ed.D.s and Ph.D.s is the result of chance variations with the random sampling process.* Inspection of Table 6 revealed that 36.7% of the Ph.D.s

published at least one article compared to 13.7% of the Ed.D.s. The chi-square test was significant ($p = .001$) which provided support to reject the null hypothesis (the alpha level for this study was set at $\alpha = .05$). Figure 2 is a bar chart depicting the publishing rates (publications per graduate per year). Reminder: the number in the denominator is published graduates, not total graduates.

This was further reviewed to understand the driving force for this significant result. Of the four campus locations that award both the Ed.D. and Ph.D., the UC Los Angeles campus was most remarkable in the quantity of both degree types (80 each) and the significant difference ($p = .000$) as shown in Table 7. The next paragraphs describe the early publishers and high publishers by degree type.

Early Publishers by Degree Type

There were 41 early publishers – those who published before graduation. Two were Ed.D. graduates and 39 were Ph.D. graduates.

Ed.D. early publishers by degree type. There were two early publishers among the Ed.D. graduates. Both had a single paper published in the two years prior to graduation and none after graduation. The early published papers were their only contribution to the literature within the study range of this dissertation. Neither of the two Ed.D. early publishers became high publishers.

Ph.D. early publishers by degree type. There were 39 early Ph.D. publishers (14% of the Ph.D. graduates). They had from one to four papers published before graduation. Of these 39 early publishers, 17 never published again and 22 (56%) continued publishing and published from one to thirteen publications in their graduation year and the two succeeding years.

High Publishers by Degree Type

There were 11 high publishers – those who had 1.0 or more publications per year.

Ed.D. high publishers by degree type. There were no Ed.D. high publishers, two Ed.D. medium publishers, 16 Ed.D. low publishers, and 113 Ed.D. non publishers. It was found in reading the publications of the two medium publishers that both authors were in non-faculty administrative academic positions (assistant dean and research specialist).

Ph.D. high publishers by degree type. There were 11 Ph.D. high publishers, 49 Ph.D. medium publishers, 42 Ph.D. low publishers, and 139 Ph.D. non publishers.

Publishing Rates by Year and Degree Type

The analysis of publishing rates by year (relative to the graduation year) and degree type was reported in Table 5 in Research Question 1 above and was contrasted with earlier studies. The results for Ed.D. and Ph.D. graduates in this study show an increasing trend through all years, similar to the other studies, except for a decrease in the last year.

The 11 Ph.D. high publishers published from 5 to 17 articles in the five year study range. It was found in reading their publications that all 11 were university-level faculty

There were 11 of the 39 Ph.D. early publishers who became high publishers. All high publishers were also early publishers. The majority (28; 72%) of the early publishers did not become high publishers.

Table 6
Number of Publications per Published Ed.D. and Ph.D. Graduates. Data is for the Five Year Period From Two Years Prior to Graduation to Two Years After Graduation. Chi-Square Tests of Significance (N = 409), n is Number of Graduates in the Sample

		No Publications		Published	
		n = 289		*n* = 120	
		n	%	*n*	%
Degree [a]					
	Ed.D	113	86.3	18	13.7
	Ph.D.	176	63.3	102	36.7

[a] χ^2 (1, N = 409) = 22.62, p = .001.

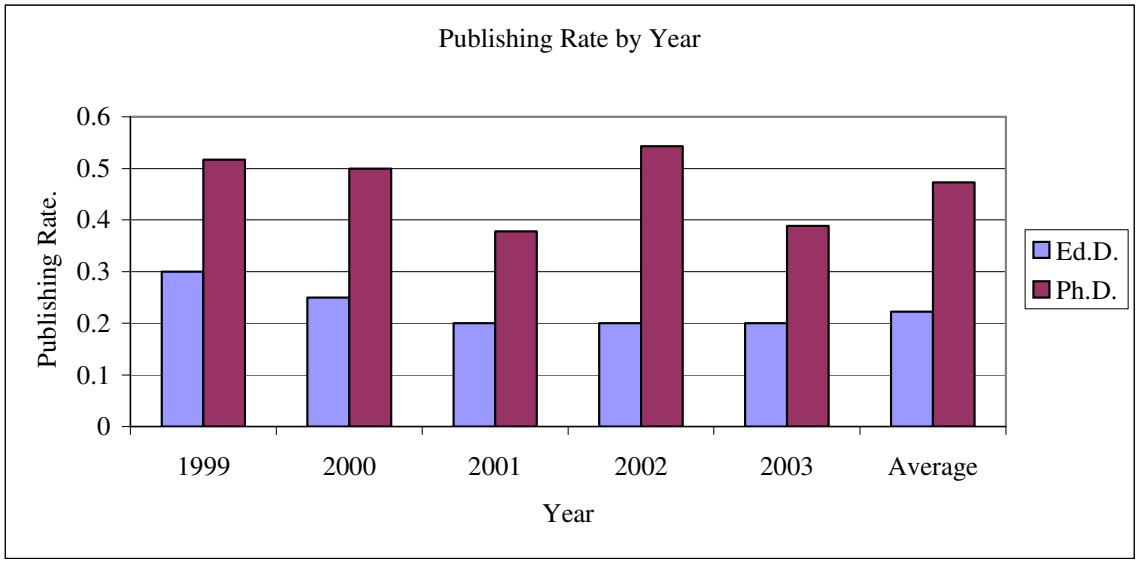

Figure 2. Bar Chart for Number of Publications per Published Ed.D. and Ph.D. Graduates. Data is for the Five Year Period From Two Years Prior to Graduation to Two Years After Graduation.

Table 7
Number of Ed.D. and Ph.D. Graduates by Campus Location. Chi-Square Tests of Significance (N = 409)

Campus of Graduates	Ed.D.	Ph.D.	Pearson Chi-Square (p =)
UC Berkeley [a]	8	95	.218
UC Davis	32	21	.227
UC Irvine	11	8	.636
UC Los Angeles	80	80	.000

[a] It should be noted that five of the dissertations from UC Berkeley were listed as being conferred with UC San Francisco. These five dissertations were listed with the first listed school (UC Berkeley).

DISCUSSION OF RESEARCH QUESTION 1

Research Question 1 asked: What are the overall publishing rates of doctoral students in education over a five year period? The research found 120 (29.3%) of the 409 doctoral graduates published 261 articles in the five year study range for a publishing rate of 0.435 publications per graduate per year.

The null hypothesis for research question 1 (H_o1) stated that the observed difference in publishing rates between graduates from year to year is the result of chance variations with the random sampling process, was not rejected by the use of the Pearson Chi-Square test and no significant differences were found between years (p = .828).

Comparison to Published Research

It was found in the current study that 29.3% of all doctoral graduates publish in the five year study range. This 29.3% publishing level is above the 15% level for education students (Nettles & Millett, 2006, p. 110), similar to the literature graduates in Lee's (2000) study, but is less than the average of 54.8% (Mallette, 2006, p. 38). One possible explanation for the difference is due to the reasons of limitation 4: There may be an undercount due to articles not being in the databases searched by this research. Another possible explanation for the difference is the population differences in the databases. The 54.8% publishing rate is for Ph.D. graduates and this research includes both Ed.D. and Ph.D. graduates. It has been shown that Ed.D. graduates have lower publishing rates as identified by Research Question 2.

Comparison of Early Publishers and High Publishers

It has been reported that 9% to 37% of Ph.D. graduates who eventually published had published prior to graduation (Hutchinson and Zivney, 1995, Zivney and Bertin,

1992, Anwar, 2004). The identification of early publishers is important because Blackburn & Lawrence (1995) state "early publication, including publication before the doctorate, predicts future production rate and total production" (pp. 79-80). This was emphasized by Nettles and Millett's (2006) discussion of predoctoral publications: "the importance of early demonstration of research productivity cannot be overstated" (p. 112).

This study identified 41 graduates to be early publishers (10% of the 409 graduate sample size) and 11 graduates who were high publishers (2.7% of the 409 graduate sample size). They published five to 17 articles in the five year study range. Of the 41 early publishers, about half (19) never published again and 22 continued publishing and published from one to 13 publications in their graduation year and the two succeeding years. The quantity of early publishers found in this study is in agreement with Hutchinson and Zivney, 1995, Zivney and Bertin, and 1992, Anwar, 2004. The majority (30; 73%) of the early publishers did not become high publishers. Although all high publishers were also early publishers, this study found that is not a certainty, nor is it even likely, that "publication before the doctorate, predicts future production rate and total production" (Blackburn & Lawrence, 1995, p. 79-80).

Summary of Discussion of Research Question 1

The research found 120 (29.3%) of the 409 doctoral graduates published 261 articles in the five year study range for a publishing rate of 0.435 publications per graduate per year. The null hypothesis was not rejected indicating there is no significant year-to-year variation ($p = .828$). There were 41 early publishers and 11 high publishers. Although all high publishers were also early publishers, this study found that is not a certainty, nor is it even likely, that "publication before the doctorate, predicts future production rate and total production" (Blackburn & Lawrence, 1995, p. 79-80).

DISCUSSION OF RESEARCH QUESTION 2

Research Question 2 asked: Do publishing rates vary by degree type (Ed.D. or Ph.D.)? The research found 18 (13.7%) of the 131 Ed.D. graduates published 20 articles in the five-year study range for a publishing rate of 0.222 publications per graduate per year. The research found 102 (36.7%) of the 278 Ph.D. graduates published 241 articles in the five year study range for a publishing rate of 0.472 publications per graduate per year. Note: the graduates in the denominator are *published* graduates, not all graduates.

The null hypothesis for Research Question 2 (H_o2) stated that *the observed difference in publishing rates between graduates with Ed.D.s and Ph.D.s is the result of chance variations with the random sampling process* was rejected by the use of the Pearson Chi-Square test ($p = .001$), indicating a significant difference in publishing rates between Ed.D. and Ph.D. graduates.

The analysis of publishing rate by year (relative to the graduation year) was reported in Table 5 and contrasted with earlier studies. The results for Ed.D. and Ph.D. graduates in this study show an increasing trend through all years, similar to the other studies, except for a decrease in the last year. One possible explanation for the decrease in the last year may be due to a delay in indexing some journals, and all the 2005 publications may not have been indexed at the time of the study. This will downwardly

skew the publishing rate statistics in 2005 (only) as compared to earlier years. One might propose a second possible explanation: there may be an undercount due to publications that are not in the database. This is possible, but unlikely because the publishing rates associated with this study are higher for the first three years of this study, but are in-line with the previous studies in last two years. The next paragraphs compare the high publishers and early publishers by degree type.

Comparison of Early Publishers and High Publishers by Degree Type

This study identified two Ed.D. early publishers, 39 Ph.D early publishers, no Ed.D. high publishers and 11 Ph.D. high publishers. The study also found that two Ed.D. graduates (1.5% of all Ed.D. graduates) and 39 Ph.D. graduates (14% of all Ph.D. graduates) who eventually published had published before graduation. The Ph.D. value of 14% is in the range of findings of Hutchinson and Zivney (1995), Zivney and Bertin (1992), and Anwar (2004). As Nettles and Millett (2006) declared: "what is surprising and somewhat novel is the growing expectation that students publish while they are in the process of pursuing their doctoral degrees" (p. 104); this researcher was also surprised to find that 41 (34%) of the 120 published graduates were also early publishers.

Neither of the two Ed.D. early publishers became high publishers, but 11 of the 39 Ph.D. early publishers became high publishers. All high publishers were also early publishers. All the Ed.D. early publishers and the majority (28; 72%) of the Ph.D. early publishers did not become high publishers. This further confirms the finding in Research Question 1 that it is not a certainty, nor is it even likely, that "publication before the doctorate, predicts future production rate and total production" (Blackburn & Lawrence, 1995, p. 79-80).

It was found in reading their publications that both Ed.D. medium publishers were in administrative positions (assistant dean and research specialist) in academic settings and all 11 Ph.D. high publishers were university-level faculty. This finding supports Archbold's (1991) premise that "individuals who aspire to scholarly (e.g., faculty) positions will usually seek the Ph.D., while individuals who choose to pursue professional jobs will seek the Ed.D. more frequently" (p. 82) and Golde and Walker's (2006) statement that "the Ed.D. aims to prepare managerial and administrative leadership in education …. [and the] Ph.D. … aims to prepare researchers, college teachers and scholars in education" (p. 247).

Rieger (1990) found that "there was no statistically significant difference between high knowledge producers [greater number of publications] and low knowledge producers holding the Ph.D. and the Ed.D." (Rieger, 1990, p. 1). Brown (1990) stated that "students pursuing the Ed.D. do not differ greatly from Ph.D. students in their evaluation of the contextual and structural features of their doctoral study to any significant extent" (p. 15). Another study found there was very little difference between, the two types of degrees, but the Ph.D. dissertations were more likely to use high level statistics (Nelson & Coorough, 1994).

In contrast to Rieger (1990), Brown (1990), and Nelson and Coorough (1994) who found no differences in the areas they studied, this study shows a significant difference ($p = .001$) between Ed.D. and Ph.D. graduates in the area of scholarly publishing.

Summary of Discussion of Research Question 2

The null hypothesis was rejected by the use of the Pearson Chi-Square test (p = .001), indicating a significant difference in publishing rates between Ed.D. and Ph.D. graduates. There were two Ed.D. and 39 Ph.D. early publishers. There were zero Ed.D and 11 Ph.D. high publishers and all high publishers were also early publishers. It was also found that the 11 Ph.D. high publishers were all university-level faculty and the two Ed.D. highest publishers were in non-faculty administrative positions supporting the thought that the Ed.D. degree is more broadly focused and applied and the Ph.D. degree is more narrowly focused and research oriented.

EDUCATIONAL IMPORTANCE

This study provided the first opportunity to compare the publishing rates of Ed.D. and Ph.D. degrees in the same large school system. This study investigated how many individual doctoral students publish to communicate research done in their dissertations. The study fills an unresearched niche in the body of knowledge on publishing trends. Additionally, this research may lead other researchers and administrators to consider curriculum adjustments that would encourage more broadly disseminating dissertation research.

SUMMARY

This study investigated the publishing rates for Ed.D. and education Ph.D. graduates from 1999 to 2003 in the University of California school system as a function of degree type and campus location. Random sampling resulted in 409 archival records from a dissertation database. A set of multi-journal databases were searched for publications by the authors of those 409 records, published within plus-or-minus (+/-2) years of their graduation year. This study provided the first opportunity to compare the publishing rates of Ed.D. and Ph.D. degrees in the same large school system.

There were twice the number of Ph.D. graduates (68.0%) compared to Ed.D. graduates (32.0%). The research found 120 (29.3%) of the 409 doctoral graduates published 261 articles in the five year study range for a publishing rate of 0.435 publications per graduate per year. The null hypothesis was not rejected indicating there is no significant year-to-year variation (p = .828). There were 41 early publishers and 11 high publishers. Although all high publishers were also early publishers, this study found that is not a certainty, nor is it even likely, that "publication before the doctorate, predicts future production rate and total production" (Blackburn & Lawrence, 1995, p. 79-80). In comparing the publishing rates of Ed.D. and Ph.D. graduates, the null hypothesis was rejected, indicating a significant difference in publishing rates between Ed.D. and Ph.D. graduates. A moderate association existed (V = .234, p = .001, α = .05) indicating that Ph.D. graduates have a higher publishing rate than Ed.D. graduates.There were two Ed.D. and 39 Ph.D. early publishers. There were zero Ed.D and 11 Ph.D. high publishers and all high publishers were also early publishers. It was also found that the 11 Ph.D. high publishers were all university-level faculty and the two Ed.D. highest publishers were in non-faculty administrative positions supporting the thought that the Ed.D. degree is more

broadly focused and applied and the Ph.D. degree is more narrowly focused and research oriented.

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Supporting Teacher Professional Identity through Mentoring Activities

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Abstract

Enhancing a teacher's professional identity is a potential solution to the drift and disconnection experienced by many teachers during their career. The rational in this study is that mid-career teacher leadership involvement in a multi-experienced professional cohort presenting and attending together at a conference is one way to increase their professional identity. The potential of an enhanced sense of professional identity through self-awareness of their mastery experiences, collaborative skills and teacher leadership is that it may impact a mid-career teacher's connection to the profession, resulting in a renewal of commitment to teaching. This research is grounded in both social learning theory and social cognitive theory.

Keywords

Professional identity, mentoring, professional learning, cohorts, collaboration.

Introduction

The enhancement to the professional identity of a teacher placed in a leadership role is accomplished through both formal and informal activities. Through these experiences teachers recognize that they are members of an active community of evaluative dialogue where ideas, methods and experiences are shared, and in so doing that they have special expertise in the profession and are able to share that knowledge. This interaction creates a process through which an active participant constructs personal knowledge, skill, and values directly from an experience within the environment. Self-realization occurs when carefully chosen experiences are supported by self and group reflection, critical analysis, and synthesis. Experiences are structured to require the learner to take initiative, make decisions, and be accountable for the results. The outcome is personal and self constructed, preparing for and leading to future experiences and personal recognitions. Relationships are developed and nurtured. Experiences may result in success, failure, adventure, risk-taking and uncertainty, since the outcome cannot be totally predictable. Everyone involved has their own perspective on a situation and event and these perspectives influence understanding and action. Lave and Wenger (1991) suggest that individuals learn as they participate by interacting with the community, its history, assumptions and cultural values, rules, and patterns of relationship; the tools at hand, including objects, technology, language and images; the moment's activity, its purposes, norms, the practical challenges. Shared knowledge emerges from the interaction of these elements. The interactions and shared experiences result in what Davis and Sumara (1997) refer to as a `commingling of consciousness'. As each participates the relational space among them all changes. This is `mutual

specification' (Varela, Thomas, and Rosch, 1991), the fundamental dynamic of systems engaging in mutual action and interaction.

Activities that involve professionals in open and dynamic discussion, mutual problem solving and/or collaborative learning draw the participants into a community of learners (or what we refer to as a professional cohort) and contribute to an understanding of both theirs and the group's capabilities. Thus it is suggested that teachers who participate together in meaningful and purposeful ways are more likely to remain in the profession because they feel valued and supported in their work (Beane 1998; Barth 1999). A variety of studies have also found clear evidence of the positive effect of professional experiences on teachers' self-efficacy and level of morale (Little, 1995). These developed and then self-recognized qualities and behaviors are what define teacher leaders (Alverdo, 1997; Crowther, 1997; O'Hair and Reitzug, 1997; Paulu and Winters. 1998; Wynne, 2001). Indicators of these qualities are listed in the following Table 1.

Table 1 - Teacher as Leader

Self Awareness	Social Skills	Social Awareness	Self Management
• Professional who makes a difference	• Encourages professional sharing	• Creates a sense of community	• Tolerant and reasonable
• Strong understanding of teaching and learning	• Willing and able to change	• Seeks professional opportunities for self and others	• Manages time and pressure in difficult situations
• Value teaching as an important profession	• Acts on opportunities for others	• Supports all teachers for positive student gain	• No-blame attitude for others

Adapted from Crowther et al, 2002

Mentoring of young teachers provides an opportunity to develop and model teacher leadership concepts. The more experienced teachers serve as a role model, encouraging, counseling, and befriending less experienced teachers for the purpose of promoting both groups professional and personal development.

Assessing the Impacts

This research is grounded in both social learning theory and social cognitive theory. The approach to leadership being developed is transformational leadership that emphasizes the significance of the person and personal traits in bringing about social and cultural change. The project was designed to develop an enhanced professional sense of self in both the mentor and those mentored. Two domains composed this evaluation aspect. (a). The effects of informal experiential activities on a teacher's sense of professional self, and (b). The effects of participating as a mentor in this cohort on their sense of professional self as a leader. The assessment utilized a multi-method design that focused on teacher's attitudes on professionalism —Likert-type questionnaires, in combination with interviews were used (Peterson, Fennema, Carpenter & Loef 1989). The feeling was that this comprehensive approach to assessment would be more likely to capture the complex aspects of the teachers sense of professional self and whether this

had been accomplished by the project activities and being part of a cohort. Kagen (1990) supports this position.

The Experiential Setting

The University of Colorado at Denver and Health Sciences Center, School of Education & Human Development Mentoring Project is a leadership program that connected first and second year science teachers with experienced science teachers in presenting at the National Science Teachers Association Conference in Anaheim, CA. The purpose of the project was to positively impact both teacher groups' sense of professional self. Five UCDHSC science workshops were accepted for presentation at the conference. Each had a team of 2-3 experienced teachers and 4-5 early career teachers, along with a number of university faculty assigned to each workshop. All participated in the planning and presentation. Table 2 lists the session titles, a brief description of each session and the presentation team makeup.

Table 2 - NSTA Presentations at Anaheim, Spring 2006

Session Title	Session Description	1-2 year teachers *	Experienced Teachers*	University Mentors *
Legal Issues Surrounding the Teaching of Science	Presented a workshop on the legal issues surrounding the teaching of science.	3	2	2
Student Inquiry Activities with Dinosaurs and Other Fossil Life	Explored methods for student inquiry into prehistoric life and ancient environments. Includes hands-on workshop using fossil mold making, dinosaur track and environmental interpretation of sediment activities.	4	6	4
Building Understanding Through a series of Connected Activities	Participants did a series of connected inquiry activities using flowers to demonstrating a method that moves students from base knowledge to more complex understandings.	4	6	3
Adventure Engineering: Exciting Students with Real	Explored an inquiry-based resource that allows students to solve real world problems	3	2	2

World Scenarios	in the context of volcanoes, asteroids, the rainforest and the biosphere.			
Environmental Literacy: Bridging the Science and Social Studies Education	Guided teachers to understand how to bridge curriculum standards and how to develop lessons and units that move children from awareness to citizenship.	4	2	2

* Some members of the group (28 total) participated in multiple workshops.

Expectations were that the new and experienced teacher groups would become more professionally connected through both the presentation and attendance at the conference as a community of practice. To assess this impact the study utilized a pre-assessment of expectations, a journal during the conference and a new technology: digital storytelling as a way for the teachers to tell their personal story of the experience after the event. Digital storytelling is commonly used to introduce, such as the professional story of an online course instructor or to stimulate a topic discussion. The stories were used as an assessment of the experience's impact on the teachers self efficacy. A coding lens was developed with which to evaluate the stories to compare common themes highlighted by the teachers. Triangulation of the digital story data with the other more traditional survey and interview assessment tools was done to determine individual professional impacts.

The National Science Teachers Association National Conference is the largest professional conference in the U.S. Eighteen thousand science teachers attended. It was expected that involving new teachers with the teachers at this conference in a professional way (presenting workshops) would positively impact their sense of self and belief that they belong in this profession. Science teacher attrition rates in the first three years teaching are listed in a number of Federal reports as high as 30%. This number is even higher for urban school science teachers that make up the majority of teachers participating in this project. For the more experienced teachers in this cohort, teacher leadership in the form of mentoring is a potential solution to the drift and disconnection experienced by many teachers during their career. One rational for this study is that mid-career teacher leadership involvement in a multi-experienced professional cohort presenting and attending together at a conference is one way to increase their professional identity and generate a higher degree of engagement in the profession. The digital stories that we asked the teachers to complete created a kind of conversation that promoted teacher self-understanding and differs from usual modes of teacher reflection. We anticipated that for the teachers the process would be more important than the product, bringing deeper understanding of self and the experience to the surface, recognizing that they are part of a worthy profession with significant impact, not just holding a job. Being around thousands of excited science teachers from across the U.S. as well as part of a

stimulating learning community from their local schools would be the seed for this realization.

The teachers were taught the digital story technology prior to attending the conference, kept a journal at the conference and convert it to digital stories upon return. Each participated in a presentation of their stories at a group gathering to further embed the experience. Digital stories ranged in length from 3-5 minutes. In addition teachers filled out a number of pre surveys, concerning their conference expectations, which in the attending group they knew and in what context and how they viewed themselves professionally. Eight of the teachers in the project were considered experienced teachers. Data connected to these eight was evaluated in this study. The combination of these data sources developed the following observations and conclusions.

Method

The first step was to determine what themes relating to teacher leadership development were present in the data sources. Drawing from a constant comparative approach, data sources were coded sequentially, using emerging codes (with an eye toward indicators of professional leadership) arising from open coding. As each new data source was examined, new codes were added to the master code list. This method was used to develop five significant codes matching teacher comments derived from a number of sources. These include: a pre-conference expectations survey, a journal developed at the conference and a digital story completed after the conference. The developed codes are:

- Sense of connection with the profession
- Sense of connection to individuals
- Value of socializing at the conference
- Value of participating in the sessions
- Personal significance of the overall experience

An analysis of the coded statements utilized a framework using the three levels of reflection identified by Surbeck, Han, and Moyer (1991): (a) reacting – commenting on feelings towards the learning experience, such as reacting with a personal concern about an event; (b) elaborating – comparing reactions with other experiences, such as referring to a general principle, a theory, or a moral or philosophical position; and (c) contemplating - focusing on constructive personal insights or on problems or difficulties. Occurrences of codes were tabulated and combined from artifacts of each individual through axial coding.

To assign a level or degree of reflection to individual thoughts or chains of thought from the artifacts, each coded entry was situated within the reflection framework. Occurrences of reflection levels were tabulated and normed as a percentage of total entries for each artifact. Then, to determine which elements of professional identity were reflected upon most deeply, themes derived from the first process were grouped according to their occurrences at the three reflection levels. Codes falling into level 2 or 3 indicated a level of reflection considered to be impacting their professional identity.

Finally, data were summarized for each of the experienced teachers, by answering the following questions:

1. Did journal and digital story reflections build on pre-conference descriptions of the teacher's professional self?
2. What evidence exists to indicate a more developed sense of professional self as a teacher?
3. What evidence exists to indicate a more developed sense of professional self as a teacher leader?
4. What evidence exists to indicate a more developed sense of connection to the teaching profession or to other teachers in the cohort?

Results

The following Table 3 displays the coded data results and examples of the statements drawn from both the digital stories and the teacher journals.

Table 3 - Coded Data Observations

Five Significant Codes	Framework Match	Examples of statements
Sense of connection with the profession 197 total statements	23% were at level 1 56% were at level 2 21% were at level 3	"Last year I was ready to quit. Now I feel good to call myself a teacher again." "This conference rejuvenated me- and my career. Seeing all those incredibly smart people and all the cool things they are doing in their classrooms." "What I enjoyed most was simply being around educators like myself." "One of the best parts of this volunteer experience was the look of surprise on the faces of colleagues as they approached the exhibition hall and saw Susan and I behind the counter. Priceless!"
Sense of connection to individuals 111 total statements	67% at level 1 18% at level 2 15% at level 3	"I had a great time getting to know all the coworkers" "I'm late for my next session and my two new friends are going to it also." "I had met everyone before, but felt like I knew them a lot better after this trip" "Saying goodbye to everyone is hard but knowing that I will soon be seeing them again keeps it sane."
Value of socializing at the conference 78 total statements	65% at level 1 19% at level 2 16% at	"It was nice socializing when we went to the Prentice Hall party. We are planning on adopting their textbooks this year and this was a good connection for the district." "We spent a couple of hours hanging out, having a few drinks and getting to know each other better. Almost every one ended

	level 3	up there so again we connected which I felt was lacking throughout the conference." "Elizabeth and I went to gather up some others that were worried about their presentation and still working on it. We chased them out of their room for a few hours and hopefully they had some fun and some relief from the stress of their presentation."
Value of participating in the sessions 154 total statements	12% at level 1 70% at level 2 18% at level 3	"I don't want to go out there and not be prepared, not have a quality session" "Cynthia was at my table and I could see that she was uneasy at first. I assisted her and she did great." "Watching the young teachers prepare for their session amazed me, they so badly wanted to do well, and they did!" "I found myself thinking how I could present at a future conference by myself."
Personal significance of the overall experience 144 total statements	12% at level 1 65% at level 2 23% at level 3	"I'm still flying from yesterdays sessions. We go see Bill Nye speaking- has me hook, line and sinker." "The new teachers were so excited to meet Bill Nye. It was wonderful to watch them as they approached and asked him for a signed picture" "The collegial spirit of teaching is not found in all professions and is something that I value."

For most of the experienced teachers- 88% (level 2-3) participation in the project was an important opportunity for them to participate in beginning teacher's success and learning. All eight mentioned a number of times in the data the importance of enculturation of the new teachers into the profession. Commonly mentioned was their sense of leadership or being on the "road to leadership.' Although extracurricular socialization was mentioned as important to the enculturation process by most of the experienced teachers- 35% (level 2-3) there was disagreement on how important or whether it should be deliberate socialization or spontaneous. The use of digital stories to reflect on the experience proved valuable, not only as a tool for our evaluation but also for the teacher's sense of the value of the experience. As one teacher noted when writing about viewing the stories " I see the same passion for education in others eyes as I do when I look in the mirror." Another said, "I feel more connected and part of a community." Evidence suggests that for at least- 77% (level 2-3) experienced teachers the culminating experience of the project did lead to feelings of being connected to a worthy profession and a belief that they had something to share with the novice teachers. Although one seem to feel disconnected with the younger teachers she mentioned her

own “shyness as a cause of this disconnect” and if she “had more time with the group she likely would have become more involved.” With this said she went on to recognize the importance of the experience for herself and how it rejuvenated her career.

Analysis of the pre-connection data indicated the relational space among most of them changed. The multiple data evidence support this change. Teachers that did not know each other prior to the conference or had little prior contact became colleagues and spoke of future collaboration. Some of them have submitted joint proposals for next years NSTA Conference. Individual’s names appeared in the journals and digital stories that had no pre conference connection. These connections did not follow any experienced or inexperienced trend but rather a mix of experience. The expansion of one’s professional circle is a necessary support in the recognitions of one’s place in the profession.

Conclusions

According to Sergiovanni, Kelleher, McCarthy, and Wirt (2004), "Success involves learning and cultivating relationships, building the capacity of teachers, figuring out better pathways to success, and providing the support teachers need to come together as communities of practice."

Professional growth requires that teachers engage in intellectual work in various informal settings other than the classroom. The potential in these experiences is an enhanced sense of professional identity through self-awareness in mentoring experiences and collaborative opportunities which impacting a mid-career teacher’s motivation and persistence.

Typically, evaluation of a professional development activity such as this one is completed at the end of the activity. The evaluation usually is restricted to the participant's initial reaction to the experience. Although assessing these factors has value, the most important factor is the long-term impact of the professional development activity. An on-going connection with this group of educators that provides them additional opportunities to collaborate is necessary in assessing real changes in their professional sense of self, changes in their professional culture (such as increased collaboration and a feeling of connection), and sense that they can have an impact on the professional as a whole. Therefore this research is not ended only beginning.

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Curriculum Analysis and Development for Advanced Foods and Catering Operations: A Study of Facilities and Resources in an Undergraduate Hospitality Class

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Abstract

The purpose of this study is to analyze curriculum development, hospitality curricula structures and planning for an advanced foods and catering course taught at the undergraduate level. The research presented here are the results of a descriptive study on using a commercial facility to educate undergraduate students in the curriculum areas of advanced foods and catering operations. Theoretical analysis, document analysis, focus groups, in-depth discussion, on-line technology, and questionnaire investigation were implemented as a means of data collection for the research study. In the educational system, the combination of hospitality and food based education is a field with a short history of development but fast increasing subjects and departments. With the attributes of integrated applied science, business management, and culinary arts, this type of modern instruction has developed into a highly variable and divergent form of education. In this context, identification of student needs and industry needs lead logically to the establishment of more sector specific forms of education with assurance of learning being based on training skill standards and the involvement of industry in academic curriculum design. The major findings of this research will provide a basis for curriculum development in advanced foods courses and commercial facilities education management.

Keywords: Hospitality, Curriculum development, advanced foods courses, On-site education, Assurance of learning.

Introduction

In the educational system, hospitality and tourism is a relatively new field of study with a short history of development. This study includes a history of the discipline, the guidelines for accreditation, and an analysis of a newly developed, implemented, and successful program at Robert Morris University. Assistant Professor Richard J. Mills, Ph. D., Professor Denis P. Rudd, Ed. D. and Professor Mark Eschenfelder, Ph. D., have coordinated this important study for Robert Morris University. The course includes: professional hands-on objectives, synthesized knowledge in demonstrated abilities, and skills that were actively engaged in food based laboratory experiences.

Curriculum development in the hospitality industry

The success of a hospitality program is dependent on many variables; program growth and program development are essential. The curriculum development is guided by the needs and demands of the hospitality industry. Deanne Williams states that the curriculum is viewed as an academic plan that includes decisions about what, why, and how a specific group expects to learn (Stark & Luttaca, 1996). Stark and Lattuca (1996) further define the curriculum within the college or university organization as a micro-plan subject to the broader influences exerted within the academic unit; the university or college from the outside community. Public views interact with student characteristics to form the basis of the educational environment for curriculum planning.

Jeou-Shyan Horng (2004) discusses the developmental trends, hospitality curricula structures and strategies in the development of food and beverage management of the vocational and technological educational system in Taiwan. It is interesting to note that hospitality education in Taiwan faces the same set of criteria of other universities and colleges in the United States. The university programs are relatively new to the university and the vocational and technological programs are growing rapidly. Horng states that hospitality management as been part of the curriculum since 1965, but the growth rate was slow before 1995 (Horng, 2004). Horng further added that, "The establishment of a department's curriculum should combine a complete system of knowledge and skills, and curriculum structure should have appropriate horizontal and vertical connections to fulfill the functions of career readiness" (Horng, 2004).

Cousins and Foskett discussed in their 1988 article. They consider food production operations in the hospitality industry which can also be used as a basis for comparison with production operations outside the catering industry (Cousins & Foskett, 1988). The emphasis within the program ensures that students engaged in hospitality courses should not perceive operations as different and separate from management itself. By thinking outside the hospitality industry, the students' focus is broadened within the hospitality field. Cousins and Foskett (1988) also discuss food and beverage service and food production. They claim that food and beverage operations teaching at Eating College should include processing of materials and service with the management of the customer experience. They also conclude that production methods have different sets of skills, knowledge, tasks and duties associated with them (Cousins & Foskett, 1988).

Food and beverage service is approached by traditional application: preparing for service, service, clearing, dish washing, etc. The service process may be seen in two ways: either the traditionally operational point of view or from the customer experience (process) point of view. Eating has adopted the customer experience or process point of view. The operational sequences as a basis for skill, knowledge, tasks and duty teaching, is related to the customer process; the commonality of skills is readily identified; 90% of all tasks and duties required in food and beverage service are contained within one service group. The intention is to develop an awareness of customer process and the range of operational options to the provider of food and beverage service.

Cousins and Foskett (1988) also include *Food Production* in their curriculum at Eating College. Eight production methods are identified and their model shows the basic flow of materials through the system. They include: Food, Storage, Preparation,

Cooking, Holding, Regeneration, and Presentation. The *Food* method separates the different foods to include: fresh, fresh cooked, fresh prepared, canned, frozen, chilled vacuum, dehydrated, smoked, salted, crystallized, acidified, pasteurized, bottled, and UHT. *Storage* distinguishes between ambient, cool, refrigerated, deep frozen, and dry storage. *Cooking* teaches blanch, warm, simmer, boil, steam, grill sauté, brown, bake, roast, broil, fry, and microwave. *Holding* demonstrates chill, vacuum, freeze, tray, hot cupboard, cold cupboard, insulated, ambient. *Regeneration* includes regithermic, microwave, convection, and traditional. *Presentation* includes Bain-marie, service flats, plates, trays, vending, buffet, trolley, dishes, and *Timbale* (p. 79). This model is appropriate for the teaching of food skills within a laboratory.

Horng (2004) discusses European hospitality education and its focus on technical training from masters to apprentices in an industrial perspective. The academic and educational systems have been developed within the last 10 to 20 years. Horng (2004) says that Switzerland's educational process has always been practice-oriented, emphasized quality and the development of core professional capabilities, social abilities and communication skills, co-opted closely with industries. This enables students to better obtain employment with the international community. Horng also discusses Australia's educational system that incorporates both North America and European standards; the teaching experience is transitioned from high school to college and for accreditation to be established, competency standards must be achieved (Horng, 2004).

Stark and Lattuca (1996) say that when courses are arranged in a sequence to integrate material within a field appropriately, the result is a holistic view of the discipline. The curriculum is divided into two dimensions to achieve and encourage coherence and involve more than one discipline; commonality in which similar curriculum units and temporality, curricular units in time sequence are utilized to complete the process. Stark and Lattuca include eight tests that are useful in evaluating the quality of higher education systems according to Moreo (1983):

- The quality of scholarship in international competition
- The ability to secure talent from the total population without regard to class or racial considerations.
- The provision of technically trained persons to fill the needs of industry, agriculture, government and welfare services.
- The provision of an opportunity for a liberal education.
- The quality and balance of service.
- The quality and balance of constructive criticism of society.
- The effectiveness of the governance of higher education.
- The degree of popular support for higher education generally and from its alumni in particular (Stark & Lattuca, 1996).

Hospitality and Tourism education is relatively new in the academic arena. It is often incorporated into other departments for further study within a relevant framework. Accredited programs usually fall within three categories: The School of Business, Dietetics and Nutrition, and Culinary Arts. Deanne Williams discusses the first formal program in the United States, which was an outgrowth of the efforts of the American Hotel Association following World War I in the 1920s (Stark & Lattuca, 1996). This resulted in Cornell University, the "Ivy League" of Hospitality programs. Following

Cornell University, other schools began offering similar programs to adapt to the rapid growth and the continually evolving nature of the industry (Riegel & Dallas, 1993). The curriculum in these universities normally requires a body of work comprehensive to both academia and industry. This philosophy seems to be adopted by universities, colleges, and other affiliated and accredited culinary schools. According to Riegel and Dallas (1993), career education programs have developed rapidly, but not necessarily uniformally; colleges and universities often respond to demand for new programs by building onto existing programs. As a result, career programs like hospitality and tourism management courses differ from traditional courses within the same educational environment (Riegel & Dallas, 1993). The subject of Riegel and Dallas' theory (1993) about relationships between work values and career commitment entails a relationship to longevity, turnover rates and career success. Substantive knowledge is key to the practice of the profession; it is necessary to apply knowledge to the field of work. The values necessary for success in the field are the subject of student preparation for the workplace. Jeanne Meister (1998) identified seven core workplace competencies:

- Learning to learn
- Creative thinking and problem solving
- Technological literacy
- Global business literacy
- Communication and collaboration
- Leadership development
- Career self-management

These competencies are defined as the accumulation of skills, knowledge, and knowing "how" to outperform the competition; Meister concludes that they form the foundation of individual employability (Meister, 1998).

Williams discusses Hospitality Management Curriculum Design; Craft/skill approach; Tourism approach; Foods and home economics approach; Business administration approach; and Combined approach (Williams, 2005).

In the *Hospitality Management Curriculum approach*, there are four groups: autonomous, business housed, home economics housed, and other housed (Moreo, 1983). Riegel and Dallas (1993) also wrote that most hospitality and tourism programs consist of four main areas: the major, general education and advanced learning skills, electives, and work experience. *Craft/skill* programs require students to acquire technical operation skills and take the "nuts and bolts" approach to the field; this approach is common to a four year hospitality management program. *Tourism approach* programs primarily focus on content of tourism and concepts trends of economic impact and many social sciences which contribute to the tourism field such as economics. *Foods and home economics approach* includes hospitality programs housed or started in colleges of home economics. Heavy emphasis is placed on food science, nutrition, food production and delivery systems, and natural and social science. Principles of management and administration are also emphasized. *Business administration approach* includes programs housed in colleges or schools of business administration and less attention to products such as food or rooms. *Combined approach* incorporates programs that may fit into business administration approach combined with home economics approach. This approach is common to independent schools and colleges.

Accreditation Commission for Programs in Hospitality Administration (ACPHA) established specific objectives for areas of the accreditation process of a hospitality management program listed below (ACPHA Handbook of Accreditation, 1994):

- To assure that the curriculum is based on those knowledge components, skills, values, and attitudes that the community of interest has identified as essential for the graduates of the hospitality program to function as a responsible practitioner, citizen and person.
- To assure that curricular offerings are developed regularly reviewed, and evaluated in terms of their effectiveness in achieving programmatic objectives.
- To assure that effective means of assessing learning outcomes have been developed.
- To ensure that the curriculum includes an appropriate mix of theoretical and applied experience for achieving the educational objectives. The specific standards for the common body of knowledge are in curriculum standard #3b listed below:
    1. Historical overview of the hospitality industry and the profession.
    2. The marketing of hospitality goods and services.
    3. The operations relative to the provision of hospitality goods and or services, including food service management and or lodging management and related services.
    4. Accounting procedures/practices.
    5. Financial management.
    6. The economic environment of profit and non-profit organizations.
    7. The legal environment of profit and non profit organizations.
    8. Ethical considerations and sociopolitical influences affecting organizations.
    9. Quantitative methods and management information systems, including computer applications.
    10. The planning for and utilization and management of personnel, including the improvement of student understanding of human behavior.
    11. Organization theory and behavior and interpersonal communications.
    12. Administrative processes, including the integration of an analysis and policy determination at the overall management level.
    13. Provision of sufficient areas of specialization to allow students to develop individual interests and talents.

Assessment of student learning: Why

In 2006, a commission appointed by Secretary of Education, Margaret Spelling, examined the future of higher education in the United States (U. S. Department of Education, 2006). Among the issues the Commission was charged to examine was transparency and accountability in higher education. The Commission recommended, "Student achievement … must be measured by institutions on a 'value-added' basis that takes into account students' academic baseline when assessing results" (U. S. Department of Education, 2006). The Commission further recommended this information be made public to provide stakeholders with an additional tool to compare institutional effectiveness. The Commission suggests, "Accreditation agencies should make

performance outcomes, including … student learning, the core of their assessment as a priority over inputs or processes (U. S. Department of Education, 2006).

The Commission's recommendations about transparency and accountability and accreditation are not new to higher education, but provide additional impetus to an existing trend. Regional and specialty accreditation agencies have been placing more importance on assessment of student learning over the past twenty years (Mundhenk, 2005). The driving force behind the increased emphasis on student learning in the accreditation process has been the desire of accreditation agencies to keep their autonomy from government interference.

The federal government has largely allowed accreditation agencies to act as the arbitrators of what constitutes acceptable performance levels for colleges and universities. Given public concern over the outcomes of post secondary education, the federal government has become increasingly concerned about the assessment of student learning as an indicator of institutional quality. If accreditation agencies do what the federal government wants in assuring the quality of higher education, by assessing student learning, the federal government has less reason to become involved in evaluating the quality of colleges and universities.

The Commission's report and the general trend toward assessing student learning have not been without criticism. William Tierney (2006) of the Center for Higher Education Policy Analysis at the University of Southern California, in a review of the report, is concerned about the Commission ignoring important aspects of higher education by focusing on higher education's function of preparing students for the workplace. While this criticism may resonate with many in academics, acting on the criticism will be restrained by the potential consequences of failing to act on the Commission's recommendations. The possibility of "No College Left Behind" legislation is a specter likely to evoke continued actions on the part of accreditation agencies and therefore, colleges and universities (Hersch, 2007).

The willingness of accreditation agencies to focus on assessment of student learning is exemplified by the actions of the Association to Advance Collegiate Schools of Business (AACSB). AACSB, an international leader in management education, has made assessment of student learning a significant factor in its accreditation process. Martel and Calderon (2005) writing in an AACSB publication define assessment as a "continuous, systematic process, the goal of which is to improve the quality of student learning" (p 2).

Assessment of student learning: How

A useful step in improving student learning is deciding what students need to learn. Specifying what students need to learn in the form of measurable learning goals and objectives provides a yardstick that can be used to measure student achievement in a manner that facilitates efforts to improve student learning. Once measurable learning goals and objectives have been established, a variety of techniques may be effectively used to assess student achievement.

Two basic approaches to the assessment of student learning are formative and summative assessment (Suskie, 2004). Formative assessment focuses on measuring student learning while it is occurring so mid –course adjustments may be made to

improve student learning outcomes (Suskie, 2004). Summative assessment focuses on the extent to which students have met learning goals at the completion of a course or program (Suskie, 2004).

Both formative and summative assessment may be done at the course level. An example of a formative assessment tool useful at the course level is minute papers. At the end of a class period an instructor asks the students a question related to a learning objective and tied to the day's class. The instructor reviews the students' responses and adjusts the next class based on the information. Summative assessment measures include "Score gains between entry and exit on published or local tests or writing assignments" (Suskie, 2004). The results of summative assessments can be used to make informed curricular and course changes to improve student learning.

Innovative trends in teaching advanced food and catering courses in an undergraduate curriculum setting

In the spring of 2006, Robert Morris University undergraduate Hospitality and Tourism Program made the decision to create an innovative style of teaching its foods based courses. The goal was to teach in a new environment while attempting to meet course goals and student assurance of learning. A variety of tests and written assignments regarding cuisine choice and recipe development were assigned. In addition, a questionnaire was distributed at the end of the spring semester Advanced Foods and Catering course. Both formative assessment and summative assessment were implemented. Assistant Professor, Richard J. Mills, who is also a certified sous chef, designed and implemented a program surrounding the two required food based courses at the university. Both courses meet the accreditation requirements under the guidelines previously described. The first course, Quantity Food Production, is designed to teach students how to take basic recipes that are traditionally prepared for one and transfer the recipes to quantity production format. The second, Advanced Foods and Catering Operations, was designed to show the student how different cultural cuisines are adapted and applied to a commercial hotel catering facility.

The decision was made by the department to take the courses and move the classroom off the campus to local country clubs and hotel properties to teach basic culinary production. With this initiative, the first course was taught at Montour Heights Country Club, approximately three miles from the university. The first obstacle was to transfer the students from the campus to the country club; this was achieved by asking students in their first class meeting, to assemble as groups and car-pool to the facility. This provided no problems; in fact, it created a more cohesive environment for the class based on cooperation between students scheduling and class room laboratory hours.

The second obstacle was to adapt the students from the classroom to a working environment in a commercial kitchen. At first, this teaching activity was a challenge because of the student's lack of knowledge regarding commercial kitchen equipment and kitchen design. As the semester progressed, the students became more comfortable with the commercial design and kitchen equipment layout in order to begin to prepare different styles of foods and beverages. Another obstacle was the actual acquisition of food products; each week, the instructor provided a summary outline of the foods to be prepared for the upcoming week. At the beginning of the course design, the instructor

did all of the food purchases following a budget of $800.00 per semester. Additionally, each commercial facility was paid a lease fee of $2000.00 per semester. In addition, the contract arrangement provided insurance to be the university's responsibility. This part of the contract was enticing to the commercial facility because each location was not held liable for accident or laboratory mishap. The lease fee not only provided income to the venue, but additionally, it provided revenue that was used to enhance equipment and supplies for the chefs that over-saw the kitchen at each facility. In the future, this lease fee may be used as a scholarship outlet for an outstanding hospitality and tourism student.

This particular style of teaching worked well at the beginning, but unfortunately, became more disengaging for student learning as the semester progressed. Therefore, the department and instructor decided to not only pick the style of food and recipe to accompany the cuisine itself, but additionally allowed the students to begin to handle all purchasing and acquisition of food from local grocers within the community. This particular change in teaching truly enhanced or increased student learning based on the simple fact that each student became more aware of the cuisine being prepared, the ingredients being purchased, and the actual prices of products utilized within the lab.

This first class was limited to 25 students who developed five groups; each group was responsible for production in the laboratory setting. This class was open to all majors within the university, and some students took the course as an elective because of an interest in cooking. This open course attracted students from multiple disciplines; this was quite popular because it gives the student the opportunity to take a course off-campus and further enrich the learning process.

The Montour Heights Country Club setting provided several obstacles that were common to a country club setting. For example, the club was closed on the night that the course was scheduled, but several courses were interrupted because of special event scheduling. Therefore, they cancelled coursed. Because the club was closed during the actual lab time, the management and staff were absent from the property. This presented a problem for the club because of insurance regulations and other club restrictions. The students were aware that the club was closed and obviously missed some of the interaction they would have otherwise experienced if the club were open.

The second offering of the course took all of the first year obstacles into consideration and redesigned and updated the curriculum. In the fall of 2006, the course was moved to The Pittsburgh Airport Marriott, approximately 5 miles from campus. This course was restricted to 25 students and at final registration was filled with a wait list of 15 students. This is an important factor based upon the fact that cooking courses are popular to a university community. The previous obstacle of transportation was addressed with little or no problem; everyone was able to make it to the laboratory. Additionally, a previous obstacle regarding the presence of management and staff was quite different at the Marriott. All staff was present for all laboratory activities based upon the principle that the hotel itself is open 365 days of the year, 24 hours a day. The students gained knowledge and skill from guest lecturers and actual hands-on activities that were performed due to increased banquet and catering activities being sold at the hotel during the semester. For example, when the Michigan State marching band came and stayed at the hotel unexpectedly, the students from the advanced foods class worked with the chef and his staff prepared 500 box lunches for the band.

The class also participated in the production of The Greater Pittsburgh Hotel Association annual Spring Fling Event in the spring of 2007. This event allowed students to plan menus, set up the banquet facility, cook the food, and service the event for 250 people. The event included action stations which is an innovative trend in catering operations. This event allowed students to not only participate in all managerial and production schedules, but also introduce them to a new innovative catering experience.

Another benefit of this classroom experience was the participation of personnel at the hotel who provided lectures for the students during each class. This reciprocity was good for the staff and the students as many chefs or staff members had never taught students previous to this course. By having management and staff as close to the student body, the students were able to obtain positions at the hotel in multiple experiences. In addition, several of the staff professed an interest in teaching; the chef now wants to become a professor. This is definitely a win-win experience for all involved.

Additionally a technological component was implemented. Each week the students were responsible to fill out recipe use cards provided by the Marriott Hotel. After the recipe was selected the students e-mailed an electronic version of the recipe to the instructor, chef at the Marriott, and finally to each group member. After the recipe was distributed the students than proceeded to shop and purchase the food for that weeks lab assignment. The lab assignments were collected of the on-line teaching companion that accompanied the course text Introduction to Catering which was authored by the instructor Richard J. Mills Jr. Each week after the recipe was completed a digital photo was taken and up-loaded to a data base that allowed students access to all of the work done in the previous labs.

A questionnaire was developed to access the students' assurance of learning in a basic foods laboratory environment:

- In your opinion, what did you like best about this course?
- What could be done to improve this course?
- Did working in a commercial hotel setting increase or decrease your ability to learn as a student?
- In twenty five words or less, how would you describe this educational experience to a future food and beverage employer?

Methodology

The methodology for this paper incorporates both the history of the discipline and the guidelines of a college or university curriculum. The focus of the study was on the courses offered at Robert Morris University. The participants included students enrolled in the Quantity Food Production course and the Advanced Food and Catering course at Robert Morris University in the fall of 2006, the spring of 2006 and the spring of 2007. Eligible students included those whose major was in hospitality and tourism and also, students from other disciplines at the university. 25 students enrolled in the spring of 2007 course were included in the questionnaire.

Study participants included students enrolled in the Advanced Foods and Catering course at Robert Morris University in 2007 spring semester. From the 25 eligible students 4 students were considered non-respondents due to missing laboratory assignments and course withdraws. The survey was designed as a narrative collection of formative

assessment and summative assessments in-order to gain insight as to how the course may be improved in the future from the student perspective. Since many surveys are numbered and do not permit student narrative engagement the choice was made to collect the following quotes directly from the student opinions. The assurance of learning objectives and the quotes provided the overall story that was collected and evaluated as to what students expected as outcomes and goals for the course; every response from *all* students was positive. The following are some sample quotes from the questionnaire that students responded to:

- In this course, I learned more than any other class. This is the only course I have ever taken college home with me.
- Must take class…well prepared….very informative. I learned quite a bit in this class. Have a greater understanding to hotel operations'
- Being able to cook and eat a variety of food… learned to read and comprehend recipes. Experienced first-hand how to set-up a banquet.
- Working in a commercial setting increased my ability to learn and get used to the back of the house.
- Great hands-on experience and exposure too many types of food and beverage in a large kitchen.
- Cooking and the friendly atmosphere of students, faculty and staff.
- My Favorite part was eating the things we made every week and being surprised that we made it. It increased my ability to learning. I would say that it was a great learning experience.
- Great course, fun opportunity for creativity and learning.
- I like that we had to choose our own recipes.
- I like the fact that we got to pick our own recipes.
- I feel that working in a commercial hotel allowed me more hands-on experience.
- Cooking different types of foods, working in a hotel setting, increased my ability to learn. I think it is a great idea to learn from a hotel setting because you get to see how things work behind the scenes.
- Yes, working in a hotel helped out a lot. It was a very valuable experience, where I got to experience a real hotel setting.
- I love this course and the foods and the people in it.

After a literature review, the paper includes a research instrument to further understand the ongoing study of foods courses within hospitality and tourism programs. To increase the instrument's reliability and validity, the questionnaire was tested with 25 students, all of whom were in the same course. The questionnaire was evaluated and confirmed by the Chair of the Department of Hospitality and Tourism, Denis P. Rudd and also, the attending Assistant Professor, Richard J. Mills. The questionnaire was administered for only the Advanced Foods and Catering at the completion of the course in the spring of 2007.

Of the four questions asked of the students, all responses were positive. In addition, an essay question provides the study with not only a quantitative analysis but also, a possible qualitative input for future studies.

Conclusion

The goal of this program was to create an innovative style of teaching its foods based courses. This was achieved as the students participated in a hands-on course and accomplished a variety of tests and written assignments. This included food choices and recipe development along with class room interaction and kitchen laboratory action. Both courses meet the accreditation requirements under the guidelines described earlier; and also, the course was designed to show the student how different cultural cuisines adapted and applied to a commercial hotel catering facility. Other obstacles were overcome as the students moved from a classroom to a working environment in a commercial kitchen. The student's lack of knowledge on the workings of a kitchen proved challenging, and this particular style of teaching worked well at the beginning of the first course, but became more disengaging for student learning as the semester progressed. The changes that made the course successful were for the professor to choose the food types and recipes to accompany the cuisine being prepared. However, the students still maintained a hands-on approach without all of the decision making challenges. This particular change in teaching style proved successful.

One benefit of this classroom experience was the participation of personnel at the hotel; the administrators provided expertise and added to lectures prepared by the professor. The reciprocity was evident as the staff and the students interacted in a strange environment. The chefs and staff had not participated in a classroom, and the students had not participated in a kitchen. This was a win-win for everyone involved.

Another innovation was the technological component. Each week the students were responsible for producing recipe cards provided by the hotel; after the recipe was selected the students electronic transfer of the recipe to the instructor, chef, and finally to each group member. After this system was in place, the student shopped for food for that week's assignment. Finally, the work room transfer to the commercial kitchen was a success from many levels: students, instructors, and commercial staff all benefited from the dialectic exchange of information and skills. These cooking courses have truly provided several unique and engaging experiences for both students and industry leaders. It is the hospitality departments hope and desire to continue to educate the students in as many real world experiences as possible.

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The Comparative Effect on Business Creativity When Web based Collaborative Learning vs. Traditional Lecturing Instruction

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ABSTRACT

The relative effectiveness of web-based collaborative learning instruction and traditional lecturing instruction were compared for business administration students in a technical school to determine the effects of business creativity on accounting courses. A pretest-posttest control group quasi-experimental design involving two classes was used. The experimental group students (n=54) received the cooperative learning instruction, and the control group students (n=55) received the traditional lecturing instruction. The "Business Creativity Scale (BCS)", was used as the research instrument. A statistical analysis suggested students taught using the web-based collaborative learning instruction scored significantly higher than students in the traditional lecturing group for business creativity. The research results showed web-based collaborative learning heightened the students' business creativity, and web-based collaborative learning could serve as a suitable and worthwhile reference that schoolteachers could apply to their teaching instruction.

Keyword: Business Creativity, Collaborative Learning, Web based Collaborative Learning

INTRODUCTION

In this fast-changing world, the prevalence of the Internet is increasing at rapid speed. Knowledge transmission is fast and boundless, and large economic benefits have been indirectly produced. Almost every nation in the world is well-prepared for this global trend (Zhao, 2001). Besides, the emergence of the Internet has intensified global competition, making business environments constantly vary. To retain business competitiveness, enterprises around the world are making efforts to create a human-based, knowledge-centered, and continuously innovative business structure, to cope with the challenges of the new era (Liu, Lai, Wang, & Chang, 2001). Therefore, appropriately applying the Internet to our education system is an important topic.

Over the last few decades, talents cultivated under today's educational system have made a great contribution to worldwide economic development. However, students have long been affected by the exams and enrollment systems, so inspiration or creativity have been overlooked (Ma, 2002). Thus, they have almost become "studying machines". Under this adverse situation, how creativity-deficient workers are able to retain their predecessors' outstanding performance in this era of knowledge economy is worrying. As a result, heightening student's creativity, to let them gain proper professional training, and preserve flexibility and creativity will be a trend in the current education reforms.

Huang & Lin (2000) pointed out teacher's instructions can be delivered through 3 methods, including collaborative learning, competitive learning, and individual learning.

In the past, teachers mainly used competitive learning and individual learning. Thus, students prioritized their personal goals and viewed classmates as academic enemies. Interaction and mutual trust between peers was deficient, and the effectiveness of learning did not significantly improve. Fortunately, collaborative learning refers to joint construction of knowledge by a group of people having a joint commitment to a shared goal (Sharan, 1980; Bouton & Garth, 1983). Many studies have empirically proven collaborative learning can strengthen the effectiveness of learning (Sharan & Shachar, 1988; Roth & Roychoudhury, 1993; Johnson, Johnson, & Smith, 1995). Further, due to the advancement of computers and Internet technologies, more and more research supported the internet is a perfect medium to perform collaborative learning (Levin & Cohen, 1985; Davits, 1988; Bump, 1990; Din, 1991; Comeaux & Nixon, 2000; Rovai, 2001). That's why this paper applied web-based collaborative learning to a technical school.

Accounting is one of the important core courses in business studies, so this study selects accounting as the research topic. Therefore, "creativity" examined by most of the previous studies will be replaced by "business creativity" to be the focus of this study. In business creativity, most of the existing studies focus on developing university education and seldom touch on technical school education. Then, this study focuses on technical school education to develop a web-based collaborative learning model for technical school education. This model will be used to verify the effectiveness of teaching and understand whether students are well prepared with business creativity for future careers. This is the main motivation of this study.

LITERATURE REVIEW

i. Collaborative Learning

Piaget (1959) pointed out human's cognitive development is determined by environmental manipulation and active participation. He strongly proposed group work provides more cognitive benefits than individual work (Golbeck & Sinagra, 2000; Druyan, 2001). Nattiv (1994) pointed out collaborative learning is a teaching method which allows students to be "inter-dependent" in learning, working, and role-playing when they deal with a shared goal to accomplish their tasks. Slavin (1995) mentioned collaborative learning makes every learner exchange information and responsible for their learning in the activity that is carefully planned and designed, so they can further interact with other learners in the group and be motivated to promote their learning. It can be discovered that collaborative learning is a systematic and structured teaching strategy, which can improve the drawback of conventional competitive learning and individual learning methods where developing cooperative and social skills is usually neglected.

Collaborative learning has been rapidly developed since 1970s. According to the theory of collaborative learning, various teaching strategies have been developed. The major strategies include Student's Team Achievement Division (STAD), Learning Together (L.T.), Teams-Games-Tournament (TGT), and Group Investigation (G-I). Among these methods, STAD is mostly adopted. STAD was developed by Slavin in 1979. As the content, criteria, and appraisal methods are similar to those of conventional teaching methods, it can be easily implemented and extensively applied. The

implementation effectiveness is also significant. Therefore, this method is also adopted in this study.

ii. Web-based collaborative learning

In recent years, because of the advancement of computers and Internet technologies, the virtual environment constructed on the Internet has allowed implementing collaborative learning to be no longer confined to traditional classrooms, making the application of technology integrated instructions an unavoidable tendency. Through the abundance, flexibility, interactivity, and boundlessness of the Internet, the conventional linear and progressive learning method can be subverted. Students can only learn at their pace but also cross the boundaries of time and space to take part in group discussions (Chen, Mo, & Cheng, 2006). Thus, many scholars have advocated the computer network as an ideal medium for performing collaborative learning (Levin & Cohen, 1985; Davits, 1988; Bump, 1990; Din, 1991; Comeaux & Nixon, 2000; Rovai, 2001). Web-based collaborative learning was innovated as a result. Tomlinson & Henderson (1995) pointed out when two or more than two learners use different computers under the support of an application system to perform information sharing and achieve the goal of collaborative learning, this learning process can be considered collaborative learning. Web-based collaborative learning has become a hot topic in the learning area and a tendency in instructional design (Strijbos, Kirschner, & Martens, 2004; Weinberger & Fischer, 2005). It has been empirically proved web-based collaborative learning can heighten the effectiveness of student's learning (Koschmann, 1996; Wilson, 1996; Dillenbourg, 1999).

iii. Business Creativity

"Business Creativity" originated from Center for Creativity and Innovation Studies, National Cheng Chi University (http://www.ccis.nccu.edu.tw/CCIS%20Epaper/list, 2005). In early years, when cultivating creativity was mentioned, the focus was usually placed on creativity in the industrial area. Cultivating creativity in the business area has been relatively less substantial and easily neglected. In fact, industrial activities and business activities coexist in human society. Thus, neither industrial creativity nor business creativity can be ignored in researching creativity. In a survey conducted by the National Youth Commission (2005), it was discovered a successful entrepreneurship requires not only creativity but also business knowledge and core expertise. The survey further revealed most people considered marketing and financial management the most essential disciplines of knowledge for starting a business. It can be clearly seen cultivating "business creativity" is essential for students to enter occupational careers.

In 2001, Ministry of Education started to proactively develop teaching materials and methodologies for creativity education, in an attempt to improve Taiwanese student's creativity. As well as the White Paper on Creativity Education, several related projects were also proposed, such as the teacher's training program on creativity and creativity design, action research on creativity teachers, and research on creativity in students. However, in the aspect of business creativity, only developing higher education is stressed currently. In technical education, due to promoting an integrated curriculum, connecting vocational curriculum to the follow-up college curriculum has become a focus

issue for scholars and teachers in the education field (Chen, Cheng, & Lai, 2006; Chen, Lai & Cheng, 2006). "Business Creativity" referred to in this study is mainly defined according to the categorization of Creativity Teaching Resource Center as student's capability of creativity in business areas.

METHODOLOGY

i. Research Design

A pretest-posttest, control-group quasi-experimental design was conducted in the two classrooms. The participants in both the experimental (web-based collaborative learning instruction) and the comparison (traditional lecturing instruction) groups were pretested immediately before the 10-week treatment. During the experimental period, each group received an equivalent amount of instructional time and was provided with the same textbook and similar materials. Besides, the teacher was also required to adopt relevant teaching resources introduced in both groups.

Because the purpose of this study was to examine whether web-based collaborative learning did or did not enhance the students' business creativity. The participants in both the experimental and comparison groups were post-tested at the end following the experimental period.

The research design is shown in figure 1:

Experimental group	Q1	X	Q2	Q1□Q3□(pre-test) Q2□Q4□(post-test) X□the experiment treatment (lasted for 10-weeks)
Control group	Q3		Q4	

Fig 1: The Research Design

ii. Participants

The participants in this research included 109 Year 1 technical school students who attended two accounting classes in Taiwan. These students were typical of first-year students, with a mean age of 18 years. The same accounting teacher taught the two classes at this school. The basic information of the participants is shown in Table 1.

Table 1 Basic information of the participants

	Experimental class	Control class
Number of students	54	55
Grade	Year 1	Year 1
Gender proportion	45 girls 9 boys	40 girls 15 boys

iii. Instructional Methods

The web-based collaborative learning was developed and used in this research according to the following five-stage methodology proposed by Slavin (1995) and Tomlinson & Henderson (1995), a method that included the following characteristics:

1. Class presentation:
According to the course's learning objectives, the teacher lectured to the whole class or led them into discussion to let all the students grasp the important content and concepts of the course.

2. Grouping on the internet:

The teacher divided the students into different teams, based on their distinct qualities on the self-built internet. The terms "distinct qualities" means the students were divided according to their race, sex, learning achievements, etc (Slavin, 1995). In this experiment, the teacher placed the students into different teams according to their previous semester's grades in an accounting course. According to the grades, the students were divided into "high competence", "mid competence" and "low competence" groups, taking up proportions of 25%, 50%, and 25% respectively. Based on the ranking of students, the students were assigned to the groups, as shown in Table 2.

Table 2. The grouping of students in the experimental group

	Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 8	Group 9
High competence	1	2	3	4	5	6 13	7 12	8 11	9 10
Mid competence	18 19 36 37	17 20 35 38	16 21 34 39	15 22 33 40	14 23 32	24 31	25 30	26 29	27 28
Low competence	54	53	52	51	41 50	42 49	43 48	44 47	45 46

After the teacher lectured to the whole class and presented the teaching material, all the team members discussed, compared, and corrected the answers to the assignment (a cooperative learning sheet was used) on the internet, so they all could master the content of the unit. During the process of team learning, all team members should endeavor to help all other members and spare no efforts, so the whole team can be successful.

3. Quizzes:
After team learning, all the students were asked to take a quiz. The quiz was done individually, and help from team members was not allowed. Each student was responsible for his or her own learning.

4. Individual improvement:

Each student's average score for previous quizzes served as the basic score. The score of the current quiz minus the basic score turned out to be the index of learning progress. All team members had to study hard to get a better accumulated score, which functioned as their greatest contribution to the whole team; that accumulated score of the team was calculated by adding the average of the total "accumulated scores" of all the team members.

5. Team recognition:

When the team's score exceeded the agreed standard, members got rewards and public praise. As well as the public praise for the group, those who had made great progress were also rewarded and praised individually.

The traditional lecturing instruction for this research highlighted lectures given by the teacher, use of textbooks and other materials, and clear explanations of important content and concepts to students in the traditional classroom. In addition, class discussions between students and the teacher and among students after the course unit were incorporated into the teaching format. The key feature of this instruction was to provide students with clear instruction and explanations.

iv. Basic information of the researchers and instructor

The participants in this experiment included researchers, an instructor, and research assistants. The tasks undertaken by each participant are explained in Table 3. The experimental group and control group were instructed by the same person, a female, 36 years old, having 12 years of experience in teaching accounting.

Table 3 Tasks undertaken by each participant in this research

Participant	Tasks undertaken
Researchers	1.Designing and planning of the experimental course 2.Designing and planning of the research 3.Responsible for preparation of facilities or materials required for the experimental teaching 4.Recording the teaching of the control group
Instructor	1.Responsible for the teaching of the course 2.Participating in the designing and planning of the course 3.Regularly reporting teaching progress and review to the researcher

v. Instrument

1. Webpage materials

In the experimental teaching, the appropriateness of materials is the most important feature. Therefore, the researcher invited six experts to evaluate the teaching materials and the designed activities according to 16 appraisal indicators in 3 constructs, including "content and structure of materials", "design of interactions between the teacher and students", and "instructional design" (Chen, 2002). According to the opinions provided by each expert, the materials and the activities were properly adjusted and adapted to form the teaching plan for this research.

BUSINESS CREATIVITY SCALE

In this study, the "Business Creativity Scale" developed by Chen, Cheng & Lai (2006) was employed to evaluate the business creativity of the research participants.

(1) Compilation process

To measure the "business creativity" of students in the business administration cluster, document analysis, in-depth interview, focus group interview, and content analysis were applied to compile a "business creativity pretest scale". This pretest scale included 52 question items for participants to answer according to their level of agreement. Likert's 5-point scale was used. For each question, five choices were available, including 1-strongly disagree, 2-disagree, 3-fair, 4-agree, and 5-strongly agree. Lower points signaled more disagreement, while higher points pointed to more agreement. After the pretest scale was compiled, three experts in creativity were invited to review the scale. Based on the suggestions provided, the scale was modified to obtain expert validity. 160 copies of the pilot-test were distributed, and 147 copies were collected. The collected questionnaires were screened immediately to sort out those with incomplete or consistent answers. At last, 122 valid responses were obtained, and the valid response rate was 76.25%. The result revealed the validity and reliability of the "Business Creativity Scale" were acceptable.

(2) Implementing the test and item selection

Based on the total number of students in business-related departments (commercial management, international trade, accounting, and data processing) of vocational schools released by Department of Statistics, Ministry of Education in 2005, random sampling was conducted on students in equal proportions for gender, department, grade, and school attributes. 1420 questionnaires were distributed to students in 16 schools in Nov, 2006. In the first step, the researcher contacted the teachers of the surveyed class and explained the process of the survey on the phone. Later, formal questionnaires were mailed to the teachers with notes attached. The teachers were asked to select a class period to conduct the survey. 1303 questionnaires were returned. 1052 questionnaires were valid, making the valid response rate 74.08%. After valid responses were obtained, an item analysis was performed to select proper question items. The analysis showed all the 52 items were suitable.

In addition, through principle component analysis of factor analysis, factors with an eigenvalue larger than 1 and items with a factor loading larger than .5 were selected. Factor analysis was conducted four times. 26 items were deleted. Finally, five factors including "intelligence", "environment", "motivation", "characteristic", and "attitude" were extracted, and the accumulated variance explained was 56.43%. Therefore, the validity of the scale was constructed.

3. Reliability Analysis

The analysis result revealed the Cronbach's α of each subscale ranged from .66 to.88, and the entire scale was .90, suggesting the entire scale was highly reliable. By this time, the formal "Business Creativity Scale" was formed.

RESULTS

i Pretest results between two groups

The independent sample t-test was conducted on the pretest results to ascertain whether there were significant differences in business creativity between the two groups, as shown in Table 4.

Table 4 Pretest results between two groups

Factor	Variable	Number	Mean	SD	t value	p value
Intelligence	Experimental group	54	3.81	.40	-1.62	.11
	Control group	55	4.00	.58		
Environment	Experimental group	54	3.21	.49	-.82	.41
	Control group	55	3.32	.62		
Motivation	Experimental group	54	3.70	.56	.26	.80
	Control group	55	3.67	.56		
Characteristic	Experimental group	54	2.33	.31	-.82	.42
	Control group	55	2.39	.30		
Attitude	Experimental group	54	1.84	.33	-.46	.65
	Control group	55	1.87	.30		

As shown above, for the five factors of intelligence, environment, motivation, characteristic, and attitude, no significant difference was observed between the two groups before the experience. Thus, it could be inferred before the experiment, there was no significant difference in the aspect of business creativity between the two groups.

ii. Posttest results between two groups

The independent sample t-test was conducted on the posttest results to understand whether there were significant differences in business creativity between the two groups, as shown in Table 5.

Table 5 Posttest results between two groups

Factor	Variable	Number	Mean	SD	t value	p value
Intelligence	Experimental group	52	4.42	.66	2.78*	.007
	Control group	53	4	.63		
Environment	Experimental group	52	3.65	.58	2.91*	.004
	Control group	53	3.22	.65		
Motivation	Experimental group	52	4.00	.67	2.00*	.049

Factor	Variable	Number	Mean	SD	t value	p value
	Control group	53	3.66	.72		
Characteristic	Experimental group	52	2.59	.41	2.77*	.007
	Control group	53	2.33	.37		
Attitude	Experimental group	52	1.96	.35	1.25	.216
	Control group	53	1.86	.33		

Note: * p < .05

From Table 5, the results revealed after the posttest, significant differences existed between the two groups in the constructs of intelligence, environment, motivation, and characteristics.

iii. Pretest and posttest results of the experimental group

The paired sample t-test was conducted on the pretest and posttest results of the experimental group to verify the growth of the group in business creativity. With missing values excluded, 35 subjects were selected for the paired sample t-test. The result is shown in Table 6.

Table 6 Pretest and posttest results of the experimental group

Factor	Variable	Number	Mean	SD	p value
Intelligence	Pretest	52	3.97	.56	.002*
	Posttest	52	4.42	.66	
Environment	Pretest	52	3.28	.60	.021*
	Posttest	52	3.65	.58	
Motivation	Pretest	52	3.64	.55	.092
	Posttest	52	4	.67	
Characteristic	Pretest	52	2.38	.30	.037*
	Posttest	52	2.59	.41	
Attitude	Pretest	52	1.86	.29	.885
	Posttest	52	1.96	.35	

Note: * p < .05

As shown above, after the experimental teaching, the experimental group presented significant growth in three aspects of business creativity, including intelligence, environment, and characteristics.

iv. Pretest and posttest results of the control group

The paired sample t-test was conducted on the pretest and posttest results of the control group to verify the growth of the group in business creativity. With missing values excluded, 35 subjects were selected for the paired sample t-test. The result is shown in Table 7.

Table 7 Pretest and posttest results of the control group

Factor	Variable	Number	Mean	SD	p value
Intelligence	Pretest	53	3.80	.40	.94
	Posttest	53	4.00	.63	
Environment	Pretest	53	3.23	.51	.26
	Posttest	53	3.22	.65	
Motivation	Pretest	53	3.68	.57	.21
	Posttest	53	3.66	.72	
Characteristic	Pretest	53	2.35	.31	.12
	Posttest	53	2.33	.37	
Attitude	Pretest	53	1.85	.31	.23
	Posttest	53	1.86	.33	

As shown above, the control group treated with the traditional lecturing instruction presented no significant growth in all the factors of business creativity, including intelligence, environment, motivation, characteristic, and attitude. It can be inferred if teachers' teaching styles are similar and there is no significant difference in student's quality, the traditional teaching method for accounting curriculum in general technical schools is unable to effectively strengthen student's business creativity.

CONCLUSIONS AND SUGGESTIONS

In this study, the pretest-posttest nonequivalent quasi-experiment design was adopted, and students in a technical school in Taiwan were selected as search subjects. Using the class as the unit, two classes in the Accounting Department in this school were selected. One of the classes was assigned as the experimental group and treated with the "web-based collaborative learning method". The other class was designated as the control group, and instruction by the traditional lecturing method was adopted. And the concurrent teacher taught these two classes. The experiment period lasted 10 weeks, with 2 hours of instructions in each week. Students in each group received 20 hours of instructions. Based on the research findings, conclusions are summarized as follows.

Students in the experimental group significantly outperformed those in the control group in the constructs of intelligence, environment, motivation, characteristics, and attitude respectively after the web-based collaborative learning method was implemented. Besides, students in the experimental group presented significantly better performance in the constructs of intelligence, environment, motivation, characteristics, and attitude respectively in the posttest than in the pretest, after the web-based collaborative learning method was carried out.

It can be discovered after the experiment, no matter in the comparison between the posttest results of the both groups or the comparison between the pretest and posttest results of the experimental group, there was no significant growth in "attitude". Through an interview with the teacher and students, it was found this was probably because the experiment period was not long enough for students to change their learning attitude. Besides, the pretest and posttest results of the experimental group revealed the growth in motivation was also not significant. Through practical observation of the researcher, it was found current technical school students are under heavy pressure for entrance exams

and heavy academic loads. Under the effect of institutionalized teaching and school environment, student's thinking gradually becomes rigid and they can only play passive roles in creative thinking activities. The research results were consistent with the opinion of various scholars (Ma, 2002, Wu, 2002). In addition, the results suggest the considerable research and professional practice about the theory of web-based collaborative learning developed in the West may be useful for understanding student group dynamics in Asia as well. Most importantly of all, the results of this present study support the conclusion that web-based collaborative learning does lead to significantly more positive business creativity.

In this study, a quasi-experiment was conducted on only some students in the business department of a technical school in Taiwan, so the experimental results might not be used to explain students in other departments. Moreover, in the experimental school, girls significantly outnumbered boys and we were unable to determine whether gender would lead to any error. Thus, it was assumed the boys and girls would present equal effectiveness of learning. This was the main constraint of this study.

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Elementary Teacher Perceptions of Hands-On Science Teaching in an Urban School System: The Greater Educational Context and Associated Outcomes

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Abstract

Forty-four elementary teachers in an urban school district were surveyed in order to (1) document teacher perceptions of various contextual factors in a school system undergoing large-scale science teaching reform, and (2) investigate the statistical relationships between teacher perceptions of the greater context of reform teaching and teacher perceptions of student and teacher outcomes. Correlation and regression analyses showed that both preparation time and opportunities for idea sharing helped explain changes in teacher confidence and student science interest; also, administrative support helped explain variations in time spent on teaching and teacher interest in science teaching. Many of the teachers' perceptions of the context of urban science reform were positive, although certain contextual problems were identified: some teachers had not been trained on the new curriculum, some teachers had not adopted the new curriculum, science kits were in need of restocking, and some teachers did not appear to be situated in a generally supportive local teaching context.

Key Words: urban education; science education; science teaching; teacher perceptions

Introduction

To promote deep conceptual understanding, science skill development, and positive attitudes toward science, it is recommended that science teaching and learning should be focused on the use of scientific reasoning and experimental procedures to investigate real-life phenomena (American Association for the Advancement of Science, 1994; National Research Council, 1996). Such "reform-based" instruction, however, can be the equivalent of a white-knuckle expedition through choppy waters, as many different factors can (and do) challenge the effectiveness with which teachers are able to implement a hands-on curriculum. To keep reform teaching smooth and on-course, science equipment and materials must be readily available, administrators must be willing to support science teaching reform efforts, assessments must be adjusted to meet the new goals of curricular reform, and ongoing professional development must be provided for the teachers involved (Bybee, 1995). These types of contextual supports are necessary components of successful educational reform because of the reality that education is a complex interaction of teachers, students, administrators, parents, school environment, curriculum, and materials – and therefore shortfalls or problems in any of these areas can have pronounced effects on the instruction that occurs in teachers' classrooms.

Despite the inarguable influence of various contextual factors on science teaching and learning, there is still one key player that that has an immediate, overwhelming influence on the day-to-day details of curriculum implementation: the classroom teacher. While certainly constrained by classroom space, available equipment, the "assigned" curriculum, and administrative guidelines, the teacher is nonetheless relatively free to modify, adapt, improve, experiment, and motivate.

The way in which a given curriculum is interpreted, tinkered with, and (ultimately) implemented is not arbitrary, of course. Keys and Bryan (2001) firmly attribute such modifications/adaptations to the teacher's own thoughts and opinions, as embodied in their conclusion that "curriculum reforms, however well meaning, are shaped and altered by teachers' beliefs and understandings of the local context" (p. 635). Restated, Keys and Bryan are making the point that the notion of a "teacher-proof" curriculum is unrealistic; the way in which a given curriculum is enacted will necessarily vary – based on teachers' individual beliefs and perceptions related to teaching, learning, and the instructional environment. Consequently, given the teacher's prominent role in curriculum implementation, classroom teachers are necessarily at the heart of educational reform (Bybee, 1993; Lumpe, Czerniak, & Haney, 1999). Administrators and other stakeholders concerned with engineering a sweeping, effective, sustainable reform must be concerned with teacher perceptions in the district(s) in which reform is being attempted.

One example of a high-profile school system that has recently attempted to engineer systemwide reform is the Baltimore City Public School System (or BCPSS), the system that is the focus of this study. Three years ago, the BCPSS adopted a hands-on science curriculum for all elementary classrooms in the system, and the reform efforts have now reached a point where research is needed to document the teacher perceptions related to those the efforts. For this reason, the authors approached the BCPSS for the purpose of collecting data on: (a) teacher perceptions of the greater educational context of the BCPSS, to determine whether conditions are adequate to sustain the systemwide reform that has been attempted, and (b) relationships between contextual factors and student and teacher outcomes.

In this study, the following research questions were formulated to assess teacher perceptions of context and the relationships between context and outcomes:

- How do the teachers perceive the greater educational context of their hands-on science teaching?
- What relationships exist between the perceptions of the teachers' greater educational context, student learning, and changes in the teachers' practices and attitudes?

Different aspects of the teachers' educational context include administrative support, availability of materials, professional development in the school system, time available for planning and peer discussions, and a host of other factors.

Ultimately, there are two goals of the present research. The first goal is to provide teacher perception information to the BCPSS so that it can target specific contextual problems that might hamper the system's ongoing science reform efforts. The second goal is to document for the larger science education community the teacher perceptions of context, as well as the relationships between perceptions of contextual factors and

outcomes, that are found in an urban school district attempting to reform its elementary-level science instruction.

Conceptual Framework and Prior Research

Although teacher practices, the greater context of teaching, and teacher attitudes and beliefs are inherently interconnected, for the sake of this paper we draw lines of separation between these three conceptual categories. Teacher practices are the actions and utterances that constitute the act of teaching. Teacher beliefs and attitudes are those affective stances and cognitive models that teachers possess with respect to teaching, learning, knowledge, science, their teaching environment, and so forth. The greater educational context is the large amalgam of factors and influences (outside the teacher) that affect teacher practice; this greater context includes the curriculum, the students, school culture, family support, and the district and state policy environment (Knapp, 1997).

A number of contextual factors have a significant impact on science teaching reform. Motz (1997) argues that, for science teaching reform to be effective and sustainable, certain contextual conditions must exist; these conditions include allocating the necessary teaching-hours to the reform curriculum, appropriate district budgeting, and an ongoing staff development program. Many of these issues are echoed by St. John, Century, Tibbitts, and Heenin (1984), who argue that a plan for successful science teaching reform must address the following questions: Is there appropriate vision and leadership? Is there appropriate professional support? Is there appropriate curricular and logistical support? Is there appropriate political and financial support? If these questions can be answered positively, then the plan for teaching reform has the strong potential to be long-reaching and sustainable.

Much of what we know about the factors that support or hinder science teaching reform are derived from educators' reflections on reform efforts that were briefly successful, and then abandoned – such as the relatively short-lived science-as-process teaching reforms from the 1960s and 1970s, which gave rise to such curricula as Elementary Science Studies (McGraw-Hill, 1968) and Science – A Process Approach (American Association for the Advancement of Science, 1963-1975). In these early reform efforts, teachers perceived many classroom-level challenges relating to reform teaching: assessment issues, equipment availability, safety, class management, and a focus on "basics" (Welch, Klopfer, Aikenhead, & Robinson, 1981). Unsurprisingly, many of these obstacles to science teaching reform are still in existence today. One such example is the case study by Keys and Kennedy (1999) of the science teaching of a practicing elementary teacher; the researchers found that challenges to the teacher's inquiry-based teaching included a lack of time, practical difficulties associated with the management and implementation of inquiry (e.g., turning student questions back over to the students), and the general constraint that some district-mandated concept standards are too abstract, and therefore cannot be taught through reform (inquiry) approaches.

Setting

The public school system chosen for this study was the Baltimore City Public School System (BCPSS). This urban school system contains 184 schools, 116 of which serve students in grades PreK-5. The population of the city of Baltimore is approximately 600,000. For the 2003-2004 academic year, ethnic demographics in the BCPSS were as follows: 87.2% African American, 11.2% Caucasian, 0.6% Asian, 0.6% Hispanic, and 0.4% American Indian. A majority of the families living in the area are economically disadvantaged, which is reflected in the high percentage (66.1%) of enrolled students who were eligible for free or reduced price meals during the year the study was conducted.

In an effort to bolster student learning, the system recently adopted the DiscoveryWorks book series (Badders, Bethel, Fu, Peck, Sumners, & Valentino, 2000) for use by all elementary level students. These curricula include modularized instruction in physical science, earth science, and life science. DiscoveryWorks activities consist primarily of hands-on activities that emphasize inquiry and investigation. It was hoped that the inquiry-based teaching style employed in the curricula would improve student retention of content and improve critical thinking skills.

In the BCPSS, science and social studies are taught in alternating 3-week blocks. Science is taught for 3 weeks, then social studies is taught for 3 weeks, then science is taught for another 3 weeks, and so on. During each science block, science is typically taught 3 days per week, one hour per day, for a total of 3 hours of science per week.

Methods

Data Collection

The BCPSS adopted the DiscoveryWorks (DW) curriculum as the official elementary level curriculum in 2001-2002. In 2002, we approached the BCPSS about conducting a survey on elementary teachers' perceptions of the greater context of urban science teaching – especially as it related to the implementation of the reform-based DW curriculum. BCPSS administrators agreed that the systemwide implementation of DW had reached a point where research on teacher perceptions would provide valuable feedback and data for the school system, and so the elementary science leaders and the BCPSS research office tentatively allowed the project to proceed. The final approval of the project came in the Fall of 2003, and our data was collected (via an on-line survey) in the Spring of 2004.

Generating the survey. Before adopting the DW curriculum, the BCPSS used an in-house elementary science curriculum (STARS) that had been collaboratively developed by teachers, administrators, and faculty from neighboring universities. A survey had been developed (Ukens, 1994) to evaluate the implementation and outcomes of the STARS curriculum project. We used the STARS survey as a starting point for our DW teacher perceptions survey, which was then significantly modified in order to meet the goals of this research project.

To ensure that the DW survey was appropriate and useful, our initial modifications to the survey were submitted to the BCPSS elementary science leaders for their feedback. Their feedback was then incorporated into the survey, with slight

modifications. This process continued until all parties were in full support of the exact nature and content of the survey.

Survey overview. The entrance page to the DW on-line survey asked the elementary teachers whether they had been using the DW curriculum. If teachers responded that they had been using DW, they were passed on to the main body of the survey. If teachers responded that they had not been using DW, they were asked the name of the science curriculum that they had been using instead; the non-users of DW did not fill out the main body of the survey.

The 41-item DW teacher perceptions survey was broken into four sections:

- *Personal Data*: Respondents provided data on their years of teaching experience, their grade level taught, the number of DW units that they teach every year, and the percentage of each DW unit typically covered;
- *Factors Affecting Implementation*: Respondents used a Likert scale (strongly agree, agree, neutral, disagree, strongly disagree) to indicate the degree to which they agreed or disagreed with assertions relating to contextual factors and their beliefs about science teaching and the DW curriculum;
- *Changes in Classroom Practice and Professional Development*: Respondents used a Likert scale (increased substantially, increased a little, stayed about the same, decreased a little, decreased substantially) to indicate how their classroom practice, student outcomes, and professional development had changed since the teachers began using the DW curriculum; and
- *Free Response*: Respondents could include additional thoughts or comments about DW-based science teaching in the BCPSS.

For the purposes of analysis (see below), the multiple-choice survey questions were re-grouped into four conceptual categories. The survey, with conceptual groupings, can be found in the Appendix.

Recruiting survey respondents. To make elementary teachers aware of the DW teacher perceptions survey, information packets were sent to each elementary level principal within the BCPSS. These packets contained: (a) a letter that described the purpose of the research project, (b) informational flyers about the on-line survey for each elementary teacher in the school, and (c) a letter of support for the project from the BCPSS elementary science leaders and office of research.

Participants. In the Spring of 2004, the DW teacher perceptions survey appeared on-line for approximately 6 weeks. During that time, 51 elementary teachers responded to the survey. Of those, 44 stated that they used the DW curriculum in their classrooms. Six of the 7 non-users of DW did teach science, but not with the DW curriculum. The last responding elementary teacher did not teach science at all. Since this project was specifically directed at teacher perceptions related to DW implementation, only those responses from the 44 DW users were analyzed.

Data Analysis

Conceptual grouping of survey questions. As originally implemented, certain sections of the on-line survey contained a mixture of items pertaining to teacher beliefs, student learning, classroom practice, and various contextual factors. For the purpose of effectively investigating and answering our research questions, all 41 survey items were conceptually re-grouped into four different categories: (1) personal data (items P1 through P4), (2) items pertaining to teacher beliefs and knowledge (items T1 and T2), (3)

items pertaining to the greater context of science teaching (items C1 through C19), and (4) items pertaining to student and teacher outcomes (items OC1 through OC15). The survey, with groupings, can be found in the Appendix. This re-grouping is in alignment with our conceptual framework, which makes a distinction between teacher beliefs/knowledge and the greater context of science teaching.

Internal consistency of the on-line survey. Responses to survey items were assigned numerical values as follows. For items C1 through C19 and OC1 through OC3, "strongly" disagree" was assigned a value of 1, "disagree" was assigned a value of 2, "neutral" was assigned a value of 3, "agree" was assigned a value of 4, and "strongly agree" was assigned a value of 5. Similarly, for items OC 4 thorough OC 15, "decreased substantially" was assigned a value of 1, "decreased a little" was assigned a value of 2, "stayed about the same" was assigned a value of 3, "increased a little" was assigned a value of 4, and "increased substantially" was assigned a value of 5.

Once all data had been collected, the internal consistencies for the contextual and outcomes groupings were calculated. Cronbach's alpha for the 20-item contextual factor grouping (with item C18 reverse-scored) was .89. Cronbach's alpha for the 15-item outcome grouping (with item OC2 reverse-scored) was .81.

Measuring teacher perceptions of the greater context of science teaching. To determine the teachers' overall perception of the greater context of science teaching in the BCPSS, we tallied the distribution of teacher responses to survey items C1 through C19 (i.e., the context grouping). "Strongly agree" and "agree" responses were collapsed into a single "agree" response, and "disagree" and "strongly disagree" responses were collapsed into a single "disagree" response.

Measuring the relationships between various contextual factors. For the sake of completeness, the on-line survey contained 19 separate items that were context-related (items C1 through C19); however, to reduce the large volume of data generated by the survey and keep our analysis focused, the authors and BCPSS personnel were most interested in investigating the interrelationships between textbook availability (C1), the degree to which activities work as intended (C3), the availability of supplies and equipment (C6), parental support (C9), time for teacher planning and preparation (C11), administrative support (C12, C13, C14), professional development (C15), and the sharing of ideas between teachers (C16). Relationships between these contextual factors were established by correlating these factors with one another.

Measuring the relationships between contextual factors and student and teacher outcomes. Although the survey assessed teacher perception of 15 separate outcomes (items OC1 through OC15), it was determined by the authors and BCPSS personnel – again, for the sake of data reduction and the need to keep our analysis focused – that certain outcomes would be more interesting and productive to analyze than others. Those outcomes were determined to be student learning (OC1), teacher interest in science teaching (OC6), student interest in science (OC7), classroom time devoted to science teaching (OC8), teacher knowledge of science concepts (OC11), and teacher confidence in his/her own science teaching (OC12).

Our method for establishing the relationships between certain contextual factors and the student and teacher outcomes was to correlate all contextual factors with each outcome, and then perform a stepwise linear regression analysis using the significantly correlating subset of contextual factors on that outcome. However, to prevent the

regression analyses from becoming diluted with an overabundance of contextual factors, which might occur if all 19 contextual factors were utilized in the correlation/regression analyses, the large number of curriculum and administration items was reduced by calculating representative values for these items. Responses to the numerous curriculum items were transformed into a single representative "curriculum" response by averaging each teacher's responses to items C2, C3, C4, C5, C7, C8, and C10; likewise, responses to the different administrative items were transformed into a single representative "administrative support" response by averaging each teacher's responses to items C12, C13, and C14. In this manner, the set of 19 possible contextual factors was reduced to 11 factors (items C1, C6, C9, C11, C15 through C19, and the representative administrative support and curriculum responses) for use in the correlation/regression analyses.

Results

Results are broken into three sections: general information about the survey respondents, teacher perceptions of greater context of science teaching in the BCPSS, and relationships between contextual factors and outcomes.

General Information about the Survey Respondents

Teaching experience and grade level of responding elementary teachers. Thirty-nine percent of responding teachers (17 out of 44) had less than five years of teaching experience, 18% (8 out of 44) had between 5 and 8 years of teaching experience, and the remaining 43% (19 out of 44) had 9 or more years of teaching experience. Fifty-two percent of responding teachers (23 out of 44) were kindergarten, first, or second grade teachers, and the remaining 48% (21 out of 44) were third, fourth, or fifth grade teachers.

Teacher beliefs and knowledge. All 44 responding teachers agreed or strongly agreed with item T1: "Children need a hands-on science program". To assess their background knowledge in science, teachers were asked to rate the extent to which they agreed with item T2: "Before teaching DW, I had adequate content knowledge to effectively teach the lessons and activities". Fifty-five percent of the responding teachers (24 out of 44) agreed or strongly agreed with this statement, 25% (11 out of 44) were neutral, and the remaining 20% (9 out of 44) disagreed or strongly disagreed with this statement.

Teacher Perceptions of the Greater Context of Science Teaching

Over 75% of teachers were in agreement (either responding "strongly agree" or "agree") with items focusing on the ease of use, readability, and appropriateness of the written DW curriculum (items C2, C3, C4, C5, C7, C8, C10). At the same time, 57% of teachers (25 out of 44) were in agreement with item C18: "I frequently modify DW lessons because the lesson would not work or would not be feasible to complete in my classroom as written". Responses to all other contextual items are summarized in Table 1.

Table 1
Response Distributions for Particular Context-related Survey Items

Survey Item	Agree	Neutra l	Disagree

DW textbooks are readily available in my classroom.	44	0	0
I have sufficient materials and supplies to implement DW lessons.	24	8	12
Parents are supportive of the DW curriculum.	11	23	10
I have adequate time to plan and prepare for instructional activities related to DW.	21	10	13
My school administration demonstrates a high priority for science.	16	15	13
My school administration has a clear understanding of how DW should be implemented.	16	17	11
The central administration actively supports the DW curriculum.	17	16	11
I have received professional development training specifically for DW.	26	1	17
I have had the opportunity to share teaching ideas about DW with other teachers.	25	8	11
I frequently modify DW lessons to meet the needs of diverse learners.	35	6	3
The noise level in my classroom is higher during DW lessons than during other parts of the day.	26	11	7

Note: "Strongly agree" and "agree" responses are jointly reported under "Agree". "Disagree" and "Strongly disagree" responses are jointly reported under "Disagree". N = 44 teachers.

Relationships between Teacher Perceptions of Different Contextual Factors

Correlations between the contextual factors of interest (outlined above) are presented in Table 2.

Table 2

Correlations between Particular Context-related Survey Items

	C1	C3	C6	C9	C11	C12	C13	C14	C15	C16
C1	--									
C3	.39**	--								
C6	.34**	.53**	--							

C9	-.09	.17	.33*	--						
C11	.34*	32*	.50**	.23	--					
C12	-.02	.26	.41**	.51**	.31*	--				
C13	.09	.22	.45**	.56**	.33*	.83**	--			
C14	.19	.16	.52**	.37*	.35*	.69**	.77**	--		
C15	.27	.38*	.49**	.24	.27	.40**	.53**	.46**	--	
C16	.09	.12	.21	.36*	.47**	.53**	.52**	.49**	.45**	--

Note: $N = 44$ teachers.
*$p < 0.05$. **$p < 0.01$.

Relationships between Teacher Perceptions of Context and Student and Teacher Outcomes

The factors that had a statistically significant correlation with student learning (item OC1) were the curriculum (measured by the average response to the curriculum survey items, as described above; $r = .56$, $p < .01$), administrative support (measured by the average response to the administrative support survey items, as described above; $r = .45$, $p < .01$), the availability of materials and supplies (item C6; $r = .31$, $p < .05$), parental support (item C9; $r = .54$, $p < .01$), professional development (item C15; $r = .43$, $p < .01$), and the sharing of ideas with other teachers (item C16; $r = .34$, $p < .05$). The result of the stepwise regression of these factors on student learning is shown in Table 3.

Table 3
Results of Regression of Contextual Factors on Student Learning

Contextual Factor	Cumulative R^2	ΔR^2	F-test	Significance
Curriculum	.32	.32	$F(1,42) = 19.3$	$p < .01$
Parental support	.49	.15	$F(1,41) = 19.4$	$p < .01$

Note. $N = 44$ teachers. Other factors did not contribute significantly to the cumulative R^2.

The factors that had a statistically significant correlation with teacher interest in the teaching of science (item OC6) were administrative support ($r = .50$, $p < .01$), the availability of materials and supplies (item C6; $r = .36$, $p < .05$), and the sharing of teaching ideas with other teachers (item C16; $r = .49$, $p < .01$). The result of the stepwise regression of these factors on teacher interest is shown in Table 4.

Table 4
Results of Regression of Contextual Factors on Teacher Interest in Science Teaching

Contextual Factor	Cumulative R^2	ΔR^2	F-test	Significance
Administrative support	.25	.25	$F(1,42) = 14.0$	$p < .01$

Note. $N = 44$ teachers. Other factors did not contribute significantly to the cumulative R^2.

The factors that had a statistically significant correlation with student interest in science (item OC7) were administrative support ($r = .40$, $p < .01$), parental support (item C9; $r = .49$, $p < .01$), time for planning and preparing (item C11; $r = .32$, $p < .05$), professional development (item C15; $r = .34$, $p < .05$), and the sharing of teaching ideas with other teachers (item C16; $r = .54$, $p < .01$). The result of the stepwise regression of these factors on student interest is shown in Table 5.

Table 5

Results of Regression of Contextual Factors on Student Science Interest

Contextual Factor	Cumulative R^2	ΔR^2	F-test	Significance
Sharing teaching ideas with others	.29	.29	$F(1,42) = 17.0$	$p < .01$
Time to plan and prepare	.39	.10	$F(1,41) = 13.2$	$p < .01$

Note. $N = 44$ teachers. Other factors did not contribute significantly to the cumulative R^2.

The factors that had a statistically significant correlation with time spent on science teaching (item OC8) were the curriculum ($r = .35$, $p < .05$), administrative support ($r = .43$, $p < .01$), the availability of materials and supplies (item C6; $r = .31$, $p < .05$), and parental support (item C9; $r = .41$, $p < .01$). The result of the stepwise regression of these factors on time spent on science teaching is shown in Table 6.

Table 6

Results of Regression of Contextual Factors on Time Spent on Science Teaching

Contextual Factor	Cumulative R^2	ΔR^2	F-test	Significance
Administrative support	.18	.18	$F(1,42) = 9.3$	$p < .01$

Note. $N = 44$ teachers. Other factors did not contribute significantly to the cumulative R^2.

The factors that had a statistically significant correlation with teacher content knowledge (item OC14) were administrative support ($r = .30$, $p < .05$), time for planning and preparing (item C11; $r = .34$, $p < .05$), and the sharing of teaching ideas with other teachers (item C16; $r = .41$, $p < .01$). The result of the stepwise regression of these factors on teacher content knowledge is shown in Table 7.

Table 7

Results of Regression of Contextual Factors on Teacher Content Knowledge

Contextual Factor	Cumulative R^2	ΔR^2	F-test	Significance
Sharing teaching ideas with others	.17	.17	$F(1,42) = 8.4$	$p < .01$

Note. $N = 44$ teachers. Other factors did not contribute significantly to the cumulative R^2.

The factors that had a statistically significant correlation with teacher confidence in his/her own science teaching (item OC15) were the curriculum ($r = .31$, $p < .05$), administrative support ($r = .43$, $p < .01$), time for planning and preparing (item C11; $r = .51$, $p < .01$), the sharing of teaching ideas with other teachers (item C16; $r = .50$, $p < .01$), and classroom noise (item C19; $r = 32$, $p < .05$). The result of the stepwise regression of these factors on teacher confidence is shown in Table 8.

Table 8

Results of Regression of Contextual Factors on Teacher Confidence

Contextual Factor	Cumulative R^2	ΔR^2	F-test	Significance
Time to plan and prepare	.26	.26	$F(1,42) = 14.5$	$p < .01$
Classroom noise level	.40	.14	$F(1,41) = 13.7$	$p < .01$
Sharing teaching ideas with others	.50	.10	$F(1,40) = 13.2$	$p < .01$

Note. $N = 44$ teachers. Other factors did not contribute significantly to the cumulative R^2.

Discussion

All 44 teachers using the DW curriculum responded that textbooks are readily available, which indicates that the BCPSS has done an effective job in supplying its elementary classrooms with texts. Also, as illustrated by the fact that 75% or more of the teachers responded positively to many of the curriculum-related survey items, teachers were generally happy with the use, readability, and appropriateness of the DW curriculum – although these responses are counterbalanced by the fact that 57% of teachers (25 out of 44) regularly felt the need to modify activities because they wouldn't quite work as written. This suggests that the DW curriculum is clearly written and well-organized, but perhaps the activity content and activity structure occasionally need fine-tuning – at least as perceived by the majority of teachers.

Teacher perceptions were decidedly mixed on the availability of equipment and supplies, as 45% of teachers (20 out of 44) fell into the neutral or disagreement category in their perception of whether there are enough materials and equipment to implement DW effectively. Similar results were found for planning and preparation time, with 52% of teachers (23 out of 44) responding neutrally or negatively toward the assertion that teachers have adequate time to plan and prepare. That the teachers would perceive a need for improved restocking procedures is fairly unsurprising, since science kit restocking is one of the known "perennial problems" of elementary science reform (Knapp, 1997, p. 239) – a problem, in fact, that was mentioned explicitly by four of the teachers in their free response comments. An equipment problem could conceivably lead to teachers abandoning a hands-on curriculum such as DW in favor of a curriculum less reliant on materials, and so the importance of equipment restocking as a crucial contextual support is one that cannot be overemphasized; the need for updated and refilled science kits is an action item that should be high on the to-do list for any reform effort, and a school system runs the risk of ignoring equipment restocking at the possible expense of the sustainability of their systemwide reforms. The other issue, the lack of sufficient planning and preparation time, has long been a contextual mainstay of the teaching profession –

and is only unique in the sense that it is one of the few contextual factors in this study that is not science-specific.

The most striking variation in teacher perceptions related to context can be seen in the distribution of teacher responses with respect to administrative support, parental support, and professional development. Thirty percent of teachers disagreed with the notion that their school administration demonstrates a high priority for science, and 25% did not perceive the central administration to be supportive of DW. Over half of the teachers held a neutral perception concerning parental support, with 23% disagreeing that parents supported the DW curriculum. The array of responses most closely approaching a bimodal distribution is found in the professional development item, with 59% of teachers verifying that they had been trained on the DW curriculum and 39% indicating that they had not been provided any DW-specific training. The parental support result is difficult to interpret, because the survey does not contain a comparative item relating to parental support for other subjects – and so the teacher responses do not help us to determine whether parental support for DW is a problem specific to this hands-on science curriculum, or is more reflective of parental support in general.

There were likely a number of different reasons why certain teachers perceived a lack of administrative support for the DW curriculum, one aspect of which could be the fact that – not unlike many other urban school systems – the BCPSS tends to concentrate more on mathematics and language/reading than on science. An upcoming event that will likely impact the BCPSS administration's focus on science is the state's intention to officially assess science learning at all levels beginning in 2007. At that time, the extent, nature, and tone of BCPSS support for elementary science teaching may change – although whether administrative support driven by testing will have positive or negative effects on science reform is difficult to predict. In other school systems, for example, test-driven science reforms have had negative impacts on teachers' professionalism and teacher-student relationships (Settlage & Meadows, 2002).

A more immediate concern for the BCPSS is that over one-third of the survey respondents had not yet received professional development specifically related to DW, the official science curriculum. Given the established connection between curriculum-specific professional development, changes in teacher beliefs and practice, and the success of reform, an increase in curriculum-related training would be a logical step toward improving the potential for sustained educational change in the system.

On the general subject of DW adoption, one bit of data that deserves to be restated and emphasized is that, of the 51 teachers who originally responded to the survey, only 44 were actually using the district-mandated DW curriculum; six of the 51 (12%) used a different science curriculum, and 1 of the 51 (2%) did not teach science at all. This marks an area in need of improvement in the system, since the use of DW in 100% of classrooms is the administrative goal. Regardless, these percentages allow us some practical insight into the percentage of classrooms that end up adopting a mandated curriculum as the result of a systemwide reform effort.

The correlations between contextual factors, which are presented in Table 2, point to a number of interesting interrelationships in the greater educational context of urban science teaching. We highlight the most notable results by focusing on those statistically significant correlations that are .50 or higher. The correlation between items C3 and C6 reinforces what we already know about effective reform-based science teaching – that

science activities work properly when there are sufficient materials available. The correlation between various teacher perceptions with administrative support may provide additional insight as to why teachers do or do not perceive the administration to be supportive. The correlations link the availability of materials, opportunities for sharing ideas with other teachers, and professional development with administrative support, all of which make a good deal of sense from the perspective of a practicing teacher; an indicator of explicit administrative support for a curriculum would include ongoing maintenance of that curriculum, as demonstrated by the devotion of money and effort toward equipment updates, peer mentoring, and continuous professional development. Other correlations point to interesting and important variations in perceptions of the greater context of teaching, such as the correlation between items C6 and C11, which indicates that teachers who perceive an availability of materials tend to feel that they also have sufficient time to prepare, whereas teachers who perceive a lack of materials tend to feel that their preparation time is less sufficient. This paints a picture where certain teachers appear to be in a generally supportive teaching context, whereas others seem to lack this contextual support. In this light, one goal of the system administration might be to provide guidance and support for the various elementary schools such that the local contexts can be made more uniform across the system, which would hopefully drive all teacher perceptions in a more positive direction.

Perhaps the most interesting results from this study are the links between particular contextual factors and perceived student and teacher outcomes. One example is the relationship between teacher perceptions of the curriculum and teacher perceptions of student learning – a relationship that is more complicated than it first appears. Since all 44 survey respondents are using the same curriculum (DW), albeit at different grade levels, one might wonder why perceptions of curriculum quality would vary from teacher to teacher. One possibility is that the DW curriculum varies significantly in quality by grade level or by unit, in which case an unevenness in curriculum quality would explain the perceived differences in learning. Another possibility is that teachers' ratings of the curriculum and student outcomes are influenced by their own beliefs about science teaching and learning; for example, those teachers who agree with the philosophy of the curriculum might perceive greater increases in student learning (whether or not they exist) as compared to those teachers who disagree with the curriculum philosophy. Determining the base explanation behind the relationship between curriculum perceptions and outcome perceptions is a non-trivial task that deserves further study.

Examining the other regression analyses, a key result is that the sharing of instructional ideas between teachers contributed significantly to the variance in three separate outcomes: perceived changes in student science interest, perceived changes in teacher content knowledge, and perceived changes in teachers' confidence toward their own science teaching. The prominence of idea sharing in these regression results gives credence to the notion that establishing a teacher mentoring and support network is a vital aspect of science reform. Planning and preparation time is yet another factor that contributes significantly to variance in perceived changes in teacher confidence and student science interest. One could imagine that teachers with adequate planning would be in a better position to provide students with a productive and interesting science experience, and would also tend to feel more positively about the flow, focus, and effectiveness of their own teaching practices. The statistical link between administrative

support and perceived changes in both teacher interest in science teaching and time spent on science teaching suggests that the administration's visibility and helpfulness in the process of reform is not to be dismissed, as it appears that teacher perceptions of local and administrative support – as one might expect – can have a significant impact on teacher beliefs and classroom practice.

Conclusion

Each time another urban school system attempts large-scale science teaching reform, there is always the danger that the system lacks the contextual supports that are necessary for successful, sustainable changes in educational practice. One of the least effective methods of implementing systemic change is the "hope" approach – where the school system adopts a new reform-based curriculum, purchases equipment and books, trains teachers, and then hopes for the best (St. John, Century, Tibbitts, & Heenin, 1984). The proponents and engineers of change must instead focus not only on immediate practical necessities such as supplies and professional development, but must also focus on issues such as school culture, family involvement, and ongoing administrative guidance – for only by recognizing and addressing the complex relationships between greater context, teacher beliefs, and classroom practice do long-term changes in science teaching and learning become a reasonable possibility.

One purpose of the present study was to conduct basic research on the statistical relationships between teacher perceptions of the greater context of science teaching and teacher perceptions of various outcomes. It was found, for instance, that both planning time and the sharing of teaching ideas have strong links to changes in teacher confidence and changes in student science interest. Another result is that perceived administrative support helped to explain a significant amount of variance in both time spent on teaching and teacher interest in science teaching. Results such as these are meaningful and relevant because they reinforce the fact that contextual supports are important aspects of education that have a direct impact on teacher/student outcomes; additionally, these results provide insight into the particular types of contextual factors that have the greatest impact.

Another purpose of the present study, a purpose that was driven by our desire to provide practical services for schools, was to identify a neighboring urban school system in the midst of reform, document teacher perceptions of contextual supports in that system, and share those results with system administrators – so that previously unknown problems of teacher perception might be identified and addressed before they become hulking obstacles that slow or stop the science reform process. Despite this purpose, much of what was discovered in our investigation of the current state of BCPSS reform is quite positive. Classrooms are well-stocked with texts, the vast majority of teachers perceive the newly adopted curriculum to be well-organized and easy to use, and a full 100% of teachers surveyed believe that a hands-on curriculum is the best type of science curriculum for their students. However, there are also a handful of problems that could derail the process of reform if they go unchecked. These problems include the existence of a significant population of teachers who have not yet been trained on the new curriculum, a smaller population of teachers who have not yet adopted the new curriculum, a pressing need for the restocking of DW science kits, and notable differences across teachers in terms of their perceptions of administrative support and

available supplies. We have shared our project results with BCPSS science leaders and administrators so that the above problems can begin to be addressed.

The final purpose of this study follows directly from the last. In addition to sharing the project results directly with the BCPSS, an underlying purpose was to share the results of our investigation with administrators and classroom teachers in other school systems. As there is no reason to think that the BCPSS is exotic or unique in its chosen plan for reform, the perception-related problems that we have identified with science reform in the BCPSS can serve as advance warnings for other urban school systems considering similar reforms. One thing that will never change is that the road to sustained educational reform is an overwhelming journey fraught with challenges, and that the agents of reform need support and information from all sides for their efforts to be successful.

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Appendix

DiscoveryWorks Teacher Perceptions Questionnaire: Survey Items, by Conceptual Grouping

Throughout this questionnaire, the abbreviation "DW" stands for DiscoveryWorks.

Personal data.

P1. How many years of teaching experience do you have?
a. this is my first year b. 2 to 4 c. 5 to 8 d. 9 to 20 e. more than 20

P2. What is your current grade level? (Leave this item blank if you teach K)
a. 1st b. 2nd c. 3rd d. 4th e. 5th

P3. How many different DW units do you typically teach per year?
a. one b. two c. three d. four or more e. none

P4. In a typical DW unit, what percentage of the lessons/activities do you typically cover with your class?
a. about 10% b. about 25% c. about 50% d. about 75% e. about 100%

*Items pertaining to teacher beliefs and knowledge***.**

T1. Children need a hands-on science program.
T2. Before I began teaching DW, I had adequate content knowledge to effectively teach the lessons and activities.

Items pertaining to the greater context of science teaching.

The following scale was used to respond to items C1 through C15.

A Strongly Disagree	B Disagree	C Neutral	D Agree	E Strongly Agree

C1. DW textbooks are readily available in my classroom.
C2. DW texts and lessons are written clearly.
C3. DW activities work as intended.
C4. DW units are appropriate for my students.

C5. DW materials and supplies are easy to use.
C6. I have sufficient materials and supplies to implement DW lessons.
C7. The DW lesson structure is easy for *teachers* to follow.
C8. The DW lesson structure is easy for *students* to follow.
C9. Parents are supportive of the DW curriculum.
C10. DW makes the role of the teacher clear as the students conduct the activities.
C11. I have adequate time to plan and prepare for instructional activities related to DW.
C12. My school administration demonstrates a high priority for science.
C13. My school administration has a clear understanding of how DW should be implemented.
C14. The central administration actively supports the DW curriculum.
C15. I have received professional development training specifically for DW.
C16. I have had the opportunity to share teaching ideas about DW with other teachers.
C17. I frequently modify DW lessons to meet the needs of diverse learners.
C18. I frequently modify DW lessons because the lesson would not work or would not be feasible to complete in my classroom as written.
C19. The noise level in my classroom is higher during DW lessons than during other parts of the day.

Items pertaining to student and teacher outcomes.
The following scale was used to respond to items OC1 through OC3.

A	B	C	D	E
Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

OC1. DW makes a difference in student learning.
OC2. My current understanding of DW science content could be improved.
OC3. I have fewer discipline problems occurring during DW lessons than during other parts of the day.

The following scale was used to respond to items OC4 through OC15.

A	B	C	D	E
Increased Substantially	Increased a Little	Stayed About the Same	Decreased a Little	Decreased Substantially

OC4. The average number of professional conferences (Maryland Association of Science Teachers, National Science Teachers Association, etc) in science education I attend per year has:
OC5. The number of hands-on science activities in my class has:
OC6. My own personal interest in teaching science has:
OC7. My students' interest in science as taught in school has:
OC8. The amount of time I devote to teaching science has:
OC9. The amount of time a visitor in my class would observe students doing science activities without my help has:

OC10. My involvement in science education outside of teaching DW (ex: science fairs, field trips, etc) has:
OC11. The number of times that student questions have led to student investigations has:
OC12. My use of cooperative learning as a teaching style has:
OC13. The amount of funds I have been able to obtain to teach science has:
OC14. My knowledge of science concepts has:
OC15. My confidence in teaching science has:
Free response.
F1. Please enter any other thoughts or comments you have about your experiences using the DiscoveryWorks curriculum.

An Application of the Principles of Action Research in Developing Teachers' Potentiality According to the National Education Act of 1999

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Abstract

This project consisted of five studies. The first study was using the principles of action research in developing teachers' skills in conducting classroom research**,** aimed to foster the skills and ability of participants in conducting classroom research to improve their teaching-learning activities. The second study was using the principles of action research in developing teachers' competency in facilitating the student-centered learning environment. The third study was using the principles of action research in developing the elementary school teachers' skills in constructing the instructional media. The fourth study was using the principles of action research in developing teachers' competency in authentic assessment. The fifth study was using the principles of action research in developing teachers' competency in constructing the school-based curriculum. This project was a training project based on the principles of action research. The participants were 7 lecturers and 2 graduate students of Faculty of Education and 27 primary school teachers from 8 schools in Khon Kaen. Mini-lecture, group activities, discussion, exercise, and presentation were used in this training program. Participant observation, interviews, tests, questionnaires, journal writings, photographs were employed for data collection. Formative and summative evaluations were used to investigate the effectiveness of the workshops. At the beginning and the end of a training session, a test was administered to assess their knowledge about some principles of classroom research, learning assessment, school based curriculum, and instructional media. A set of criterion score was predetermined for each test. Mentoring was used in enhancing and empowering the participants in conducting classroom research.

The results indicated that through this training project, the researchers and participants had developed self-esteem, self-respect, team building, sharing, collaborative work and a sense of belonging. Moreover, the participants had acquired skills in teaching and learning process especially constructing instructional media, cooperative learning and conducting classroom research to improve their teaching. In particular, the participants conducted research and were encouraged to present their papers at the Third Conference in Educational Research on September 11, 2005 at the Faculty of Education, Khon Kaen University, Khon Kaen, Thailand. 20 papers were presented in poster session.

Keywords: Action research**,** competency**,** student-centered**,** authentic assessment**,** curriculum

Introduction

According to the new Constitution, the National Education Act B.E 2542 (1999) has become effective since August 20, 1999. Learning reform is emphasized as a vital part of education reform, which called for the weaving and integrating of learning process: curriculum, learning activity and learning assessment for the development of the learners at their own pace and to the best of their potentiality as stated in Section 22 of the National Education Act B.E 2542 (1999) (Office of National Education Committee, 1999). The Act put its emphasis on the development of quality of human resources, life-long education for all, participation of all segments of society in education provision, and continuous development of the bodies of knowledge and learning processes. The teachers were considered to be an important agent in driving and gearing the education reform to be in a tract of success It is essential to emphasize knowledge, morality, learning process and a balance integration of subject matters, such as scientific and technological knowledge and skills (Office of National Education Committee, 1999). The teacher's role is very important as a change agent in learning reform and economic reform. Teachers are expected and assumed responsibilities to teach learners to be self-confident, to be able to work collaboratively, to solve a variety of problems, to communicate effectively and to be creative and critical in their thinking (Jeans and Sararat, 2002). Therefore, teachers have to improve their teaching behaviors, learning and vision for dealing with the effect of globalization towards changing of society whereas knowledge, information technology and communication have been dramatically changed. Teachers not only transfer knowledge but also encourage and promote learners to show their capabilities and potentiality. Teachers have to promote and install environmental awareness as well as skills in acquiring and constructing knowledge which are essential skills in life-long learning. These skills are necessary for the learners in the age of information technology and knowledge-based society. Learning reform is the vital part of all concern for an increasing of competitive potentiality of the country (Watanachai, 2001).

In the age of information technology, the learners have to learn to critique and to organize essential information. At present, learning is not only occurred in a classroom setting but learning resources are in everywhere. The teacher is not the only one who knows best in conveying knowledge but leaning and problem-solving should be collaborative work among teacher, learners and stakeholders. It is imperative that teachers find ways to improve their teaching because the recent teaching and learning methods were not enough to stimulate children's thinking and action. In order to motivate children to think and act more efficiently, teachers should develop effective learning processes by conducting classroom research (Office of National Education Committee, 1999). Thathong and Thathong (2002) found that there were 2,304 teachers (80.8 % of 2,852 teachers) in region 9 who have never conducted classroom research. Their knowledge about conducting research was at a medium level ($\overline{X}$ = 2.67, SD =1.13) and their needs of training on classroom research was at a high level ($\overline{X}$ = 4.08, SD = 0.94). Thathong, et.al. (2004) conducted a research on collaboration of teachers and educational researchers to improve the teaching learning activities on environmental education through the principle of action research found that teachers were lack of skills in conducting classroom research and needed mentors to give suggestions in conducting

research. Mentoring process helped these teachers conduct their own research and encouraged them to present their research findings to public. Thathong et.al. (2004) also proposed a model of three phases in conducting a workshop on classroom research. It should provide content knowledge of research and teaching process in the first phase. The second phase should be provided during a period of conducting research and the third phase should be provide after collecting research data.

Classroom research is a systematic and reliable process to investigate knowledge and information in a context that needs to be improved and developed. In addition, both learners and teachers may benefit from research as part of the learning process and learn together from different type of teaching-learning media and other sources of knowledge (Office of National Education Committee, 1999)

Background of the study

This project consisted of 5 studies, The first study was using the principles of action research in developing teachers' skills in conducting classroom research**,** aimed to foster the skills and ability of participants in conducting classroom research to improve their teaching-learning activities. The second study was using the principles of action research in developing teachers' competency in facilitating the student-centered learning environment. The third study was using the principles of action research in developing the elementary school teachers' skills in constructing the instructional media. The fourth study was using the principles of action research in developing teachers' competency in authentic assessment. The fifth study was using the principles of action research in developing teachers' competency in constructing the school-based curriculum.

Purpose of the study

The purposes of this project were (1) to develop teachers' competency in a) conducting classroom, b) facilitating the student-centered learning environment; c) constructing instructional media, d) authentic assessment, and e) constructing school based curriculum; (2) to develop participation and collaboration between community and educational institutions; and (3) to create network of collaboration among the educational researchers and teachers.

METHOD

There were five workshop sessions conducted at the Faculty of Education.

1. A workshop on classroom research was conducted during 24-25 April, 26-27 June, 11 and 18 July 2004; and again during 18-19, 21-22 April, and 5-6 May 2005..
2. A workshop on facilitating the student-centered learning environment at the Faculty of Education during 30 April, and 1, 5-6 May 2004; and again during 26-27 March and 24-25 April 2005.
3. A workshop on construction of instructional media using principles of action research was conducted during 8-9 and 15-16 May 2004; and again in 2-3 April and 9-10 April 2005.
4. A workshop on authentic assessment was conducted during 22-23, 29 May, and 20 June 2004; and again during 23, 27-28 and 30 April 2005.

5. A workshop on constructing of school-based curriculum was conducted collaboratively at the Faculty of Education and Ban Tamadua School during 30 March, 8 ,27, 29 April, and 5, 7, 30 May 2004; and again during 12-13, 19-20, 29, 31 March and 16 May 2005.

Participants were required to work collaboratively using the principles of action research to improve their teaching. They were required to conduct two pieces of classroom research and integrate at least two subject matters in their teaching-learning activities. In addition, participants had to meet in a group for once a month to report their progress and ask for suggestions and advice in conducting their research. Mini-lecture will depend on needs and problems in conducting research of participants. Figure 1 depicts the cycle of action research in conducting the project.

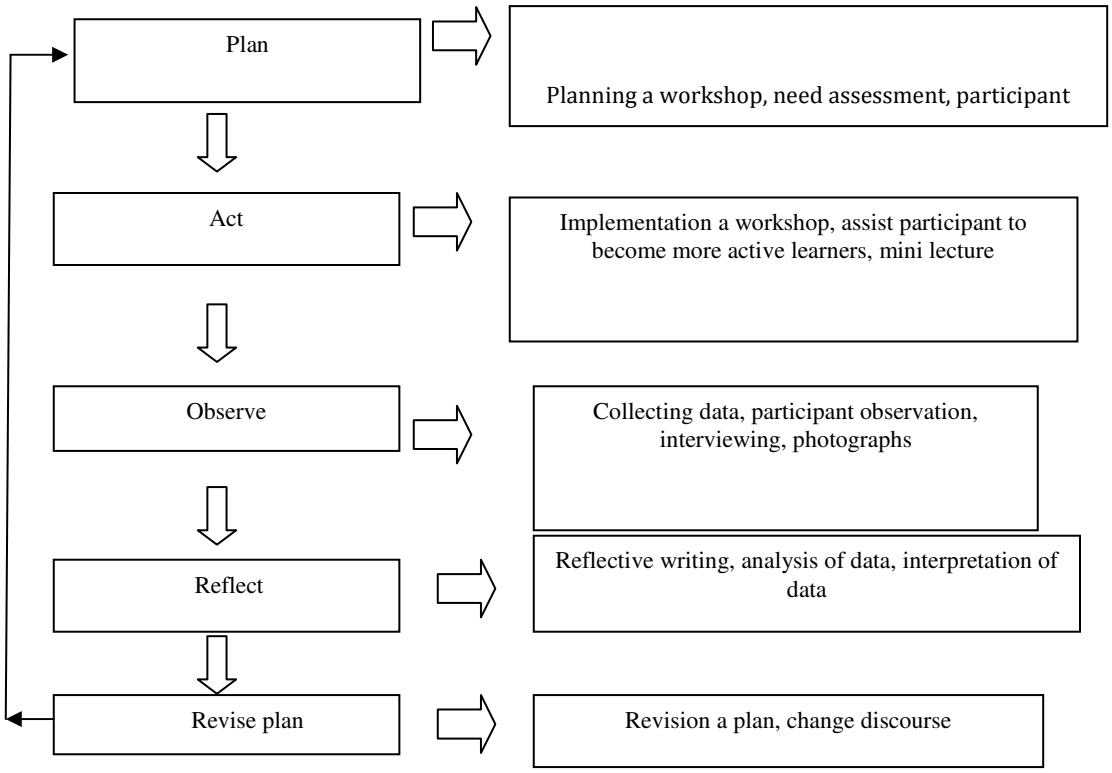

Figure 1. A cycle of action research (adapted from Kemmis & McTaggart.1992)

Participants

The participants were 7 lectures (2 males and 5 females) of the Faculty of Education, Khon Kaen University and 27 elementary school teachers from 8 schools in Khon Kaen Province. There were 8 male and 19 female teachers with an average age of 44 years. Their ages ranged from 28 to 56 years. All teachers completed B.Ed. degree. Two participant observers were graduate students in the Department of Educational Evaluation and Research Design, who observed and used semi-structured interviews with some participants to assist the researchers to reflect on the activities after completion and to validate these reflections.

Techniques for collecting data and monitoring the study

In monitoring the study, the researchers employed various techniques for collecting data such as interviewing, participant observations, journal writings, self-report, testing, reflective writings, taking photographs and using questionnaires.

Techniques for analyzing of data

Data were analyzed both quantitatively and qualitatively. In analyzing qualitative data, a process of interpretative approach was used to understand the essences of a phenomenon under investigation by focusing on meanings of events and phenomena and the social events (Jeans, 1997; Comstock, 1982; Newman, 2002). The triangulation technique was used to cross-reference a number of participants' perceptions of an event (Grundy and Kemmis, 1981; Elliot, 1991). Data were cross-checked by interviewing the participants using three different interviewers to determine the consistency and accuracy of the data. To ensure trustworthiness and authentic ideas or viewpoints, journal-writing reports were read and verified by participants.

During the ongoing workshops, the participants were asked to reflect their opinions. Both open-and closed-ended questionnaires were used at the end of the workshop. In study 1 and 2, the participants were asked to indicate their characteristics before and after the participation using a five-point rating scale questionnaire. In scoring the instrument, numerical values of one through five were also assigned to each level of opinions on their characteristics: lowest (1), low (2), medium (3), high (4), and highest (5). Means ($\overline{X}$) and standard deviations (SD) were computed. If assumptions of parametric statistics were not met, Wilcoxon signed ranks test was used to determine significant differences between the means of participants' characteristics both before and after the participation. If significant differences were found, it meant that their characteristics were positively changed.

At the end of a training session of study 1, 3-5, 30-item test was administered to assess participants' knowledge about conducting research and 20-item tests were administered to assess participants' knowledge about instructional material, authentic assessment, and curriculum based construction. A percentage of passing was 60 for all studies. At least 50% of participants should pass a test. Both open-and closed-ended questionnaires were used at the end of the participatory workshop to assess the effectiveness of the workshop in terms of the participants' satisfaction. The participants were asked to indicate their opinions after participating in the workshop using a five-point rating scale questionnaire. The steps of workshops were based on the ideas of action research

Planning step

The researchers discussed the contents, activities, and schedules of the workshop among lecturers. A tentative plan was established.

Acting step

In this step, the participants performed their activities according to the contents, processes and schedules. These activities were mainly mini-lecture, group discussions, justifications, and presentations.

Observing step

This step was an observation and data collection step. The researchers gathered

the information by various methods of collecting data such as participant observations, interviewing, taking photographs, testing, self-reporting and writing reflections.

Reflecting step

This step was to analyze and interpret data and reflect on the first day by the researchers and an observer. The reflections of the first day activities were used to create and aid in re-planning (tentative) program for the next day.

Re-planning step

The action plans for the next days were adjusted as a result of the reflections and observations of the previous day's activities.

Results

Characteristics and Achievement outcomes

Before and after each of the workshops, the participants were asked to take the tests. A criterion score of passing for each study was 12 except for the study 1 which was 18. It was found that there were significant differences between means of pretest and posttest scores for all studies. For study 1,3 and 4, the percentage of participants passed a test which indicated statistically significant higher than 50% of participants ($\chi 2 = 5.143$, p=0.023; $\chi 2 = 4.84$, p=0.028, $\chi 2 = 6.40$, p=0.011) as illustrated in Table 1.

Table1

Passing proportion, mean, standard deviation and test statistic of pretest and posttest scores for each study

Study	Pretest		Posttest		t-value	sig	Passing	H_o:p = 0.50	
	$\overline{X}$	S.D	$\overline{X}$	S.D				χ^2	Sig
1	16.60	2.24	19.24	3.09	-4.823	.000	0.71	5.143	.023
3	9.94	2.10	12.59	2.48	-4.605	.000	0.63	1.815	.178
4	11.14	2.20	13.19	2.91	-3.462	.002	0.72	4.840	.028
5			13.70	1.42			0.90	6.400	.011

In addition, the participants were asked to indicate their knowledge and ability in conduction research and facilitating student-centered activities before and after participating in the workshops in order to assess more of the participants' outcomes by using 1 = lowest, 2 = low, 3 = medium, 4 = high, and 5 = highest. The results are indicated in Table 2, 3, 4, and 5.

Table 2

Comparison of participants' knowledge and understanding about conducting research before and after participating in the program using Wilcoxon Signed Ranks Test

	Before		After		Wilcoxon Z-value
	$\overline{X}$	SD	$\overline{X}$	SD	
1.Analysis of problem	1.63	0.65	3.54	0.66	-3.349*
2.Assessment of research topic	1.71	0.69	3.38	0.82	-4.097*
3.Identification of problem	1.96	0.75	3.63	0.65	-4.136*
4.Writing of research question	1.71	0.69	3.79	0.72	-4.276*
5.Writing of research proposal	1.63	0.71	3.75	0.79	-4.268*

6.Research design	1.43	0.51	3.32	0.71	-4.315*
7.Constructing of instruments	1.71	0.69	3.83	0.71	-4.346*
8.Collection of data	2.00	0.72	3.75	0.79	-4.262*
9.Analysis of data	1.67	0.70	3.58	0.78	-4.280*
10.Presentation of data	1.75	0.73	3.58	0.78	-4.284*
11.Interpretation of data	1.54	0.72	3.71	0.69	-4.263*
12.Report writing	1.54	0.77	3.71	0.62	-4.262*
Total	1.69	0.70	3.63	0.73	

Table 3

Comparison of participants' ability in conducting research before and after participating in the program using Wilcoxon Signed Ranks Test

	Before		After		Wilcoxon Z-value
	$\overline{X}$	SD	$\overline{X}$	SD	
1.Analysis of problem	1.54	0.72	3.42	0.65	-4.370*
2.Assessment of research topic	1.54	0.66	3.42	0.65	-4.423*
3.Identification of problem	1.88	0.80	3.79	0.66	-4.356*
4.Writing of research question	1.63	0.77	3.71	0.75	-4.360*
5.Writing of research proposal	1.67	0.82	3.71	0.62	-4.283*
6.Research design	1.46	0.60	3.28	0.51	-4.225*
7.Constructing of instruments	1.75	0.68	3.71	0.69	-4.398*
8.Collection of data	1.92	0.72	3.67	0.71	-4.373*
9. Analysis of data	1.58	0.72	3.54	0.66	-4.240*
10.Presentation of data	1.67	0.70	3.46	0.66	-4.285*
11. Interpretation of data	1.50	0.72	3.63	0.72	-4.276*
12. Report writing	1.58	0.78	3.63	0.58	-4.362*
Total	1.64	0. 73	3.58	0. 60	

The results in Table 2 and 3 illustrated that the desirable characteristics of research were fostered and enhanced in participants after participated in the workshop on classroom research. All of knowledge and ability in conducting research were shifted up more than 1.68 on the rating scale, which indicated significant differences at the .05 level. However, all of the participants' characteristics about research were improved.

The results are illustrated in Table 4, which indicated that participants' knowledge and understanding about student-centered activities were fostered and enhanced in participants after the participation. All of knowledge and understanding were shifted up 1.3 to 2.39 on the rating scale, which indicated significant differences at the .05 level. There were three categories that shifted 2 levels on the rating scale. They were teaching-learning activities (Integrating within substance), writing infusion instruction activities, and writing parallel instruction activities

Table 4

Comparison of participants' knowledge and understanding about student-centered

activities before and after participating in the program using Wilcoxon Signed Ranks Test

	Before		After		Wil-coxon Z-value
	$\overline{X}$	SD	$\overline{X}$	SD	
1. providing student-centered activities	2.69	0.62	4.00	0.40	-4.660*
2. writing student-centered lesson plan	2.38	0.75	3.92	0.63	-4.594*
3. using community resource in learning activities	2.46	0.86	4.23	0.82	-4.550*
4. teaching-learning activities (Integrating within substance)	2.08	0.84	4.08	0.63	-4.527
5. teaching-learning activities (Integrating between substance)	1.92	0.84	3.85	0.88	-4.335*
6. writing infusion instruction activities	2.08	0.93	4.31	0.74	-4.520*
7 writing parallel instruction activities	1.77	0.71	4.15	0.67	-4.496*
8. constructing learning activities	2.31	0.74	4.08	0.483	-4.543*
9. constructing instructional media using local materials	2.31	0.62	3.69	0.74	-4.261*
10.providing project-based activities	2.15	0.67	3.69	0.2	-4.597*
Total	2.22	0.76	4.00	0.65	

The results are illustrated in Table 5, which indicated that the participants' ability in providing student-centered activities were fostered and enhanced in participants after the participation. All of abilities were shifted up 1.38 to 2.54 on the rating scale, which indicated significant differences at the .05 level. There were four abilities that shifted 2 levels on the rating scale. They were teaching-learning activities (Integrating within substance), teaching-learning activities (Integrating between substances), writing infusion instruction activities and writing parallel instruction activities.

Table 5

Comparison of participants' ability in providing student-centered activities and after before participating in the program using Wilcoxon Signed Ranks Test

	Before		After		Wilcoxon Z- value
	$\overline{X}$	SD	$\overline{X}$	SD	
1. providing student-centered activities	2.58	0.58	3.96	0.34	-4.617*
2.writing student-centered lesson plan	2.27	0.67	3.92	0.63	-4.556*

3. using community resource in learning activities	2.31	0.84	4.23	0.82	-4.533*
4. teaching-learning activities (Integrating within substance)	1.92	0.84	4.08	0.63	-4.512*
5. teaching-learning activities (Integrating between substance)	1.81	0.85	3.92	0.89	-4.420*
6. writing infusion instruction activities	1.88	0.86	4.31	0.74	-4.509*
7. writing parallel instruction activities	1.65	0.69	4.19	0.69	-4.493*
8. constructing learning activities	2.27	0.72	4.04	0.45	-4.563*
9. constructing instructional media using local materials	2.23	0.59	3.73	0.72	-4.388*
10.providing project-based activities	2.08	0.63	3.69	0.62	-4.617*
Total	2.10	0.74	4.00	0.67	

Satisfaction outcomes

Results of Study 1 and 2 were illustrated in Table 6. The participants indicated their opinions and satisfactions towards both programs at high levels ($\overline{X}$ = 4.26, SD = 0.61; $\overline{X}$ = 3.91, SD = 0.64). The highest levels of opinions were congruence of content and activities ($\overline{X}$ =4.90, SD = 0.31), climate in a meeting room ($\overline{X}$ =4.59, SD = 0.50), and level of gained knowledge ($\overline{X}$ = 4.59, SD = 0.57) for study 1; whereas capability of instructors ($\overline{X}$ = 4.64, SD = 0.49) was indicated the highest level for study 2

Table 6

The means and standard deviations of participants' opinions towards activities used in the workshop of Study 1 and Study 2

Topics	Study 1		Study 2	
	$\overline{X}$	SD	$\overline{X}$	SD
1. Clarity of content	4.14	0.52	3.88	0. 60
2. An appropriateness of using media	4.24	0.64	3.48	0.71
3. Climate in a meeting room	4.59	0.50	4.24	0. 60
4. An appropriateness of materials	4.31	0.54	3.44	0.65
5. Sequence of presentation	4.28	0.53	3.76	0.72
6. Clarity of presentation	4.14	0.64	4.00	0.76
7. Interesting of presentation	4.07	0.70	3.92	0.70
8. An opportunity to ask questions	4.00	0.67	3.96	0.74
9. Easiness to understand	4.32	0.72	4.12	0.78
10. Level of satisfied expectation	4.00	0.76	3.60	0.65
11. Participation in session activities	4.28	0.59	3.63	0.71

12. Level of gained knowledge	4.31	0.60	3.92	0.49
13. An appropriateness of activities	4.59	0.57	3.76	0. 60
14. Interesting of activities	4.07	0.75	4.00	0.50
15. Usefulness of activities	4.17	0.54	4.08	0.41
16. An appropriateness of time allocation	4.28	0.59	4.44	0.58
17. Congruence of content and activities	4.31	0.60	3.40	0.82
18. An appropriateness of presentation	4.90	0.31	3.92	0.49
19. Easy to participate	4.00	0.54	3.96	0.54
20. Capability of instructor	4.14	0.69	4.64	0.49
total	4. 26	0. 61	3.91	0.64

Results of Study 3 and 4 were illustrated in Table 7. The participants indicated their opinions and satisfactions towards both programs at high levels ($\overline{X}$ = 4.17, SD = 0.61; $\overline{X}$ = 4.23, SD = 0.58). The highest levels of opinions were climate in a meeting room ($\overline{X}$ = 4.54, SD = 0.51) for study 4, capability of instructors ($\overline{X}$ = 4.58, SD = 0.51; $\overline{X}$ = 4.75, SD = 0.44) and usefulness of activities ($\overline{X}$ = 4.52, SD = 0.51; $\overline{X}$ = 4.63, SD = 0.50) for both study 3 and study 4.

Table 7
The means and standard deviations of participants' opinions towards activities used in the workshop of Study 3 and Study 4

Topics	Study 3		Study 4	
	$\overline{X}$	SD	$\overline{X}$	SD
1. Clarity of content	4.00	0.59	4.12	0.45
2. An appropriateness of using media	4.13	0.61	4.25	0.68
3. Climate in a meeting room	4.42	0.65	4.54	0.51
4. An appropriateness of materials	3.79	0.78	4.00	0.51
5. Sequence of presentation	4.21	0.51	4.21	0.42
6. Clarity of presentation	4.25	0.53	4.25	0.53
7. Interesting of presentation	4.38	0.50	4.29	0.62
8. An opportunity to ask questions	4.22	0.60	4.25	0.68
9. Easiness to understand	4.21	0.72	4.33	0.76
10. Level of satisfied expectation	4.08	0.41	4.04	0.69
11.Participation in session activities	3.88	0.74	3.92	0.78
12. Level of gained knowledge	4.29	0.81	4.21	0.66
13. An appropriateness of activities	4.00	0.51	3.96	0.55
14. Interesting of activities	4.12	0.54	4.29	0.46
15. Usefulness of activities	4.25	0.53	4.29	0.55
16.An appropriateness of time allocation	4.52	0.51	4.63	0.50
17.Congruence of content and activities	3.67	0.82	4.00	0.66
18.An appropriateness of presentation	4.21	0.51	4.17	0.48
19. Easy to participate	4.25	0.53	4.13	0.54
20.Capability of instructor	4.58	0.50	4.75	0.44

total	4.17	0.61	4.23	0.58

Results of Study 5 illustrated in Table 8. The participants indicated their opinions and satisfactions towards activities in a workshop at high level ($\overline{X}$ = 4.40, SD = 0.56). The four ranks of highest levels of opinions were capability of instructors ($\overline{X}$ = 5.00, SD = .000), usefulness of activities ($\overline{X}$ = 4.91, SD = 0.30), participation in session activities ($\overline{X}$ = 4.82, SD = 0.41), and climate in a meeting room ($\overline{X}$ = 4.82, SD = 0.41).

Table 8
The means and standard deviations of participants' opinions towards activities used in the workshop of study 5

Topics	$\overline{X}$	SD
1. Clarity of content	4.09	0.83
2. An appropriateness of using media	4.10	0.74
3. Climate in a meeting room	4.82	0.41
4. An appropriateness of materials	4.27	0.47
5. Sequence of presentation	4.64	0.51
6. Clarity of presentation	4.18	0.75
7. Interesting of presentation	4.36	0.67
8. An opportunity to ask questions	4.27	0.47
9. Easiness to understand	4.55	0.69
10. Level of satisfied expectation	4.55	0.52
11.Participation in session activities	4.20	0.42
12. Level of gained knowledge	4.82	0.41
13. An appropriateness of activities	4.18	0.60
14. Interesting of activities	4.18	0.41
15. Usefulness of activities	4.55	0.52
16.An appropriateness of time allocation	4.91	0.30
17.Congruence of content and activities	3.45	0.82
18.An appropriateness of presentation	4.50	0.53
19. Easy to participate	4.27	0.47
20.Capability of instructor	5.00	0.00
total	4.40	0.56

Reflections

At the end of each phase of the participatory workshop, all participants were asked to anonymously write their reflections. Every participant said that the workshop was worthwhile and necessary. They appreciated the friendly and democratic atmosphere of the workshop; the opportunity to develop and acquire skills in conducting classroom research on teaching strategies and instructional media; the opportunity to develop and enhance skills in collaborative work and constructing instructional materials; and some of opportunity to participate in the workshop. They claimed that they also had the opportunity to develop skills in interpersonal relations, collaborative work, and problem-

solving. They also developed their ability to discuss, report, speak, and respond to feedback. Some participants said that they were invited to the nearby schools to talk about classroom research and infusion instruction strategies.

> My wife and I participated in this project. We were invited to talk in a session how to conduct research for academic promotion to teachers in our sector. We also talked about how to integrate subject matters in teaching to the nearby school teachers
> (Interviewed participants during a follow up study)
> Thank you for this project. We are very proud of our own school-based curriculum. We have known a process of constructing curriculum. Thank you for assistance and hard working of all members of our schools.
> (Extracted from a participant's journal)

> I am very proud of our school-based curriculum. Thank you for all dedications and hard work of teachers. It was shown on the showcase along with our research works at the open day of our region education 4.
> (Extracted from interviewing a participant)
> We were invited to speak how to constructed school-based curriculum for a school nearby our school.
> (Extracted from interviewing two participants)
> I was very glad to make a right decision to participate in this project. I have gained knowledge as well as weight and enjoyed practicing collaborative work. I was very happy to be a member of this group. I motivated myself not to skip any activities provided by this workshop
> (Extracted from a participant's journal)
> I have gained a lot of experience without paying for participating in the workshop. I really liked materials and enjoyed lunch and coffee break. I have learned to write a proposal to conduct a research.
> (Extracted from a participant's journal)
> I was very impressed in knowledge transmission and friendly atmosphere. Ajarn Theerachai was very keen in explaining ideas in a simple way but there were too much contents in some days.
> (Interviewed a participant)
> The climate in a meeting room was very friendly. I wish this kind of activities should be provided for other teachers in Khon Kaen. I think that I could write an effective lesson plan using some knowledge gained from this workshop.
> (Extracted from a participant's journal)
> I have learned to use different kinds of paper folding and group activities for dividing groups of students
> (Interviewed a participant)
> The model of providing workshop should be like this because teachers should know some theories and then guidelines for applying. The researchers in this project acted like mentors for every step of conducting research.
> (Extracted from a participant's journal).
> We enjoyed delicious lunch so we had sleepy eyes therefore we had to move

ourselves before the session began. We really enjoyed group process activities. We acted like a child and participated with joy

(Extracted from a participant's journal).

I have made a right decision to participate in this project. I have gained knowledge and enjoyed practicing collaborative work. I like activities and applied some activities to my students.

(Extracted from a participant's journal)

I would like to express my feeling that I am very happy to have an opportunity to join a group process activity. I have gained knowledge and enjoyed practicing collaborative work.

(Extracted from a participant's journal)

I used to participate in training on classroom research but I still can't conduct a classroom research. I see the light at the end of the tunnel. I am very proud of myself to conduct a survey research. It is my first research report.

(Extracted from a participant's journal)

Conclusions

The results of this research showed the effectiveness of the workshops in terms of achievement outcomes and satisfaction outcomes of participants. These results also showed that there were improvement and change of participants' knowledge and ability in conducting research and facilitating student-centered activities after participating in this project. Some activities about integration instruction were appeared to be their first experience. They had more chances to express their opinions to the group. They also had an opportunity to learn communication techniques and teamwork skills from working as a group. Many participants thought that they could implement these skills and experiences in their teaching careers. The results also indicated that through this training project, the researchers and participants had developed self-esteem, self-respect, team building, sharing, collaborative work, a sense of belonging, and skills in problem-solving. Networking was established because they have to work collaboratively. The participants were very satisfied with workshop and research activities. They have gained a lot about working as a group. They knew how to work with other people and knew themselves better. They have also developed skills in conducting research on teaching strategies and instructional media to improve their teaching-learning activities. Moreover, the participants had acquired skills in teaching and learning process especially constructing instructional media, cooperative learning and conducting classroom research to improve their teaching. In addition, the benefit of this training project was not limited to personal development of teachers but also their students as student-centered.

In particular, the participants conducted research and were encouraged to present their papers at the Third Conference in Educational Research on September 11, 2005 at the Faculty of Education. 20 papers were presented in poster session.

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Evaluating Performance Improvement through Repeated Measures: A Primer for Educators Considering Univariate and Multivariate Designs

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Abstract

Repeated measures analysis is an important tool for educators committed to evaluating the performance of their students and courses. While evaluations can be performed using a series of t-tests, repeated measures provides practitioners and researchers a more sophisticated tool to analyze the impact of education over time or interventions that employ concurrent tests to measure a particular set of knowledge, skills, or attitudes. This paper provides educators with the information they need to choose between and interpret results based on the univariate and multivariate approach to repeated measures analyses. It also serves to explain the sphericity assumption and its impact on repeated measures designs.

Keywords: univariate, primer, sphericity assumption, repeated measures, evaluation, research design

Introduction

In order to evaluate learning programs, relevant skills, knowledge, and attitudes from program participants are often measured multiple times (Kirkpatrick & Kirkpatrick, 2006). For example, participants may be measured on their ability to perform a particular skill: (a) before taking a course (i.e., pre), (b) immediately after completing a course (i.e., post and retro), and (c) one month after completing a course (i.e., follow-up). To determine if there is a statistical or practical difference between these measurements, a series of t-tests could be conducted (e.g., post-pre, after-post, follow-up-pre). However, the results from such a procedure would be difficult to collectively interpret as the process does not provide for a single omnibus test (R. Henson, personal communication, April 19, 2006). Additionally, the process inflates familywise Type I error rate. This means that the reported probability levels would actually overestimate the statistical significance of the mean differences (Hinkle, Wiersma, Jurs, 2003).

A more appropriate technique to analyze three or more measurements is the repeated measures design (Maxwell & Delaney, 2004). Repeated measures designs are also called within-subjects designs (Girden, 1992). In the case where the design contains a between-subjects factor in addition to a within-subjects factor, the design may be called a mixed-model, randomized block, or a split-plot design (Lamb, 2003). This paper presents a within-subjects repeated measures design with one within-subjects factor and no between-subjects factor (i.e., one-way within-subjects design). Readers interested in

more advanced repeated measures designs are directed to Maxwell and Delaney (2004) and Stevens (2002).

Two approaches for implementing a one-way within-subjects design are discussed: (a) univariate, and (b) multivariate. Before presenting the two approaches, advantages and disadvantages of repeated measures are reviewed as well as the underlying statistical assumptions for the two techniques. The paper concludes by summarizing the differences between the univariate and multivariate approaches.

Advantages and Disadvantages

Advantages

Maxwell and Delaney (2004) cited two advantages of within-subjects design: (a) sample size and (b) precision. In the case of a repeated measures design, each subject contributes *n* scores, where *n* equals the number of measurements. In the example previously depicted, *n* equals 4. As a result of each subject contributing *n* scores, the number of subjects needed to achieve a certain level of statistical power is often much lower in within-subjects designs than in between-subject designs where participants contribute only one score on the dependent variable (Maxwell & Delaney). Venter and Maxwell (1999) showed that in the case of a two-level design, the total number of subjects N_W needed for the within-subjects design is related to N_B, the total number of subjects in the between-subject design, as follows:

$$N_W = N_B\,(1 - \rho)/2 \qquad (1)$$

where ρ is the population correlation between scores at the two levels of the within-subjects design. Table 1 further illustrates the sample size benefits of a one-way two-level repeated measures design.

<Insert Table 1 about here>

It is important to note that Venter and Maxwell's (1999) formula relies on compound symmetry and is therefore most applicable to the univariate approach to repeated measures. However, in the case of a two-level design, the univariate and multivariate approaches are identical (Maxwell & Delaney, 2004). Therefore, the sample size benefits of a one-way two-level repeated measures design are identical for both repeated measures techniques (i.e., univariate and multivariate). A generalization of Venter and Maxwell's formula is presented in the univariate section of this paper. Considerations for determining sample size in a multivariate analysis are presented in the multivariate section.

In addition to requiring fewer subjects than between-subjects designs, repeated measures designs provide greater precision since subjects serve as their own control (Stevens, 2002). Because comparisons in the repeated-measures designs are made within-subjects, variability in individual differences between-subjects is removed from the error term (Maxwell & Delaney, 2004). Figure 1 illustrates this point. In the repeated measures design, the error term (SS_{Res}) does not include the variable among individuals (SS_I) as its counterpart (SS_W) does in the between-subjects design. As the variance among individuals is partitioned out of the error term, repeated measures designs are much more powerful than completely randomized designs (Stevens, 2002) and most likely result in a larger eta-squared (K. Roberts, personal communication, July 5, 2004).

<Insert Figure 1 about here>

Disadvantages

Tanguma (1999) identified three disadvantages of repeated measures design: (a) practice effects, (b) differential carryover effects, and (c) the potential for violations of statistical assumptions. Descriptions of the first two disadvantages and techniques for management are discussed. As conforming to the underlying statistical assumptions is a critical issue for all research designs (Hinkle, Wiersma, & Jurs, 2003), such issues are reserved to a subsequent section of the paper devoted to the subject.

Practice effects

Practice effects occur when subjects change systematically during the course of an experiment (Tanguma, 1999). Such changes may involve a positive or negative effect (Lewis, 1993).

In the case of education, a positive practice effect may indicate an improvement in subjects' knowledge, skills, or attitudes. However, in lieu of a learning program being responsible for the change, the improvement may be an artifact of the participants being retested using the same or similar instrumentation (Gall, Gall, & Borg, 2003). A technique to manage practice effects is to integrate a control group into the repeated measures design since the re-testing effect should manifest itself equally in the control and the experimental group (Campbell & Stanley, 1963).

Tanguma(1999) indicated that a negative practice effect may result from fatigue or boredom. He recommended that researchers lengthen the rest period between measurement occasions to manage fatigue and provide incentives as a technique to motivate participants throughout the course of the experiment.

Counterbalancing is also identified as a technique to manage practice effects (Lamb, 2003; Maxwell & Delaney, 2004; Tanguma, 1999; Wells, 1998). However, counterbalancing is most appropriate for designs where subjects are observed in different treatment conditions (Maxwell & Delaney) as counterbalancing is a way of ordering treatments so that each treatment is administered an equal number of times first, second, third, and so on, in particular sequences of conditions given to different subjects (Tanguma) . In the case of evaluating the effects of a learning program, participants are usually subjected to one treatment and then observed longitudinally over time (Kirkpatrick & Kirkpatrick, 2006). Counterbalancing therefore would not be an appropriate technique to manage the practice order effects when measuring participants using the traditional occasions (e.g., pre, post, retro, and follow-up).

Differential carryover effects

An artifact of counterbalancing may be differential carryover effects. "Differential carryover effect occurs when the carryover effect of Treatment Condition 1 onto Treatment Condition 2 is different from the carryover effect of Treatment Condition 2 onto Treatment Condition 1" (Maxwell & Delaney, 2004, p. 556). Tanguma (1999) asserted that a possible solution to differential carryover effects is providing participants sufficient time between treatments so that the treatment condition dissipates completely from the subjects' system. Maxwell and Delany disagree and assert that a within-subjects design should be abandoned if differential carryover effect is a potential threat to validity. For the typical learning program evaluation, differential carryover effects is not an issue since implementing a counterbalanced design is not appropriate for reasons previously stated.

Statistical Assumptions

Stevens (2002) identified three assumptions for a single-group repeated measures analysis: (a) independence of observations, (b) multivariate normality, and (c) sphericity. Of the three assumptions, the first two apply to the multivariate approach while all three apply to the univariate approach.

Independence of observations

Violation of independence of observations can lead to increased Type I error rate (Hinkle, Wiersma, & Jurs, 2003). While this assumption is typically met through random selection (Gall, Gall, & Borg, 2003), learning programs are usually evaluated with intact groups. The interaction of the group may affect the scores of the members resulting in correlated observations (Lamb, 2003). Correlated observations can cause an overestimation of the true probability and is resolved by testing at a more stringent level of significance (Stevens, 2002).

Multivariate normality

The properties of ANOVA and MANOVA that make them robust to violations of multivariate normality carry over to repeated measures designs (Stevens, 2002). However, statistical tests of sphericity are not robust to the assumption of multivariate normality (Olejnik & Huberty, 1993). In the absence of multivariate normality, statistical tests of sphericity may indicate heterogeneity of variance between measurement occasions when they should fail to reject the null hypothesis (Minke, 1997). See Henson (1999) for techniques to assess multivariate normality.

Sphericity

Testing for Sphericity. Simply stated, the sphericity assumption is met when the variance at each measurement occasion is equal (K. Roberts, personal communication, July 5, 2004). Girden (1992) identified two techniques to test for sphericity: (a) examining variances of differences between all pairs of measurement occasions and (b) examining the matrix of orthonormal contrasts.

Variances of Differences between Pairs of Measurement Occasions. The variance of differences between two measurement occasions can be computed using the following formula (Girden, 1992):

$$\sigma^2{}_{A-B} = \sigma^2{}_A + \sigma^2{}_B - 2\sigma_{AB} \quad (2)$$

where $\sigma^2{}_A$ is the variance of a set of scores under measurement occasion A, $\sigma^2{}_B$ is the variance of a set of scores under measurement occasion B, and $\sigma^2{}_{AB}$ is the covariance of the two sets of scores. The more direct way of determining variance between two occasions is to compute the variance of the difference scores (Girden). Using either technique, sphericity is met if the variances between all pairs of measurement occasions are equal (Tanguma, 1999).

Using the variance-covariance information in Table 3 based on the heuristic data in Table 2, $\sigma^2{}_{A\text{-}B} = 79.817$, $\sigma^2{}_{A\text{-}C} = 233.635$, $\sigma^2{}_{A\text{-}D} = 91.273$, $\sigma^2{}_{B\text{-}C} = 163.636$, $\sigma^2{}_{B\text{-}D} = 111.272$, $\sigma^2{}_{C\text{-}D} = 59.818$. Table 4 illustrates that the same variances are computed when using difference scores. For the data set identified in Table 2, the sphericity assumption is not met.

<Insert Table 2 about here>
<Insert Table 3 about here>
<Insert Table 4 about here>

Matrix of Orthonormal Contrasts

Girden (1992) and Stevens (2002) asserted that sphericity is also said to exist if:

$$C^T \sum C = \sigma^2 I \quad (3)$$

where C is a matrix of (k - 1) orthogonal contrasts, C^T is the transpose of C, $\sum$ is the variance-covariance matrix, and I is an identity matrix. Multiplying the matrix of orthogonal contrasts identified in Table 5, its transpose (Table 6), and the variance-covariance matrix for the data in Table 2 (Table 3) results in the covariance matrix of transformed variables depicted in Table 7. For the dataset illustrated, the sphericity assumption is not met as the covariance matrix for the transformed variables does not have equal variances on the diagonal (Stevens, 2002).

<Insert Table 5 about here>
<Insert Table 6 about here>
<Insert Table 7 about here>

Mauchly's Sphericity Test. Maxwell and Delaney (2004) highlighted that while sphericity tests such as the techniques outlined by Girden (1992) indicate variance inequalities in the sample, the sphericity assumption is only violated if it holds in the population as well. The authors recognized that even if sample variances are unequal, such inequalities might simply reflect sampling error. Therefore, they recommended that Mauchly's sphericity test (i.e., Mauchly's *W*) be used to test the null hypothesis that the homogeneity condition holds in the population.

While Mauchly's *W* has limitations in behavioral science research (including the analysis of learning program outcomes) due to its sensitivity to multivariate normality (Stevens, 2002), it is presented here since the results of the test are automatically generated in software packages (e.g., SPSS 14.0 for Windows) that conduct repeated measures analyses. Furthermore, studies conducted by Huynh and Mandeville (as cited in Keselman, Rogan, Mendoza, & Breen, 1980) found that for short-tailed distributions, the test basically maintains the true rate of Type I error below the level of significance alpha.

Figure 2 depicts the results for the Mauchly's test for the dataset represented in Table 2. The results are interpreted the same way as Levene's test for homogeneity of variance in ANOVA. If the *p-calc* value generated is greater than or equal to the *p-crit* value defined by the researcher, then homogeneity of variance is assumed. Otherwise, the sphericity assumption is not met. In the example provided, Mauchly's test indicates that the heterogeneity of variance between measurement occasions is statistically significant at the .05 alpha level (p = .018).

<Insert Figure 2 about here>

Managing Violations to Sphericity. If the sphericity assumption is not met, the *F* ratio generated by the univariate repeated measures analysis is positively biased, rejecting falsely too often (Maxwell & Delaney, 2004). For example, if the alpha level is set at .05 and the sphericity assumption is not, univariate repeated measures analyses may falsely reject the null hypothesis 10% or 15% of the time (Stevens, 2002). To adjust for the positive bias, the degrees of freedom for the repeated measures *F* test may be corrected using one of three adjustments: (a) Greenhouse-Geisser, (b) Huynh-Feldt, and (c) Lower-

bound. However, it is important to note that while the adjusted tests provide better control for Type I error rate, they are only approximate (Maxwell & Delaney).

The Greenhouse-Geiser formula shown below results in a parameter ($\hat{\varepsilon}$) that identifies the extent to which the covariance matrix deviates from sphericity (Stevens, 2002):

$$\frac{a^2(\overline{E}_{jj} - \overline{E})^2}{(a-1)((\sum\sum E^2{}_{jk}) - (2a\sum \overline{E}^2{}_{j.}) + (a^2\overline{E}_{..}^2))} \quad (4)$$

where E_{jk} is the element in row j and column k of the sample covariance matrix, $\overline{E}_{jj}$ is the mean of variances along the diagonal in the sample covariance matrix, $\overline{E}_{j.}$ is the mean of all entries in j^{th} row of the sample covariance matrix, $\overline{E}_{..}$ is the mean of all entries in the sample covariance matrix, and a is the number of measurement occasions. The resulting parameter is used to correct the degrees of freedom for the measurement occasion and error term. For the dataset depicted in Table 2, $\hat{\varepsilon}$ is .610. Applying the $\hat{\varepsilon}$ to the unadjusted degrees of freedom for the measurement occasion ($(a - 1) = 3$) and the error term ($(n - 1) * (a - 1) = 33$) results in corrected degrees of freedom of 1.820 and 20.115, respectively.

The Huynh-Feld formula results in a parameter ($\tilde{\varepsilon}$) that identifies the extent to which the covariance matrix deviates from sphericity (Stevens, 2002):

$$\frac{n(a-1)\hat{\varepsilon} - 2}{(a-1)(n-1-(a-1)\hat{\varepsilon})} \quad (5)$$

where n is the number of subjects, a is the number of measurement occasions, and $\hat{\varepsilon}$ is the Greenhouse-Geisser adjustment. The resulting parameter is used to correct the degrees of freedom for the measurement occasion and error term. For the dataset depicted in Table 2, $\tilde{\varepsilon}$ is .725. Applying the $\tilde{\varepsilon}$ to the degrees of freedom for the measurement occasion and the error term results in corrected degrees of freedom of 2.175 and 23.920, respectively.

The lower-bound adjustment simply sets the degrees of freedom for the measurement occasion to one and the degrees of freedom for the error term to (n - 1). The lower-bound adjustment suggests that no matter how badly the homogeneity assumption is violated, the largest possible critical F value needed requires one and (n – 1) degrees of freedom (Maxwell & Delaney, 2004).

Figure 3 illustrates the associated effect on the p-value for each of the three adjustments. Of the three techniques, the Greenhouse-Geiser formula provides a moderate correction, the Huynh-Feld is the least conservative, and the lower-bound adjustment is the most conservative. The Greenhouse-Geiser formula tends to underestimate ε, while the Huyn-Feld adjustment tends to overestimate ε (Stevens, 2002). Therefore, Stevens recommended that in lieu of using any of these three adjustments directly that researchers use the average of the Greenhouse-Geisser and

Huyn-Feld adjustments in order to correct the degrees of freedom for the repeated measures *F* test. Alternatively, he indicated that researchers choose the Greenhouse-Geisser test to be *somewhat conservative.*

<Insert Figure 3 about here>

Univariate

In presenting the univariate approach to repeated measures, the following tasks are considered: (a) calculating sample size, (b) conducting the omnibus test, (c) computing effect size, (d) analyzing contrasts, and (e) reporting results. The topics are presented in approximate procedural order.

Calculating Sample Size

Although Cohen's classical text (1988) on power analysis provides power tables for a variety of situations, it does not provide tables for repeated measures. However, formulas for determining the appropriate sample size for a single group repeated measures design can be derived after first determining the sample size needed for a between-subjects design (Stevens, 2002). The following is one such formula (Maxwell & Delaney, 2004):

$$N_W = N_B\,(1 - \rho)/a \qquad (6)$$

where N_W equals the sample size for the within-subjects design, N_B is the sample size for the between-subjects design, ρ is the average correlation for the subjects' responses to all measurement occasions, and a is the number of measurement occasions. It is important to note that the formula relies heavily on sphericity. In cases where the sphericity assumption is not met, researchers are directed to Elashoff (as cited in Maxwell & Delaney, 2004).

Conducting Omnibus Test

The univariate repeated measures omnibus test for a single group compares an *F-calc* to an *F-crit* similar to a between-subjects ANOVA. However, the difference between the two approaches relates to variation among individuals: First, the denominator of the *F-calc* (error term) excludes the variation among individuals. Second, the degrees of freedom for the error term excludes the degrees of freedom associated with individuals. Table 8 outlines the formulas for computing the repeated measures *F-calc*. Table 9 depicts their use based on the data identified in Table 2 assuming that the sphericity assumption has been met.

<Insert Table 8 about here>

<Insert Table 9 about here>

The univariate technique for conducting a repeated measures omnibus test for a single group can also be conducted using a statistical software package. Figure 4 identifies the SPSS code to conduct a repeated measure test for the data identified in Table 2. Figure 5 relates relevant output to an ANOVA summary table consistent with the information provided in Table 9.

<Insert Figure 4 about here>

<Insert Figure 5 about here>

Computing Effect Size

In addition to determining the statistical significance of a univariate repeated measures design, it is also important to analyze the practical significance of the test (Henson, in press). This can be accomplished by computing omega squared (ω^2). The formula for ω^2 in one-way within-subjects designs based on the univariate approach is as follows (Maxwell & Delaney, 2004):

$$\omega^2 = \frac{(k-1)(MS_{occasions} - MS_{error})}{SS_{total} + MS_{individuals}} \quad (7)$$

where *k* equals the number of measurement occaions, *MS* denotes mean square, and *SS* denotes sums of squares. Applying these formulas to the data in Table 2 results in an ω^2 of .0377, indicating that the measurement occasion accounted for 3.77% of the variance in the dependent variable.

Analyzing Contrasts

In addition or in lieu of conducting a univariate repeated measures omnibus test (Oljenik & Huberty, 1993), researchers may want to analyze specific means differences or conduct trend analyses. In either case, this is accomplished by testing contrasts. The univariate formula for testing contrasts is as follows (Maxwell & Delaney, 2004):

$$F_{calc} = n\overline{D}^2 / MS_{error} \quad (8)$$

where *n* equals the number of subjects, *D* is the transformed variable resulting from applying the contrasts to the original data, and MS_{error} is the pooled average error term generated by the omnibus test. As the univariate formula employs a pooled error term, it relies heavily on the sphericity assumption. If the assumption is not met, MS_{error} should be replaced with an individual error term. Testing contrasts with a separate variance estimate approach is consistent with multivariate analyses. Therefore, its formula is outlined in the multivariate section.

To illustrate the process of conducting a trend analysis, a contrast matrix is identified in Table 10. Applying the contrast matrix elements to the data in Table 2 results in a set of transformed variables identified in Table 11. Applying the formulas to the transformed variables indicates that the linear and quadratic trends are not statistically significant ($F_{linear}(1,11) = 3.19$; $p > .05$ and $F_{quadratic}(1,11) = .20$, $p > .05$). However, the cubic trend is statistically significant ($F_{cubic}(1,11) = 5.69$; $p < .05$).

<Insert Table 10 about here>

<Insert Table 11 about here>

Statistical software packages also report the results of polynomial trends as a byproduct of conducting a repeated measures analysis. Figure 6 outlines the relevant trend analysis output generated by SPSS for the data in Table 2. However, SPSS employs a separate variance estimate approach in lieu of the pooled error term. Therefore, the *F* values generated by SPSS are different than the hand calculations previously noted ($F_{linear}(1,11) = 2.475$; $p = .144$; $F_{quadratic}(1,11) = .219$; $p = .649$; $F_{cubic}(1,11) = 7.066$; $p = .022$).

<Insert Figure 6 about here>

Reporting Results

In addition to reporting the ANOVA summary table (as depicted in Table 9 and Figure 5), researchers need to report on results of a priori tests, null hypothesis tests, effect size calculations, and post-hoc analyses (Henson, in press; Ojenick & Huberty, 1993). The following provides an example write-up of the results of the tests conducted for the data in Table 2. The data obtained from the four points of measurement lacked

sphericity (Mauchly's $W = .034$; $p = .018$). Therefore, the Greenhouse-Geisser adjustment was employed in analyzing the repeated measures ($\hat{\varepsilon} = .610$). We fail to reject the null hypothesis that the amount of perceived knowledge measured at four different points of time relative to a learning intervention are equal ($F(1.829, 20.115) = 3.027$, $p=.064$). As indicated by the univariate ω^2 (Maxwell & Delaney, 2004), occasion accounted for 3.77% of the variance in perceived knowledge. Trend analysis indicated that the cubic trend was statistically significant ($F(1,11) = 7.066$, $p = .022$).

Multivariate

In presenting the multivariate approach to repeated measures, the following tasks are considered: (a) calculating sample size, (b) conducting the omnibus test, (c) computing effect size, (d) analyzing contrasts, and (e) reporting results. The topics are presented in approximate procedural order.

Calculating Sample Size

Maxwell and Delaney (2004) outlined sample size tables for conducing repeated measures analyses using the multivariate approach (pp. 640-643). The authors indicated that the values were obtained by using a noncentrality parameter value of:

$$\delta^2 = nd^2 / 2(1 - \rho_{\min}) \tag{9}$$

where n equals the sample size, d is the expected effect, and $\rho_{\min}$ is the minimum correlation between measurement occasions. They further noted four patterns to the tables: First, the required number of subjects generally increases as the number of levels increases. Second, the number of subjects increases as the level of desired power increases. Third, as d increases, the number of subjects needed decreases. Fourth, as $\rho_{\min}$ increases, the number of subjects decreases as higher correlations are indicative of greater consistency in subjects' scores across measurement occasions making effects easier to detect.

When considering the sample size requirements for a multivariate test compared to a univariate test, the multivariate approach is less powerful in the presence of sphericity (Stevens, 2002). Maxwell and Delaney (2004) also noted that all other things being equal, the multivariate approach loses power when compared to the univariate approach, as the number of subjects (n) decreases. They further asserted that the multivariate approach may be mathematically impossible when n is less than the number of levels (k) + 10. However, in cases where n is greater than k + 10 and there is a large violation of sphericity ($\varepsilon < 0.7$), the multivariate procedure is more powerful (Field, n. d.).

Conducting Omnibus Test

Hotelling's T^2 is consistently used (e.g., Girden, 1992; Stevens, 2002; Tanguma, 1999) as the multivariate statistic to analyze repeated measures. It is important to note that the multivariate analysis is not performed on the original scores but on the differences between adjacent measurements (Tanguma). Table 11 identifies the latent variables constructed for the data in Table 2.

As the following formulas show, Hotelling's T^2 (formula 11) is analogous to the t statistic (formula 10) for dependent samples:

$$t^2 = \frac{\overline{d}^2}{s_d{}^2 / n} \quad (10)$$

where d is the mean difference between two dependent samples and s_d^2 is the variance of difference scores, and n is the number of subjects.

$$T^2 = n y'_d \, S_d{}^{-1} y_d \quad (11)$$

where n is the number of subjects, y'_d is the row vector of mean differences on the (k - 1) difference variables, S_d is the matrix of variances and covariances on the (k – 1) difference variables (Stevens, 2002).

As depicted in Figure 7, T^2 for the data in Table 2 is 8.21. Applying the following formula that converts T^2 to an F statistic results in an F_{calc} of 2.24:

$$F = [(n - k + 1) / ((n - 1)*(k - 1))] \, T^2 \quad (12)$$

where n equals the number of subjects and k equals the number of measurement occasions.

The resultant F_{calc} is insufficient to reject the null hypothesis at the .05 alpha level with 3 (k – 1) and 9 (n – k – 1) degrees of freedom.

<Insert Figure 7 about here>

The multivariate technique for conducting the repeated measures omnibus test for a single group can also be conducted using a statistical software package. Figure 8 identifies the SPSS code to conduct a multivariate repeated measures test for the data identified in Table 2. Figure 9 identifies relevant SPSS output. Note that the Hotelling trace coefficient (.74670) depicted in Figure 9 is a derivative of the T^2 previously computed, where:

$$\text{Hotelling trace coefficient} = T^2 / (n - 1) \quad (13)$$

where n equals the number of subjects. Also note that the F statistic identified (2.24) is the same as the F_{calc} previously computed. The multivariate tests (Pillais, Hotellings, and Wilks) conducted also provide identical F statistics and p-values. Chen (2004) indicated that while the tests usually provide similar results, Wilks' output should be chosen in the event the results are different.

<Insert Figure 8 about here>

<Insert Figure 9 about here>

Analyzing Contrasts

While the omnibus multivariate repeated measures test is performed on latent variables, the multivariate approach to testing contrasts is performed on the original scores. The process mirrors the univariate approach. The only exception is that the error term in the multivariate approach is an individual error term such that the multivariate formula for testing contrasts is as follows (Maxwell & Delaney, 2004):

$$F_{calc} = n\overline{D}^2 / S^2{}_D \quad (14)$$

where n equals the number of subjects, D is the transformed variable resulting from applying the contrasts to the original data, $S^2{}_D$ is the variance for the vector of transformed variables.

Applying the multivariate formula to the transformed variables identified in Table 11 indicates that the linear and quadratic trends are not statistically significant ($F_{linear}(1,11) = 2.475$; $p > .05$ and $F_{quadratic}(1,11) = .219$, $p > .05$). However, the cubic trend is statistically significant ($F_{cubic}(1,11) = 7.066$; $p < .05$).

Statistical software packages also report the results of polynomial trends as a byproduct of conducting a multivariate repeated measures analysis. Figure 10 outlines relevant trend analysis output generated by SPSS MANOVA command for the data in Table 2. While the univariate analyses are based on *t*-values (i.e., t_{linear} = 1.572, $t_{quadtratic}$ = .467, t_{cubic} = -2.658), the *p*-values generated (i.e., p_{linear} = .144, $p_{quadtratic}$ = .649; p_{cubic} = .022) are the same as those generated from the univariate *F* tests resulting from the General Linear Model (GLM) command (see Figure 6). This illustrates that SPSS employs a multivariate approach (i.e., an individual error term) when testing contrasts as a consequence of the GLM or the MANOVA command.

<Insert Figure 10 about here>

Computing Effect Size

In addition to determining the statistical significance of a multivariate repeated measures design, it is also important to analyze the practical significance of the test (Henson, in press). This can be accomplished by computing omega squared (ω^2). The formula for ω^2 in one-way within-subjects designs based on the multivariate approach is as follows (Maxwell & Delaney, 2004):

$$\omega^2 = 1 - \frac{n\Lambda}{df_{error} + \Lambda} \tag{15}$$

where *n* equals the number of subjects, *df* denotes degrees of freedom, and Λ equals the Wilks' lambda value. Applying this formula to the multivariate results in Figure 9 results in an ω^2 of .282, indicating that the measurement occasion accounted for 28.2% of the variance in the composite dependent variable. It is important to note that the multivariate omega squared is approximately seven times larger than the univariate omega squared for the same data. While this may appear to be an advantage of the multivariate approach, total variance is conceptualized differently between the two approaches. In particular, variation attributable to systematic individual differences is excluded from the total variance in the multivariate conceptualization (Maxwell & Delaney, 2004). Maxwell and Delaney asserted that since variability due to subjects should be included in the conceptualization of total variance, the univariate version of omega squared is preferred.

Reporting Results

The following provides an example write-up of the results of the multivariate approach to testing the repeated measures for the data in Table 2. Using Wilks' lambda criteria, we fail to reject the null hypothesis that the composite amount of perceived knowledge measured at four different points of time relative to a learning intervention are equal ($F(3,9) = 2.240$, p=.153). As indicated by the univariate ω^2 (Maxwell & Delaney, 2004), occasion accounted for 3.77% of the variance in perceived knowledge. Trend analysis indicated that the cubic trend was statistically significant ($F(1,11) = 7.066$, p = .022).

Summary

In considering the differences between the multivariate and univariate approaches to repeated measures analyses, Maxwell and Delaney noted four issues: (a) statistical assumptions, (b) tests of contrasts, (c) Type I error rate, and (d) Type II error rate (power). After summarizing the differences between the univariate and multivariate

considerations for each of these subjects, this paper concludes by presenting guidelines to use when considering the two approaches.

Statistical assumptions

The distinction between the statistical assumptions required for the two approaches is sphericity. While the sphericity assumption is not applicable to the multivariate approach, the univariate approach assumes sphericity. In particular, the univariate approach to conducting omnibus tests, contrast tests, and sample size calculations requires sphericity.

Tests of Contrasts

Testing contrasts in the multivariate approach employs individual error terms, while the univariate approach employs a pooled error term. Therefore, the univariate approach to testing contrasts can provide misleading results when the sphericity assumption is violated.

Type I Error Rate

Type I error rate can be two to three times higher than the nominal value in the univariate approach when sphericity is violated. While ε adjustments provide better control, they are not exact. The multivariate approach produces exact Type I error rates assuming that its statistical assumptions have been met (Maxwell & Delaney, 2004).

Type II Error Rate

Under the condition of sphericity, univariate tests provide better power than the multivariate approach. When sphericity is not met, neither test is uniformly more powerful than the other. However, as the degree of violation of sphericity increases, the power for the multivariate test increases.

Guidelines

Faced with the differences between the univariate and multivariate approaches, Field (n.d.) identified the following rules of thumb for choosing between univariate and multivariate approach to repeated measures analyses: (a) The multivariate approach is preferred when there is a large violation of sphericity ($\varepsilon < 0.7$) and when n is greater than ($k + 10$). (b) The univariate approach is preferred when sphericity holds ($\varepsilon > 0.7$) or when the sample size is small.

Stevens (2002) provided a different guideline for considering a repeated measures approach. He indicated that if researchers can meet Maxwell and Delaney's (2004) rule of thumb relating sample size to number of levels ($n > k + 10$) that they conduct *both* the adjusted univariate and multivariate test and discern any differences in treatment effects. He further recommended that researchers following this advice set the experimentwise level of significance for each test to half of the overall desired alpha level.

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Table 1.
Sample Size Required to Detect a Medium Difference between Two Means (power = .80)

ρ	Between-Subjects	Within-Subjects
0.0	128	64
0.3	128	45
0.5	128	32
0.7	128	20

Source: Maxwell & Delaney (2004, p. 562).

Table 2.
Heuristic Dataset

Subject	A	B	C	D	Mean
1	96	108	122	110	109
2	117	103	133	127	120
3	107	96	107	106	104
4	85	84	99	92	90
5	125	118	116	125	121
6	107	110	91	96	101
7	128	129	128	123	127
8	84	90	113	101	97
9	104	84	88	100	94
10	100	96	105	103	101
11	114	105	112	105	109
12	117	113	130	132	123
Total	1284	1236	1344	1320	

Note: The grand mean (M_{grand}) of the 48 scores is 108.

Table 3.
Variance-Covariance Matrix for Data in Table 2

	A	B	C	D
A	200.545	154.364	97.455	143.636
B	154.364	188.000	121.182	127.364
C	97.455	121.182	218.000	168.091
D	143.636	127.364	168.091	178.000

Table 4.
Variance of Difference Scores for Data in Table 2

Subject	A-B	A-C	A-D	B-C	B-D	C-D
1	-12.000	-26.000	-14.000	-14.000	-2.000	12.000
2	14.000	-16.000	-10.000	-30.000	-24.000	6.000
3	11.000	0.000	1.000	-11.000	-10.000	1.000
4	1.000	-14.000	-7.000	-15.000	-8.000	7.000
5	7.000	9.000	0.000	2.000	-7.000	-9.000
6	-3.000	16.000	11.000	19.000	14.000	-5.000
7	-1.000	0.000	5.000	1.000	6.000	5.000
8	-6.000	-29.000	-17.000	-23.000	-11.000	12.000
9	20.000	16.000	4.000	-4.000	-16.000	-12.000
10	4.000	-5.000	-3.000	-9.000	-7.000	2.000
11	9.000	2.000	9.000	-7.000	0.000	7.000
12	4.000	-13.000	-15.000	-17.000	-19.000	-2.000
Variance	79.818	223.636	91.273	163.636	111.273	59.818

Table 5.
Matrix of Orthonormal Contrasts for Data in Table 2

Occasion	C1	C2	C3
A	.707	.408	.289
B	-.707	.408	.289
C	.000	-.816	.289
D	.000	.000	-.866

Table 6.
Transpose of Matrix identified in Table 5

Occasion	A	B	C	D
C1	.707	-.707	.000	.000
C2	.408	.408	-.816	.000
C3	.289	.289	.289	-.866

Table 7.
Covariance Matrix of Transformed Variables for Data in Table 2

	T1	T2	T3
T1	39.898	17.308	-12.248
T2	17.307	115.649	28.060
T3	-12.248	28.060	26.675

Table 8.
Formulas for Conducting the Repeated Measures Omnibus Test

Source	*SS*	*df*	*MS*	*F*
Occasions	$\sum(T^2/n)-(G^2/N)$	*k-1*	$SS_{occasions}/df_{occasions}$	$MS_{occasions}/MS_{error}$
Individuals	$\sum k(M_{subject}-M_{grand})^2$	*n-1*	$SS_{individuals}/df_{individuals}$	
Error	$SS_{total} - SS_{individuals} - SS_{occasions}$	*(k-1)(n-1)*	SS_{error}/df_{error}	
Total	$\sum X^2-(G^2/N)$	*N-1*		

Note: T = sum of the test scores for each particular test, G = sum of all the scores; $\sum X^2$ = sum of all squared scores; N = number of scores in the entire experiment; $M_{subject}$ = mean of each individual's scores; M_{grand} = grand mean of all scores; n = number of individuals; k = number of occasions

Table 9.
Repeated Measures ANOVA Summary Table and Related Computations for Data in Table 2

Source	*SS*	*df*	*MS*	*F*
Individuals	$4*[(109-108)^2 + (120-108)^2 + (104-108)^2 + (90-108)^2 + (121-108)^2 + (101-108)^2 + (127-108)^2 + (97-108)^2 + (94-108)^2 + (101-108)^2 + (109-108)^2 + (123-108)^2] = 6624$	12-1= 11	602.18	
Occasions	$[(1284^2/12) + (1236^2/12)+ (1344^2/12) + (1320^2/12)] – (5{,}184^2/48) = 552$	4-1= 3	184.00	3.03
Error	9182 – 6624 – 552 = 2006	(4-1)*(12-1)= 33	60.79	
Total	$569054 – (5184^2/48)$ = 9182	48-1 = 47		

Note: *F-crit* (3,33) ~= 2.84; therefore, the null hypothesis is rejected at the .05 alpha level.

Table 10.
Matrix of Orthonormal Contrasts to Analyze Polynomial Trends for Data in Table 2

	Contrasts		
Measurement	Linear	Quadratic	Cubic
A	-0.671	0.500	-0.224
B	-0.224	-0.500	0.671
C	0.224	-0.500	-0.671
D	0.671	0.500	-.224

Table 11.
Transformed Variables and Latent Variables based on Data in Table 2

Subject	Linear	Quadratic	Cubic	A-B	B-C	C-D
1	12.52	-12.00	-6.26	-12	-14	12
2	13.42	4.00	-17.89	14	-30	6
3	1.79	5.00	-7.60	11	-11	1
4	8.05	-3.00	-8.50	1	-15	7
5	-0.45	8.00	1.34	7	2	-9
6	-11.63	1.00	10.29	-3	19	-5
7	-3.58	-3.00	-0.45	-1	1	5
8	16.55	-9.00	-11.63	-6	-23	12
9	-1.79	16.00	-3.58	20	-4	-12
10	4.02	1.00	-5.37	4	-9	2
11	-4.47	1.00	-6.71	9	-7	7
12	13.86	3.00	-8.05	4	-17	-2
Mean	4.02	1.00	-5.37	4	-9	2
Variance	78.56	54.91	48.92			

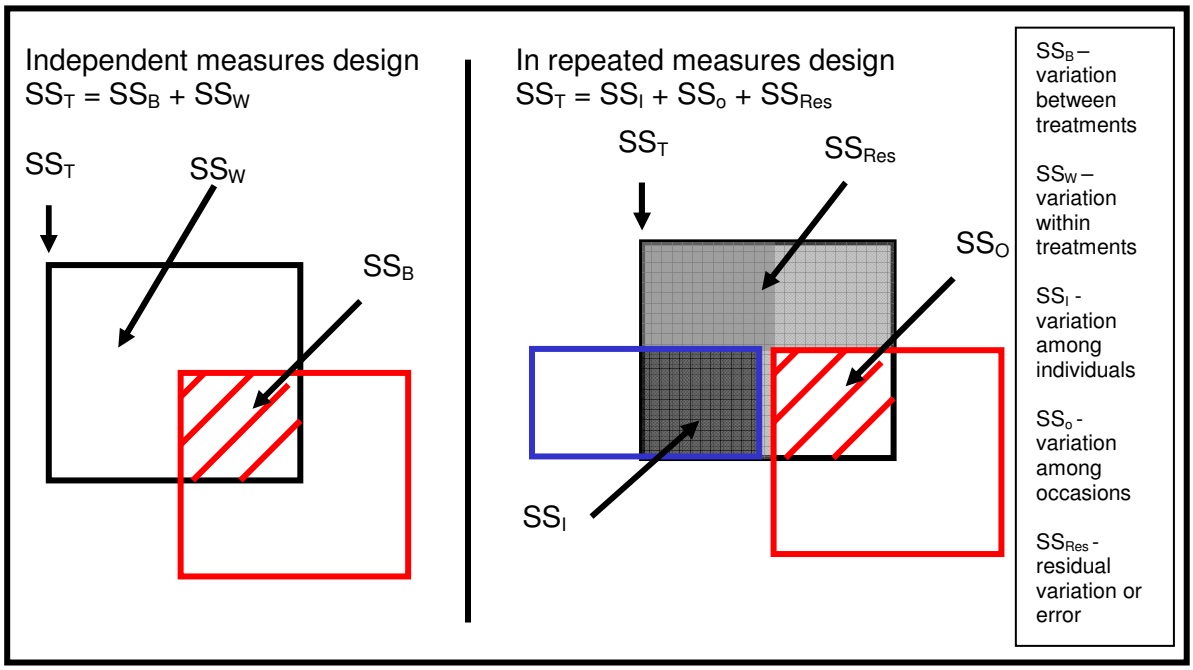

Figure 1. Comparison of Sum of Squares Partitioning between Designs (K. Roberts, personal communication, July 5, 2004).

Mauchly's Test of Sphericity(b)

Measure: MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.	Epsilon(a) Greenhouse-Geisser	Epsilon(a) Huynh-Feldt	Epsilon(a) Lower-bound
occassion	.243	13.768	5	.018	.610	.725	.333

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.
b Design: Intercept
Within Subjects Design: occassion

Figure 2. Results of Mauchly's Test of Sphericity for Data in Table 2.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
occassion	Sphericity Assumed	552.000	3	184.000	3.027	.043
	Greenhouse-Geisser	552.000	1.829	301.865	3.027	.075
	Huynh-Feldt	552.000	2.175	253.846	3.027	.064
	Lower-bound	552.000	1.000	552.000	3.027	.110
Error(occassion)	Sphericity Assumed	2006.000	33	60.788		
	Greenhouse-Geisser	2006.000	20.115	99.727		
	Huynh-Feldt	2006.000	23.920	83.863		
	Lower-bound	2006.000	11.000	182.364		

Figure 3. Univariate F Test Results for Data in Table 2.

```
GLM
 A B C D
  /WSFACTOR = occassion 4 Polynomial
  /METHOD = SSTYPE(3)
  /CRITERIA = ALPHA(.05)
  /WSDESIGN = occassion .
```

Figure 4. SPSS Code to Conduct Repeated Measures Analyses for Data in Table 2.

Tests of Within-Subjects Effects

Measure: MEASURE_1

Source		Type III Sum of Squares	df	Mean Square	F	Sig.
occassion	Sphericity Assumed	552.000	3	184.000	3.027	.043
	Greenhouse-Geisser	552.000	1.829	301.865	3.027	.075
	Huynh-Feldt	552.000	2.175	253.846	3.027	.064
	Lower-bound	552.000	1.000	552.000	3.027	.110
Error(occassion)	Sphericity Assumed	2006.000	33	60.788		
	Greenhouse-Geisser	2006.000	20.115	99.727		
	Huynh-Feldt	2006.000	23.920	83.863		
	Lower-bound	2006.000	11.000	182.364		

Tests of Between-Subjects Effects

Measure: MEASURE_1
Transformed Variable: Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	559872.000	1	559872.000	929.739	.000
Error	6624.000	11	602.182		

Source	*SS*	*df*	*MS*	*F*	*p*
Individuals	6624	11	602.18		
Occasions	552	3	184.00	3.03	.043
Error	2006	33	60.79		
Total	9182	47			

Figure 5. Relevant Univariate SPSS Output and ANOVA Summary Table for Data in Table 2.

Tests of Within-Subjects Contrasts

Measure: MEASURE_1

Source	factor1	Type III Sum of Squares	df	Mean Square	F	Sig.
factor1	Linear	194.400	1	194.400	2.475	.144
	Quadratic	12.000	1	12.000	.219	.649
	Cubic	345.600	1	345.600	7.066	.022
Error(factor1)	Linear	864.000	11	78.545		
	Quadratic	604.000	11	54.909		
	Cubic	538.000	11	48.909		

Figure 6. Trend Analysis SPSS Output (GLM command) for Data in Table 2.

$$T^2 = 12 \begin{bmatrix} 4 & -9 & 2 \end{bmatrix} \begin{pmatrix} 79.82 & -9.91 & -40.00 \\ -9.91 & 163.64 & -56.09 \\ -40.00 & -56.09 & 59.82 \end{pmatrix} \begin{bmatrix} 4 \\ -9 \\ 2 \end{bmatrix}$$

$$= 8.21$$

Figure 7. T^2 Computations for Latent Variables in Table 12.

```
MANOVA A B C D
 /WSFACTORS=Measure(4)
/CONTRAST(Measure)=POLYNOMIAL
/PRINT= SIGNIF(AVERF) TRANSFORM.
```

Figure 8. SPSS Code to Conduct Multivariate Repeated Measures Analyses for Data in Table 2.

```
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
-
EFFECT .. MEASURE
 Multivariate Tests of Significance (S = 1, M = 1/2, N = 3 1/2)
Test Name        Value    Exact F Hypoth. DF   Error DF  Sig. of F
Pillais           .42749    2.24010       3.00       9.00       .153
 Hotellings       .74670    2.24010       3.00       9.00       .153
 Wilks            .57251    2.24010       3.00       9.00       .153
 Roys             .42749
 Note.. F statistics are exact.
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
-
```

Figure 9. Multivariate Repeated Measures SPSS Output for Data in Table 2.

```
Estimates for T2
 --- Individual univariate .9500 confidence intervals
MEASURE
  Parameter     Coeff.  Std. Err.    t-Value     Sig. t Lower -95%  CL-
Upper
        1   4.02492236    2.55841    1.57321     .14397   -1.60610
9.65594
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
-
 Estimates for T3
 --- Individual univariate .9500 confidence intervals
MEASURE
  Parameter     Coeff.  Std. Err.    t-Value     Sig. t Lower -95%  CL-
Upper
        1   1.00000000    2.13910     .46749     .64928   -3.70813
5.70813
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
-
 Estimates for T4
 --- Individual univariate .9500 confidence intervals
MEASURE
  Parameter     Coeff.  Std. Err.    t-Value     Sig. t Lower -95%  CL-
Upper
        1   -5.3665631    2.01885   -2.65823     .02226   -9.81002    -
.92310
- - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - - -
-
```

Figure 10. Trend Analysis SPSS Output (MANOVA command) for Data in Table 2.

Learning about the School Budget: A Constructivist Model

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ABSTRACT

If principal preparation programs in school finance effectively and adequately address as many aspects of the school and district culture into the study of the topic, candidates for certification will receive better preparation and understanding as they step into campus leadership positions. Designing a three-year budget using state designated "windfall dollars" to solve "real" problems of a district and school may be the most effective way for the student to develop an understanding of how budgets can impact the operation of schools. Furthermore, the principal candidates may develop effective ways to utilize the totality of school districts information, both financial and cultural, into becoming effective and ethical budget planners.

School districts and budgets are complex and are politically vulnerable. Through the budget building process students will develop a sense of what the school should be and could be. The professor of school finance has the ability to change the financial and cultural information provided to the students in this project as they see fit.

Keywords: Constructivist, School budgets, Group projects, School finance, Budget projects

INTRODUCTION

Upon his arrival to campus, the new dean of our college met individually with each professor. Prior to the meeting we were informed that he expected us to discuss with him our philosophy of learning, be it Constructivism or Instructivism. All professors in the department were to inform him where we stood on a scale of one to ten, with ten being that we followed an exclusively Constructivist Model and one being that our pedagogy was entirely Instructivist. Certainly, the individual instructor was free to roam anywhere on the imposed continuum between the two apogees. Most of the instructors in the college scurried to scrutinize their teaching methodology prior to the conversation with the new dean.

All of my classes are principal preparation for practicing teachers that have aspirations of obtaining their administrator licensure or achieving a master's degree in education administration.

A few years ago when considering how best to organize the conditions for student learning about building a school budget so as to maximize the engagement of prospective principals, one thought leaped to my mind: focus the learning on the real-life experiences of practicing school principals. The principal must be able to allocate available dollars to find the best solution possible for the education of the students in his charge.

Brooks (1993) defined Constructivism succinctly: "meaning is not given to us in our encounters, but it is given by us, constructed by us, each in our own way, according to how our understanding is currently organized."

A Constructivist vision statement was developed by Stein et al., (1994): "Constructivism leads to new beliefs about excellence in teaching and learning and about the roles of both teachers and students in the process. In constructivist classrooms, students are active rather than passive; teachers are facilitators of learning rather than transmitters of knowledge.

Constructivism implies that teachers embrace a holistic view of instruction, apart from the lecture methodology of direct instructivism. The school budget model that I have developed to train aspiring principals embraces the frameworks of simulation, strategy and role-playing, case studies, learning by design, and group, cooperative, and collaborative learning. Students must assimilate the new experience of building a school budget into an already existing framework of what they understand about how school buildings are organized for the education of children and how revenue and expenditure dollars are coded through the district accounting manual.

According to Waggoner (2005) when students encounter the prospect of designing a school budget they have to reconcile the assignment with their previous ideas and experiences of the budgeting process. It is my experience that students in a principal preparatory class for school finance have only a minimal understanding of how district revenue and expenditure accounts are set up and how the budgeting process is completed.

The first portion of the semester is dedicated to understanding the coding of revenue and expenditure accounts in various school districts. Fortunately, each school district within a given state uses the same state accounting manual for school districts, which is based on the generally accepted accounting principles required by the Government Accounting Standards Board. Understanding the coding system for a particular state gives the student insight into how neighboring states track revenue and expenditures.

The school budgeting model that I have constructed is flexible enough, depending on the size of the class and the needs of the students, to allow two or three students to collaborate as principal in a particular building in the district, or allow an individual student to work on the project alone as "the principal" of a building.

My school finance class has served students in New Mexico, Texas, Missouri, and Oklahoma. While the school budget building process is fundamentally the same, the coding system and accounting manual are totally different in both states. It is very easy to group the students according to the state they reside in so that they are able to gain more experience and practice in using their state financial coding manual.

The budget building project is a rather sophisticated activity that helps the students reach the objective of internalizing financial aspects of the school, from the development of a mission statement to the allocation of dollars. The student plays an active role in assimilating knowledge onto his/her existing framework.

THE FINANCE PROJECT

All of the statistical data and school and district information is fictional and the professor may add to, delete from, or make any changes necessary to give a group a students unique challenges. School buildings and districts are similar in many aspects across the country, but circumstances and financial times can easily dictate an entirely different set of facts.

This is the setup that is presented to the students: You are a newly hired principal at one of the schools in the Cooley School District located in Cooley, Ohio.

The state legislature has just passed a bill that establishes a "School Improvement Fund" for schools in the state. The money is guaranteed for three years only and the legislature expects to see demonstrated improvement after the three years in test scores. The legislature has made no commitment to a fourth year of funding; in fact, Governor Taft has flatly said "This is it." This is the attempt by the legislature of Ohio to put more dollars into the schools. The money is formula driven and will be distributed by school building, not district, based on building demographics. The legislature of Ohio was very specific in wanting this "windfall" money to be site-based driven. Unfortunately, for school districts throughout Ohio, the governor did not sign the legislation until June 27 and the dollars will be allocated for the first year on September 1. This does not give the principal much time to determine how to best utilize the money, which must be spent (not just allocated) in the fiscal year for which the money is provided. All of the severe and profound special education students are transported to another school district and are not impacted by the new monies, as far as the building principal is concerned.

The past performance of students at Cooley places students as meeting standards in social studies, but falling below state and national standards in mathematics and English. All three of the previous principals in the district were managers at best and there has not been a serious attempt to improve much of anything. The district has gone through four superintendents in the past seven years so needless to say, continuity has been lacking. The "ex-principals" have been left on their own. None of the ex-principals or superintendents had apparently ever heard the terms "site-based" or "collaborative management." There is a new superintendent in Cooley, currently in her fifth month on the job. She fired all of the principals and has hired four new ones to be change agents. (With the flexibility of the finance project, more or less buildings and principals can easily be added.). All of the new principals will be beginning their first year in the principalship and come from Eastern New Mexico University, thought to be a "hotbed" of newly trained administrators. The word has spread to Ohio. The new money was an unexpected bonus for everyone, and although it comes late, no district is going to turn it down.

JEFFERSON SCHOOL

The following data applies specifically to each of the three buildings in the district:

K-5 Jefferson Elementary – 874 total students, which include: 151 students in kindergarten; 171 students in 1st grade; 122 students in 2nd grade; 177 students in 3rd grade; and 113 students in grade 4; 5th grade has 140 students.

Seventy-three percent of the students qualify for free/reduced lunch.

Fifty-four students at Jefferson are in self-contained special education classes, which include: 18 kindergarten students, 5 first graders, 5 second graders, 7 third graders, 11 fourth graders, and the rest in 5th grade. All students at Jefferson have art two days per week for 20 minutes with a special art teacher. Because there is no gym at Jefferson, physical education classes are held outside when weather permits and in the students' classroom when the weather does not permit. In actuality, because there is no special

physical education instructor, when the weather is inclement physical education typically does not occur in many classrooms. Sixteen percent of the remaining students have Title 1 services. Student demographics indicate 41% white; 17 % Black; and 42% Hispanic. Jefferson was constructed in 1953 and is not air-conditioned except for the principal's office and the counselor's office. The counselor serves one-half time at Jefferson. (The thinking by the superintendent three-times removed was that counselors are needed in elementary schools more than junior highs or high schools. At one time the district had five guidance counselors, but budget cuts eliminated 4 ½ of them 2 years ago. The current counselor is K-12 certified, however.) There is no early childhood program at Jefferson, although a concerned citizen's group has lobbied for one for the past two years. An energy audit of the entire district was conducted 3 years ago. There was no extra money in the budget so a building bond referendum was attempted. It failed 60% to 40%. The audit indicated that Jefferson should have new energy efficient lighting ($400,000); a new energy efficient boiler ($185,000); a central cooling system attached to the boiler ($232,000); and the flat roof should be replaced with a new shingled pitched roof to prevent further leaking and water damage ($1,374,000). Periodically, the roof will leak in various places. Custodians patch it when this happens. Many of the tiles in the classrooms (there are dropped ceilings) are stained. Last year, a group of concerned parents went to the board complaining that their children were becoming sick because of the 'mold' growing on the ceiling and walls as a result of the moisture created by the periodic roof problems. The board tabled the concern, pending further study. The enrollment capacity at Jefferson is 880.

WASHINGTON SCHOOL

Washington School – grades 6, 7, & 8 – 295 total students, which include: 81 sixth graders, 115 seventh graders, and 99 students in grade 8. Seventy-five percent of the students qualify for free/reduced lunch. Eleven students at Washington are in self-contained special education classrooms. Four in 6th grade, four in 7th grade, and three in grade 8. Thirty-nine percent of the remaining students have Title 1 services. Student demographics indicate 51% white and 5% Black, 44% Hispanic. Art is not offered; however, former principals have requested it. Physical education is offered every day for 50 minutes. The Washington gym was constructed in 2001 and is recognized as one of the finest facilities in the state. The gym has 4 locker rooms, 2 for males and 2 for females. Regional and sectional tournaments are held there every year. The total cost of the gym was $1,850,000 paid for by a bond referendum. The seating capacity of the gym is 2,400. Most community events are held in the Washington gym including high school prom, baccalaureate, and graduation. Washington has a traditional 8-period day. Regular classes are tracked into A/B/high C students and into low C / D/F/ students. There is often controversy among staff and parents as to which students are high or low C. Typically, just 'C' students are tracked as high C, until they prove otherwise. The energy audit indicated no deficiencies of a major nature and the minor ones that were identified were corrected by in-house custodial staff at minimal expense. Washington is a three-story brick structure that served as the district high school until 1967 when the new high school was constructed. Currently, there is a four year tuck-pointing plan in place, whereby one side (of the 4-sided building) is being newly tuck-pointed each summer.

Each side will cost $40,000. The first portion of the building will be completed by September 1. There is no elevator available in Washington for disabled students. This was the subject of a law suit filed against the district in 1995. The issue was resolved when accommodations were made on the first floor for the three years that this student was at Washington. Accommodations involved moving different grade levels to the first floor each year.

When students are temporarily disabled (broken leg, etc.) they are often home schooled for the duration or carried up the steps by staff. Three current 5th grade students are wheelchair bound. The staff has been through this switching of floors routine before and is NOT looking forward to it happening again. The cost of an elevator is $450,000. It is believed that a wheelchair lift connected to the existing stairwell would cost $285,000. Enrollment capacity at Washington is 650. Beginning band is offered at grade 6 and continues throughout the curriculum.

BUSH CAMPUS

Bush Campus – Grades 9 -12 – 300 total students, which includes 80 freshmen, 73 sophomores, 66 juniors and 81 seniors.
22% of the students have signed up for free/reduced lunch.
There are no self-contained special education classrooms at Bush.
Unlike Washington, all students are mainstreamed.
Seventy-five percent of the students have Title 1 services for English and/or math.
Student demographics indicate 66% white; 3% Black; and 31% Hispanic.
Freshmen and sophomore students at Bush are on a Block-4 schedule, with classes on alternating days. (For example, Algebra I occurs on Monday & Wednesday and every other Friday. Biology occurs on Tuesday & Thursday and every other Friday – both Algebra I and Biology are first period of Block One.)
The plan is to place junior and senior students on Block 4 next year (2006-07).
This is the current Block-4 schedule for freshmen. Underlined classes are required.
(Remember: Wednesday, Thursday & alternate Fridays repeat)

Monday – 1	Tuesday -1
Algebra I	Biology
Monday – 2	Tuesday -2
U.S. History	English
Monday -3	Tuesday -3
U.S. Literature	Physical Ed
	Band – T/TH/F *

*students in band are excused from PE T/TH alternating F

Monday -4	Tuesday -4
Electives:	Electives:
Home Ec	Driver Ed / Health (age must qualify for driver ed) **
Ag	French I
Study Hall*	Study Hall*
Civics	Chorus

* Only one Study Hall is permitted per student per semester.
** One semester each.

There are two concurrent sections of PE.
There are three sections of the other required classes.
This is the current Block-4 schedule for sophomores. Underlined classes are required

Monday -1	Tuesday -1
Electives:	Electives:
Study Hall*	Study Hall*
Swine production	Driver Ed / Health (typically 100% of sophomores
French II	Chorus qualify – if not or they
Home Ec II	have taken it as freshmen – then SH)

Monday -2	Tuesday -2
Geometry	Speech / Consumer Ed / Oklahoma History / Intro to Life**
Monday -3	Tuesday -3
English	Physical Education
	Band T/TH

*Students in band are excused from PE on T/TH/ alternative F

Monday -4	Tuesday -4
Biology II	Geometry

* Only one Study Hall is permitted per student per semester.
** Each class meets for one-quarter.
There are two concurrent sections of PE.
There are three sections of the other required classes.
The Block-4 schedule for freshmen and sophomores has been in place for two years. The teachers enjoy the 100-minute planning period each day.

(On occasion there are students that work in districts that are involved in the block scheduling, or students that wish to understand the financial impact of block scheduling.)

Bush was first constructed in 1970. There is room at Bush for potentially 725 students. Two superintendents ago the thinking was to split the high schools into 2 buildings, North and South, with North housing the 9th and 10th grades and a NEW HIGH SCHOOL (South) housing grades 11 and 12. The board gave the matter serious thought and rejected the idea by a vote of 4-3.

Bush has no major construction issues. The energy audit revealed that more efficient lighting is needed at a cost of $281,000, which includes dropping the ceilings in all classrooms. The entire campus is centrally air-conditioned. Attendance at Bush is 94.5%.

The gym at Bush is used exclusively as a physical education and practice facility because all of fold-up bleacher seating was removed due to safety concerns five years ago. It is impossible to have “basketball games” at the facility.

Bush is the only building in the Cooley District that is fully Internet connected. There is a computer lab of 25 stations.

Parents came to the board last March asking that a work study program be implemented in the district for seniors. The board is reviewing the concern.

It has become apparent that there is a significant attrition problem of students once they enter high school.

Typically, 35% of the senior class goes on to some form of higher learning. There are no advanced placement classes, although the local junior college has proposed 'something' in the form of cooperative programming.

The Athletic Booster Club has five issues with the board of education: (1) The boosters would like an all-weather track around the football field ($150,000) at Bush. (2) The varsity football program is 2-26 over the past three years. The Boosters want the football coach fired. Mr. Raymond is a veteran of thirty-six years in the district and could retire if he only would. He indicates that if the board will give him $40,000 (in what he calls 'get lost' money) he will retire. Mr. Raymond also teaches English and is highly regarded as a teacher. (3) The gym facilities at the high school are inadequate. There are no shower facilities ($40,000).
(4) The booster club would like to begin a soccer program beginning with the 5th grade. The cost would include uniforms / supplies / and one coach ($6,000). Fathers have volunteered to coach and help coach at all levels, except for the head coach. (5) There are 4 sports for boys and only 3 sports for girl's grades 6-12.

OTHER DISTRICT ISSUES

There is a disconnect between the curriculums at Jefferson and Washington. Reading books, workbooks, and additional materials for reading (including tests) were purchased last year at Jefferson ($245,000) for K-5. The emphasis is on whole language. The reading series at Washington is 8 years old and emphasizes phonics exclusively.

Thanks to the last principal at Jefferson there are math manipulatives for each classroom and the math curriculum emphasizes 'hands-on' learning and the use of calculators. The math program at Washington places no emphasis on 'hands-on' learning and teachers there believe that the use of a calculator by students is detrimental to their true understanding of math.

The district teaching staff is advanced in terms of experience. There are 11 teachers (including Mr. Raymond) that are either eligible to retire at full-benefits or will be within two years. All of these staff members are making in excess of $60,000 per the contract. A beginning teacher with a BA will make $30,600 per the current salary schedule.

The breakdown of the building location of this retirement eligible group is: 4 at Jefferson; 3 at Washington; and 4 at Bush. (These teachers are found at Years 22 – MA + 45 on the salary schedule.)

Ten of the teachers in this group are considered to be obstinate and very resistant to change. "They" have seen it all before. The feeling among many is that there have been "too many principals and too many superintendents. Just leave me alone and let me teach."

The Third Reauthorized United Evangelical (TRUE) Church of Cooley has strongly hinted (in fact ground has been broken) for a "Christian School," which would in its inception be only for grades PreK-4. The plan is to expand it one or two grade levels per year as enrollment increases and/or demand dictates.

Unfortunately, it is supposed that most of the students enrolling at TRUE will be the more affluent students.

It is projected that the TRUE School might take away as many as 190 students from the district in the first year. If this happens, the state of Ohio will adjust the funding for the second year of the 'windfall' money accordingly. The school will not open until September 2010.

(I wish to caste no dispersions on any current or future "TRUE" Church. This example and ensuing anagram is totally fictitious.)

The copy machines, one in the office and one in the teacher work room, at Bush have not operated since April. They need to be replaced if copies are to be made on site. The cost of two new machines that are rented under contract for four years is $7,000 per machine per year. This will ensure 900,000 copies each. Copies made over 900,000 per machine will be billed at 15.5 cents for copy. Last year Bush ran 2,620,000 copies in the workroom and 890,000 copies in the office.

Drug use and gang problems are a concern at both Washington and Bush. The lunch period at Washington is not closed. The lunch period at Bush is open campus for juniors and seniors only.

Corporal punishment is allowed throughout the Cooley School District. Three students were expelled last year for gang activity at the high school.

A drug testing policy for student athletes and club participants has not been implemented because of the cost. There are 195 total students participating in interscholastic activities at Bush and 310 at Washington. The cost of one urine drop is $25.00.

The Ministerial group of Cooley is rabid that a drug testing policy be developed. Five district students were expelled last year for drug use.

FINANCIAL INFORMATION

Student Enrollment History:
FY06 = 1469
FY05 = 1489
FY04 = 1511
FY03 = 1696
FY95 the district had a total enrollment of 1017.

Nine years ago Miller's Cave School District consolidated with Cooley. No students are housed in Miller's Cave. The K-12 building was destroyed by fire in 1998.

The school board at Harper Valley has indicated a willingness to consolidate with Cooley. When this occurs, Cooley would grow by 80 students, K-5; 72 students, 6-8; and 71 students in the high school. This consolidation will happen in FY 09.
District Property Value = $195,000,000
EAV/EPV in Ohio based on 33 1/3% of property value.
Current School District tax rate is $1.89. Projections are that because of difficulties in the manufacturing industry, the EAV will drop 10% in FY07 and another 10% in FY08. The three year windfall dollars will be allocated to districts based on FY06 building census data, and attendance updated each June 1.
Use current data to figure FY07 windfall revenues.

PK students (if the program would exist would generate $1000 per student: – and an extra 20% per each child on free/reduced lunch and/or participating in Title I.) Due to the fact that Cooley has no PK program these dollars can not be utilized.
Grades 1 – 4: $500 per student - 20% extra per each child on free/reduced lunch (and/or) participating in Title I.
Grades 5 – 8: $400 per student – 10% extra per each child on free/reduced lunch (and/or) participating in Title I.
Grades 9 – 11: $350 per student.
Grade 12 - $250 per student.

A portion of the new legislation contains a portion commonly known as 'the minority allocation act.' Each minority student in a particular building will generate an additional $1000 in grant revenue.

Number of certified personnel:
Jefferson 42 regular teachers; 4 special education teachers; ½ time counselor.
Washington: 31 regular teachers; 2 special education teachers; ½ time counselor.
Bush: 48 regular teachers; and 1 special education teacher.
This was the administrative configuration at Cooley in FY06.
Jefferson has a principal and a vice principal.
Washington has a principal and a dean of students.
Bush has a principal, a vice principal, and a dean of students / athletic director.

The Superintendent's office consists of the superintendent, assistant superintendent for finance; and assistant superintendent for curriculum & transportation. The central office is housed downtown away from all of the schools.

I attach a salary schedule to the project. For the purpose of coding the salary schedule, Jefferson is A; Washington is B; Bush is C. Therefore the number of teachers at Years 6, BA+00 at Jefferson is A-4. On the same step at Washington is B-3, etc. All of your certified staff is listed. You add the salaries to find out what the total salary of your building is for FY06.

Health insurance costs for the district are capped at $3,000 per year per certified staff, which covers 95% of the health premiums. The insurance benefits are not reflected in the salary schedule. The benefits are in addition to the salary.

LEGISLATIVE SPECIFICATIONS FOR WINDFALL SPENDING

The finance students are told how the state legislature (in this example, Ohio) has directed the schools in their allocations of the windfall dollars. An instructor may 'tinker' with the mandate of the legislature in anyway that they see fit.

1. No more than forty percent of the individual building's windfall dollars may be utilized for new construction or renovation in any given FY.
2. At least twenty percent of the individual building's windfall dollars in any given FY must be utilized for staff development and training.
3. Up to two percent of the windfall dollars in any given FY may be used for administration of the grant.
4. Up to twenty percent of the windfall dollars in any given FY may be used for the creation of new positions.

5. At least fifty percent of the windfall dollars in each FY must be used for classroom co-curricular materials. Ten percent of this amount may be utilized for individual equipment valued at more than $500.

For the purpose of the activity, the students are asked to use the state revenue code to allocate the funds into various accounts. I provide the revenue codes. The students also must properly execute the expenditure coding to the proper funds, functions, or objects, whatever the state of residence of the student calls for. All revenue and expenditures coding must be explained and justified for the current FY and the following two FYs.

WHAT IS ASKED OF THE STUDENTS

In my finance class I stress that the budget decisions need to be school site-based. This project lends itself well to that philosophical perspective. Each student is asked to outline the times and date of their site-based meetings that were called to discuss the "windfall dollars." The students are to given fictional names, yet real attributes to those selected for the meetings. For example, if a teacher is included in the meeting, the person might be given the fictional name of Mrs. Redenbacher, but her position as third grade teacher is the key component. The students are asked to given a fictional date and time of the meeting(s) and an accounting of how the committee was selected.

The finance students, through the site-based council, are to formulate a mission statement for the building, three goals for the building and two objectives for each goal, in regards to the spending of the money.

The finance students are asked to describe the current state of their particular building and address the issues that face their building (and the district) in the coming three years. Among the questions that the students must answer are:

1. How much additional revenue will your building receive in this FY, and the following two fiscal years? Show and explain all calculations.
2. How much additional revenue will the district receive in this FY, and the following two fiscal years. Show and explain all calculations.
3. How much money in local property tax can the Coley School District expect to collect this FY?
4. What is the Equalized Assessed Valuation (EAV) or the Equalized Property Value (EPV) per student in the school district?
5. What will the total payroll be for the Cooley District this FY?
6. What is the average class size in your building?
7. What personnel changes are you recommending in the following two-years (if any)?

The assignment for the aspiring principals is to take the totality of the information concerning the school district, their assigned building, and the windfall dollars and present the proposed school budget to the superintendent and board of education at a preliminary budget hearing. The report encompasses both an oral presentation and a written documentation of the presentation for "public" consumption at the board meeting.

Yager (1991) suggested that in a constructivist classroom there should be a student produced product that reviews and critiques solutions which have been elicited, discussed and accepted by others.

There are many nuisances built into the project. It is always a matter of opinion, but Cooley seems to be top-heavy with administration in the central office. The buildings in the district are at times underutilized and in need of closing or over utilized and a building program should be considered. There is always the question of should retirement eligible disgruntled staff be bought out?

SUMMARY

I believe that the school budget project can be tapered in any fashion that the professor wishes, both in addition to, and subtracted from, to make the learning experience applicable to any constructivist school finance experience. There are many benefits to including this type of project in a school finance principal-preparation program. A major benefit inherent in the process is the improvement of teaching when focusing on improving student understanding and achievement. The process of the project can be extensive, but it is a process that any good teacher follows when adjusting the instruction to meet the needs of all students. It is crucial that all of the necessary financial calculations and the state financial coding system are thoroughly understood by the finance students prior to the presentation of the project.

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An Investigation of the Effects between Academic Self-concept, Nonacademic Self-concept, and Academic Achievement: Causal Ordering Models

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Abstract

The two purposes of this research were 1) to compare the goodness of fit index of causal ordering models of academic self-concept, nonacademic self-concept, and academic achievement with different self-concept factors and 2) to develop and to validate the causal ordering model of academic self-concept, nonacademic self-concept, and academic achievement. The research sample consisted of 820 grad nine students. The research instrument consisted of Self-Descriptive Questionnaire and four academic achievement tests in four subjects. The data were repeatedly collected for three times. The data analyses were employed by descriptive statistics, MANOVA, and CFA.

The major findings were 1) the fully causal ordering model of academic self-concept, nonacademic self-concept, and academic achievement including 2 factors of self-concept was the best fitted to the empirical data, 2) the model development and validation resulted in chi-square = 641.981, df = 600, p = 0.114, CFI = 0.998, NNFI=0.998, GFI = 0.957, and AGFI = 0.953. The second order effect of academic self-concept to academic achievement was the biggest effect, the third order effect of nonacademic self-concept to academic achievement was the biggest effect, and the third order effect of academic achievement to academic self-concept and nonacademic self-concept were the biggest effects.

Keywords: Academic Achievement, Academic Self-concept, Nonacademic Self-concept, Causal Ordering Model

Introduction

In the present time, the student academic achievement was underlined to become the main direction in the national education because the student academic achievement is the most suitable indicators to show the educational successful. As this reason, every country have been tried to develop various learning processes for enhancing academic skills. Furthermore, this idea was obviously taken part in the educational policy in An Education Reform Act for Further Development for The Thai People: National Education Act of B.C. 2542. The major content emphasized the development of many functions of Thai education system (example: teachers, instruments, curriculum, administration and parent and community cooperation). After the act, the educational organization revealed the result of national achievement tests in six important subjects during the national education act have implemented. All of achievement scores were under satisfaction or under fifty percents every years. The trend of academic achievements was fluctuated in narrow scores. Moreover, most academic achievements have declined continuously in the last four years especially in Mathematics and English subject. This phenomenon made many questions about educational development process due to it cannot improve the factor that everyone has expected.

The crisis of academic achievement is not only important problem in Thailand but it also in many countries over the world. Most countries have resolved this problem by rapidly developing educational staffs and innovated for learning. In contrast, some countries look backward to elucidate in some important psychology variables linking with the student academic achievements for three decades ago. One of many interesting variables is self-concept, perception of oneself about strength, weakness, attitude, and value by social and environmental interaction (Rogers, 1951; Marsh & Craven, 1997; Slavin, 2003; Huitt, 2004). In theory, the person who have positive self-concept frequently success in activities but easily fail in activities for who have negative self-concept (Wigfield & Karpathian, 1991; Franken, 1994). The knowledge from many educational researches clearly pointed out that self-concept was the important factor effecting in student academic achievement. Self-concept was separated in two main factors; academic self-concept and nonacademic self-concept (Marsh & Shavelson, 1985; Marsh, 1990). The academic self-concept explained thirty-three percent in academic achievement variance (Lyon, 1993) and the nonacademic self-concept explain fourteen percent in academic achievement variance (William, 1993). For this result, Self-concept has been continuously selected to research and development in education, behavioral modification, and personal clinical therapy.

Recent sdudies reveal interesting methodologies and find effects between academic self-concept and academic achievement in longitudinal aspect with three time measurements (three waves) in a causal ordering model (Marsh, 1990; Guay, Marsh, & Boivin, 2003, Marsh, 2003). The effects in the model can be considered in four ways: Top-Down Effect (TD), Bottom-Up Effect (BU), Horizontal Effect (HE), and Reciprocal Effect (RE). All of these effects benefit to develop both academic achievement and academic self-concept in suitably period (the first year, the second year, and the third year). Causal Ordering Modeling was applying to study the longitudinal effects between two variables having interaction effects like academic achievement and academic self-concept (Guay, Mageau, & Vellerland, 2003; Trauwein, L**ü**dtke, Köller, 2006). Nevertheless, the causal ordering effect between self-concept and academic achievement

was manifested just only one from two factors of self-concept. There is nonacademic self-concept not yet to elucidate in the same process and same model.

Nonacademic self-concept is about the perception of one-self in the nonacademic activities. It's involves with other groups of people in student's real life such as parent, friends, teacher, and community (Roger, 1959 cited in Hjelle & Ziegler, 1992; Mead, 1993 cited in Burn, 1979; Gross, 1992 cited in Reinecke, 1993). In addition, the nonacademic self-concept not only has a cause in the classroom, but it also has many outside classroom causes. It shows that nonacademic self-concept gives much more information than academic self-concept for improving student skill, character, behavior, social, and academic achievement. The results of this study may be used to guide teacher planning to help coordinate types of academic and nonacademic activities needed to improve student outcomes.

Research Purposes

The two purposes of this research were to compare the goodness of fit index of causal ordering models of academic self-concept, nonacademic self-concept, and academic achievement with different self-concept factors and to develop and validate the causal ordering model of academic self-concept, nonacademic self-concept, and academic achievement.

Theoretical Framework

The research conceptual framework was developed from self-concept factors setting by Marsh and Shavelson (1985) and Marsh (1990) to select variables amalgamated with considering causal ordering effects from Guay, Mageau and Vellerland's causal ordering model (2003) for three research hypothetical models. Each model is three times repeated measures and different self-concept factors. The first model is a causal ordering model between academic self-concept, nonacademic self-concept, and academic achievement (full path model) [see figure 1], the second model is a causal ordering model between nonacademic self-concept and academic achievement [see figure 2], and the third model is a causal ordering model of academic self-concept and academic achievement [see figure 3]. Each hypothetical model has different latent variables and observed variables depend on research questions. The first latent variable is the academic achievement (ACH) defined by the achievement score from four subject tests measured in Mathematics (MAT), English (ENG), Science (SCI), and Thai Language (THA). The second latent variable as the academic self-concept (ASC) is defined by the student perception with themselves in strength, weakness, attitude, and value in academic competencies measured from four observe variables; Mathematics Academic Self-concept (MSC), English Academic Self-concept (ESC), Science Academic Self-concept (SSC), and Thai Language Academic Self-concept (TSC), and the last latent variable is the nonacademic self-concept (NSC) is defined by the student perception with themselves in strength, weakness, attitude, and value to achieve in nonacademic competencies measured from four observe variables; physical ability (PAB), peer relation (PER), physical appearance (PAP), and self-efficacy (SEF) (only one observe variable selected from related literature). The three hypothetical models were shown in figures 1-3 below.

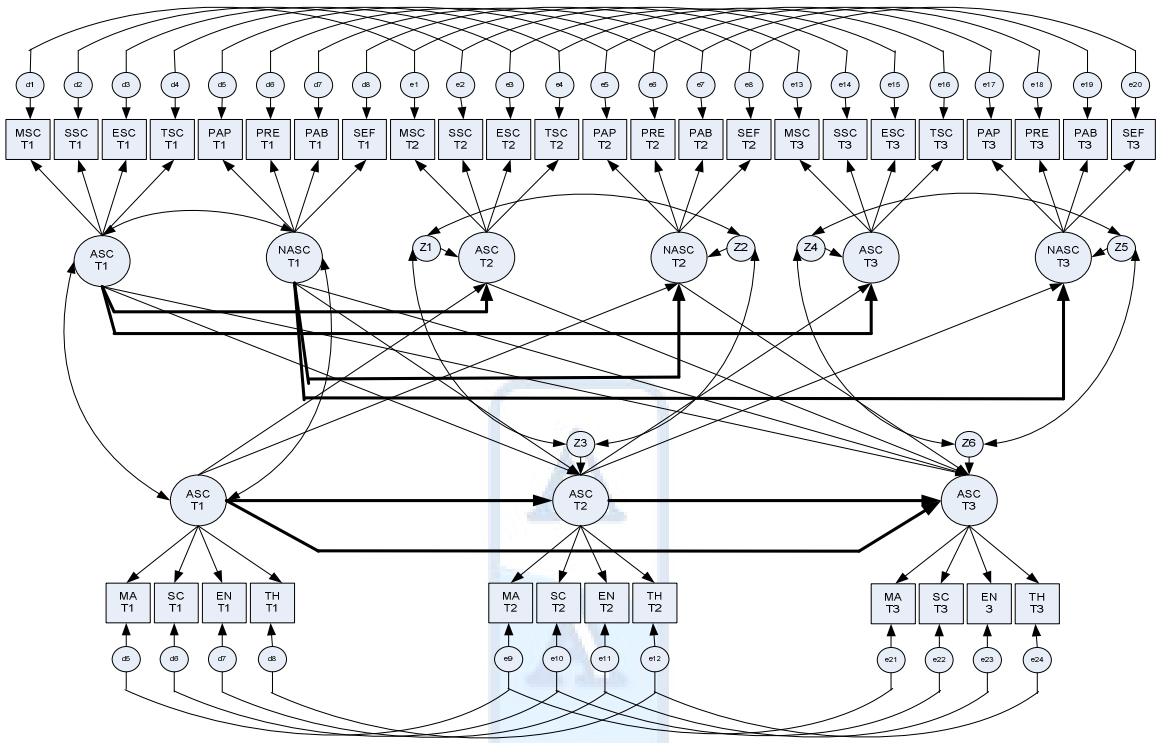


Figure 1. A causal ordering model of academic self-concept, nonacademic self-concept, and academic achievement. (full path model)

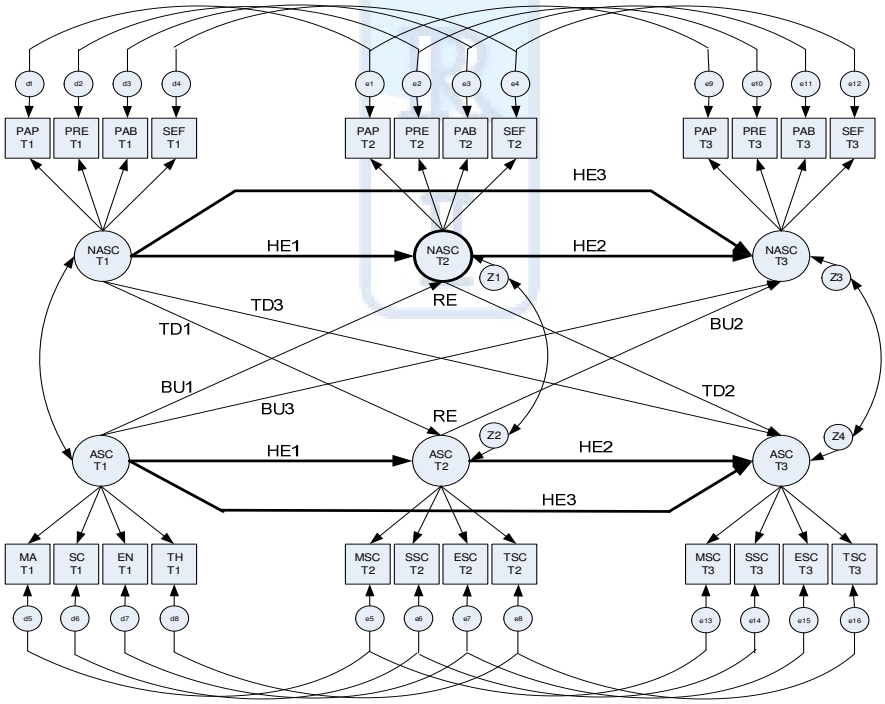


Figure 2. A causal ordering model of nonacademic self-concept and academic achievement.

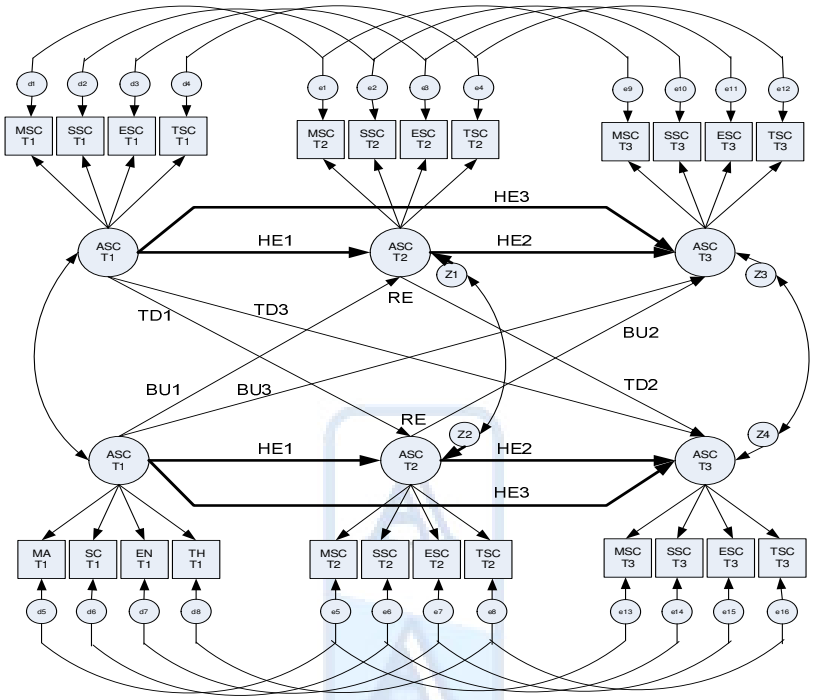


Figure 3. A causal ordering model of academic self-concept and academic achievement.

Methodology

Participants

The research population was ninth-grade students in public schools under the office of educational service area in six regions of Thailand. The research sample consisted of 820 students, 20 cases for each variable (Hair, Anderson, Tatham, & Black, 1998; Blentler & Chou, 1987 cited in Kelloway, 1998), 294 males and 526 females from all regions (north 139, central 130, west 125, east 134, south 138, and Bangkok/capital city 130 students) and obtained from three stage random sampling. The unite sampling of each stages were provinces, schools, and classes; respectively.

Research Instruments

The research used two types of instruments. The first type was the student's self-descriptive questionnaire (six rating scales varied from the most unlike me to the most like me respectively) for measuring in self-concept variables, comprised with 78 items and reliability of 0.925. The guide lines of questions in the questionnaires were translated from SDQII (Marsh, 1998) in Mathematics academic self-concept, English academic self-concept, physical appearance, peer relation, and physical ability. The goodness of fit statistics from structural validity of a questionnaire shows good fit between the instrument factors and the empirical data [χ^2=18.360, df=19, p=0.499, CFI=1.000, GFI=890, AGFI=0.790, and RMSEA=0.000]. The second type instrument was four student achievement tests in Mathematics, English, Science, and Thai Language subjects with 46 items, 50 items, 50 items, and 50 items respectively, mean of item difficulty 0.416, 0.452, 0.490, and 0.488 respectively, mean of item discrimination 0.425, 0.442,

0.473, and 0.460 respectively, and reliability of each test 0.865, 0.876, 0.893, and 0.897 respectively.

Data Collection and Data Analysis

The research data was collected from three time measurements in the early period, middle period, and final period of an educational year with the same research sample. The first set was collected at the early of May, 2007, the second set was collected at the end of September, 2007, and the third was collected at the end of February, 2008. Each instrument used an hour for data collection process per time. The research data was employed descriptive statistics to explore the basic data including with testing the mean different between gender and among three measurements by MANOVA and employed the confirmatory factor analysis (CFA) for model development and validation by using LISREL program. Each research sample was assigned six digit numbers to be code for easily linking each data measurement together.

Results

The basic result of three times data analyses from nine grad students were 296 males (36.09%) and 526 females (63.91%). The data distribution inclines to be normal distribution. The Thai Language Academic Self-Concept variable (TSC) has the highest mean score (3.01, 3.01, and 3.12 time order respectively) over all observed variables of Academic Self-Concept (ASC). The Peer Relation variable (PER) has the highest mean score (3.10, 3.12, and 3.19 time order respectively) over all observed variables of Nonacademic Self-Concept (NSC). The Thai Language Achievement variable (THA) has the highest mean score (21.27, 21.85, and 23.53 time order respectively) over all observed variables of Academic Achievement (ACH).The descriptive statistics shows in table 1. The multiple correlation analysis of 36 observed variables show 537 pairs were statistical significant at .01, 26 pairs were statistical significant at .05, and 93 pairs were no statistical significant. Furthermore, Three variable scores (MAT, SCI, and THA) of female were statistical significant at .01 grater than male, five variable scores (ENG, ESC, SSC, TSC, and PER) of females were statistical significant at .05 greater than males, and four variable scores no statistical significant. [see Appendix]

The result of confirmatory factor analysis of three research hypothetical models, the causal ordering model of academic self-concept, nonacademic self-concept and academic achievement (model 1) was the best fit with the empirical data with the relative chi-square 23.22. The second and the third best fit with the empirical data were the causal ordering of nonacademic self-concept and academic achievement (model 2) and the causal ordering of academic self-concept and academic achievement (model 3) with the relative chi-square 27.07 and 35.25 respectively. Moreover, the result from model comparison shows the statistical significant different at .05 during three research hypothetical models. The goodness of fit statistics of each research hypothetical models shows in table 2.

Table 1 Descriptive statistics for repeated measures of research variables

Time	Variable		Min	Max	$\bar{x}$	S.D.	C.V.	Sk	Ku
1	ACH1	MAT1	4.00	36.00	14.62	4.96	0.34	0.91**	1.23**
		ENG1	5.00	37.00	16.58	5.91	0.36	0.97**	0.71**
		SCI1	8.00	41.00	19.93	6.18	0.31	0.65**	0.24
		THA1	7.00	38.00	**21.27**	6.33	0.29	0.18*	-0.62**
	ASC1	MSC1	0.20	5.00	2.46	0.75	0.30	0.01	0.45*
		ESC1	0.50	4.90	2.48	0.68	0.27	0.36**	0.73**
		SSC1	0.50	5.00	2.70	0.67	0.25	0.59**	0.98**
		TSC1	0.20	5.00	**3.01**	0.77	0.26	0.42**	-0.17
	NSC1	PAB1	0.63	4.88	2.96	0.76	0.26	-0.08	-0.21
		PER1	1.11	5.00	**3.10**	0.68	0.22	-0.04	-0.07
		PAP1	0.63	5.00	2.68	0.68	0.25	0.23**	0.46**
		SEF1	0.85	4.85	2.76	0.62	0.22	0.53**	1.04**
2	ACH2	MAT2	4.00	40.00	15.22	6.00	0.39	1.33**	2.13**
		ENG2	6.00	43.00	17.09	6.10	0.36	1.11**	1.12**
		SCI2	6.00	42.00	21.65	6.38	0.29	0.56**	-0.10
		THA2	4.00	40.00	**21.85**	6.90	0.32	0.35**	-0.68**
	ASC2	MSC2	0.30	5.00	2.58	0.74	0.29	0.13	0.46*
		ESC2	0.20	5.00	2.62	0.68	0.26	0.26**	0.70**
		SSC2	0.60	5.00	2.78	0.66	0.24	0.32**	1.05**
		TSC2	1.00	5.00	**3.01**	0.67	0.22	0.51**	0.16
	NSC2	PAB2	0.84	5.00	3.01	0.71	0.24	0.28**	-0.13
		PER2	1.00	4.89	**3.12**	0.66	0.21	0.15	-0.19
		PAP2	0.75	4.75	2.75	0.59	0.21	0.37**	0.57**
		SEF2	1.08	5.00	2.75	0.55	0.20	0.77**	1.80**
3	ACH3	MAT3	4.00	43.00	17.20	6.67	0.39	1.15**	1.13**
		ENG3	4.00	42.00	18.78	6.77	0.36	0.90**	0.81**
		SCI3	8.00	45.00	22.82	7.26	0.32	0.43**	-0.13
		THA3	9.00	45.00	**23.53**	7.53	0.32	0.35**	-0.72**
	ASC3	MSC3	0.20	5.00	2.69	0.75	0.28	0.04	0.45*
		ESC3	0.20	5.00	2.70	0.75	0.28	0.17*	0.65**
		SSC3	0.20	5.00	2.93	0.66	0.23	-0.20*	1.52**
		TSC3	0.60	5.00	**3.12**	0.64	0.21	0.32**	0.40*
	NSC3	PAB3	0.50	5.00	3.17	0.70	0.22	0.02	0.27
		PER3	0.67	5.00	**3.19**	0.61	0.19	-0.02	0.52*
		PAP3	0.38	5.00	2.89	0.64	0.22	-0.04	1.73**
		SEF3	1.00	4.90	2.86	0.58	0.20	0.54**	1.33**

* $p < 0.05$, ** $p < 0.01$

Table 2 The goodness of fit index of three research hypothetical models.

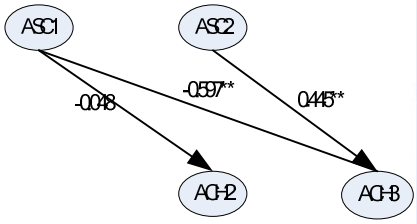
model	χ^2	df	RMSEA	CFI	GFI	AGFI	χ^2/df
1	13238.06	570	0.16	0.75	0.53	0.45	23.22
2	6443.62	238	0.17	0.77	0.60	0.50	27.07
3	8425.13	239	0.20	0.77	0.54	0.42	35.25

model comparison	$\Delta\chi^2$	Δdf	χ^2/df	summary
1 : 3	4812.93**	331	23.22 : 35.25	model 1
3 : 2	1981.51**	1	35.25 : 27.07	model 2
1 : 2	6794.44**-	332	23.22 : 27.04	model 1

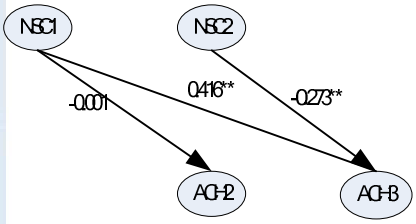
** $p < 0.01$

The result of model development and validation, the causal ordering model of academic self-concept, nonacademic self-concept, and academic achievement (model 1 or full self-concept factors model) was good fit with the empirical data with χ^2 = 641.981, df=600, p=0.114, CFI=0.998, GFI=0.957, AGFI=0.953, NNFI=0.998, RMSEA=0.009, and relative chi-square=1.069. Overall the model, the error of observed variables and latent variables inclined to decrease whereas most factor loadings of observed variables from three time repeated measures were continuously increased. The observed variables of academic achievement (ACH) were the highest factor scores during 0.643 to 0.819, the factor score of academic self-concept (ASC) were during 0.396 to 0.699, and the factor loading of nonacademic self-concept (NSC) were during 0.367 to 0.813.

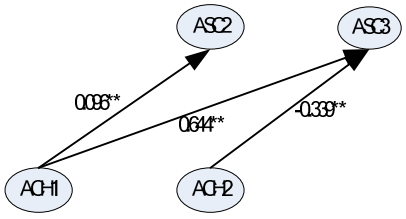
For the direction of causal effect in the model including with 1) Top-Down effect (TD): The second order effect of top-down effect from academic self-concept (ASC) to academic achievement (ACH) was the highest effect and grater than the first order effect (the second highest effect) by four times approximately. The third order effect of top-down effect from nonacademic self-concept (NSC) to academic achievement (ACH) was the highest effect and grater than the first order effect (the second highest effect) by three times approximately. 2) Bottom-Up effect (BU): The third order effect of bottom-up effect from academic achievement (ACH) to academic self-concept (ASC) was the highest effect and grater than the second order effect (the second highest effect) by five times approximately. The third order effect of bottom-up effect from academic achievement (ACH) to nonacademic self-concept (NSC) was the highest effect and grater than the first order effect (the second highest effect) by one time approximately. 3) Horizontal effect (HE): The horizon of all three latent variables



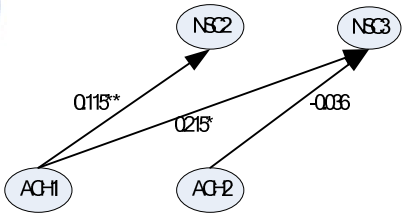
(4A) TD effect: ASC→ACH



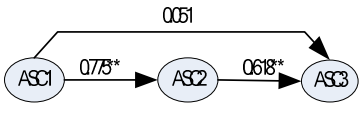
(4B) TD effect: NSC→ACH



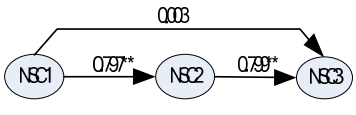
(4C) BU effect: ACH→ASC



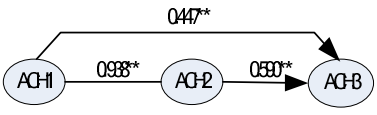
(4D) BU effect: ACH→NSC



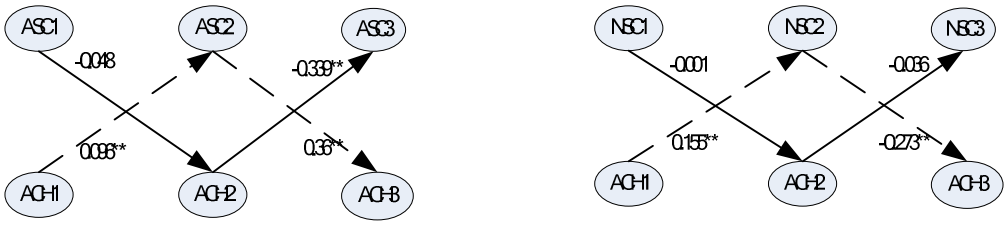
(4E) HE: ASC



(4F) HE: NSC



(4G) HE: ACH



(4H) RE: ASC↔ACH (4I) RE: NSC↔ACH

Figure 4. The causal paths of causal ordering model of academic self-concept, nonacademic self-concept, and academic achievement.

has similar order. The first order effect was the highest effect and grater than the second and the third order, respectively. 4) Reciprocal effect (RE): The reciprocal effect from academic self-concept (ASC) to academic achievement (ACH) is positive and grater than the input effect three times approximately and the reciprocal effect from academic achievement (ACH) to academic self-concept (ASC) is negative and grater than the input effect three times approximately. The reciprocal effect from nonacademic self-concept (NSC) to academic achievement (ACH) is negative (opposite direction with the input effect) and grater than the input effect one time approximately and the reciprocal effect from academic achievement (ACH) to nonacademic self-concept (NSC) is negative (opposite direction with the input effect) and merely different with the input effect. The causal ordering effects were shown in figure 4 and figure 5. The percent variance explained in academic achievement, nonacademic self-concept, and academic achievement were 98.3%, 71.8%, and 68.9% , respectively.

Discussion

The result of causal ordering comparison show the best fit model which is the full path model with two factors of self-concept due to the model was measured from multiple observed variables more than other causal ordering models. In addition, the full path model was designed to use all two factors of self-concept which strongly supported the self-concept factor separation by March and Shavelson (1985). Further more, the rest two causal ordering models with different one factor of self-concept show the causal ordering of nonacademic self-concept and academic achievement were more fit with the empirical data than academic self-concept and academic achievement due to the nonacademic self-concept was social factor correlated with multiple important social factors from inside and outside student's school and community (Roger, 1959 cited in Hjelle & Ziegler, 1992; Mead, 1934 cited in Burn, 1979; Gross, 1992 cited in Reinecke, 1993). In contrast, the academic self-concept was affected just only from learning processes in the classroom. It is supported the important role of nonacademic self-concept in student's real life proposed by William (1993).

The result of model development and validation show the causal ordering model of academic self-concept, nonacademic self-concept, and academic achievement have good fit with the empirical data, CFI and NNFI should more than 0.90 and 0.95, respectively, and RMSEA should less than 0.05 (Guay, Mague, & Vellerland, 2003), due to the model was selected from the lowest relative chi-square of three research hypothesis models. More over, The model was used multiple highly correlated variables (more than 85% was significant at .01 level) rely on Guay, Mague and Vellerland's suggestion to

measured at least three or more observed indicators in one latent variable, especially in the complex model.

From the fitted model, most the third order effects of TD and BU effects were highly and significantly. These all effects were one academic year effects which were supported from many prior research results that suggest at least one year period between each measurement will reveal dominantly effect between variables (Marsh, 2003; Guay, Marsh, & Boivin, 2003; Guay, Mageau, & Vallerland, 2003). However, the rest effect, the first order and the second order effect, some are negative effects and some are positive effects which contrast with prior research results due to two main reasons that 1) the short period of each measurement not enough to make dominantly effect cause of dissertation data collection limitation and 2) between the middle academic year, each school was during many special activities from inside and outside (e.g. assurance activity, sport competitive activity, special days, teacher evaluation for professionalization) that mainly disturb student learning activities

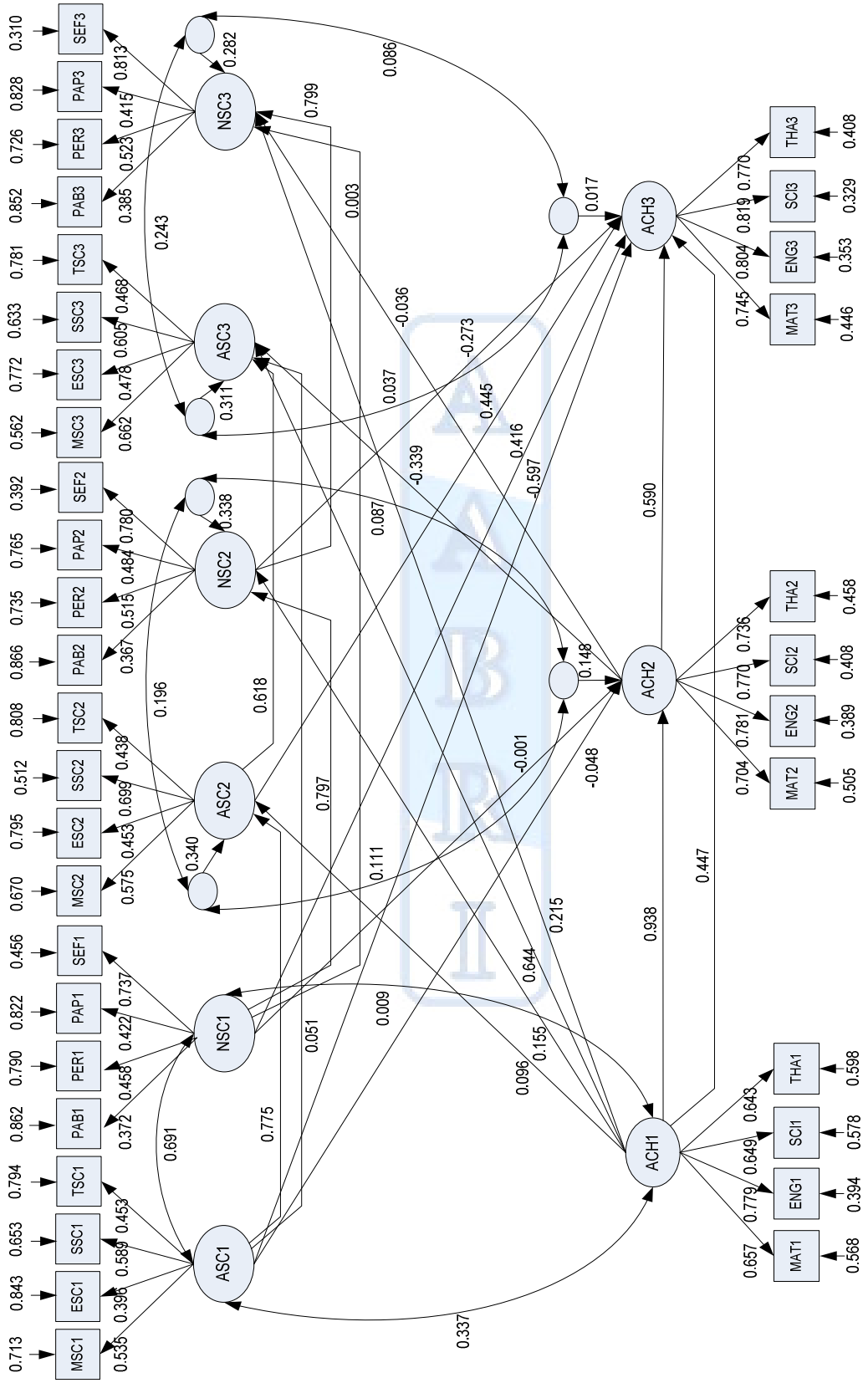


Figure 5. The causal ordering model of academic self, nonacademic self-concept, and academic achievement.

continuously. For these two reasons highly probably effects to four reciprocal effects differ from the result of prior research.

The horizontal effects of academic self-concept, nonacademic self-concept, and academic achievement were similar that is the first order effect is grater than the second order effect and the third order effect respectively. However, the third order effects between academic self-concept and nonacademic self-concept were different from academic achievement that is the third order effects of self-concepts were closely zero whereas the third order effect of academic achievement was more strongly and significantly because academic achievement was continuously developed since the student was young. The student was faced with academic experience in educational system for along time whereas academic self-concept and nonacademic self-concept were developed later than academic achievement when the age of student during adolescence and reactive with social (Fraine, Damme, & Onghena, 2007; Huitt, 2004; Marsh, 2003; Hartter, 1999; Sprintall , Sprintall, & Oja, 1998; Sprintall & Sprintall, 1990).

Recommendations and Suggestions Future Research

This study expands knowledge from prior researches and much remains to be done.

The following recommendations are made for implementation of the processes identified herein:

School administrators and teachers should emphasize to improve student positive self-concept both academic and nonacademic self-concept equal to improve student academic development. The research result reveal closely relationship between academic self-concept, nonacademic self-concept, and academic achievement especially during the early first semester which is the most important period to set various activity for improving student positive self-concept.

Administrators and teachers should fix the activities to improve nonacademic self-concept. The activities should be the closely and relatively with the student's interesting, not too easy and not exceed the student's potential, from easy to difficult. The teacher should select student group activities more than single activities when the first semester had begun. In addition, the teacher should fix the activities to improve academic achievement, especially in English and Science at the second semester had begun. The administrator and the teacher should brainstorm and fix the kind of the activities and period to take suitably the activities to the student.

The important role of teacher is a good reflector of the student's activity both in academic and nonacademic areas. Informing students about their progress and choices allows them to improve themselves. Many prior studies (e.g. Roberson & Stewart, 2006; Hay, 2005) confirmed the beneficial result when the researchers employed the reflection method in their experiments.

Most of the effects in the causal ordering model appear after the process was in place for a significant period (approximately one year). Structuring a similar study over a longer period of time may improve study validity.

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Appendix: Correlation matrix

Var	MAT1	ENG1	SCI1	THA1	MSC1	ESC1	SSC1	TSC1	PAB1	PER1	PAP1	SEF1
MAT1	1.000											
ENG1	0.498**	1.000										
SCI1	0.458**	0.505**	1.000									
THA1	0.402**	0.496**	0.446**	1.000								
MSC1	0.228**	0.047	0.175**	0.103**	1.000							
ESC1	0.132**	0.281**	0.250**	0.302**	0.125**	1.000						
SSC1	0.085*	0.011	0.217**	0.122**	0.399**	0.253**	1.000					
TSC1	-0.005	0.004	0.118**	0.219**	0.160**	0.281**	0.230**	1.000				
PAB1	-0.115**	-0.235**	-0.142**	-0.087**	0.213**	-0.016	0.211**	0.263**	1.000			
PER1	0.068	-0.019	0.059	0.029	0.177**	0.073**	0.223**	0.170**	0.246**	1.000		
PAP1	-0.109**	-0.171**	-0.035	-0.049	0.068	0.075*	0.220**	0.265**	0.337**	0.261**	1.000	
SEF1	0.152**	-0.003	0.132**	0.073*	0.262**	0.195**	0.293**	0.245**	0.259**	0.349**	0.333**	1.000
MAT2	0.735**	0.510**	0.418**	0.380**	0.174**	0.100**	0.053	-0.054	-0.153**	0.043	-0.163**	0.080*
ENG2	0.470**	0.741**	0.462**	0.439**	-0.050	0.184**	-0.020	0.031	-0.263**	-0.026	-0.154**	-0.032
SCI2	0.506**	0.559**	0.666**	0.479**	0.204**	0.199**	0.209**	0.098**	-0.076*	0.107**	-0.014	0.138**
THA2	0.433**	0.554**	0.467**	0.732**	0.059	0.263**	0.125**	0.196**	-0.123**	0.035	-0.071*	0.062
MSC2	0.259**	0.090*	0.204**	0.197**	0.763**	0.122**	0.303**	0.180**	0.180**	0.141**	0.016	0.211**
ESC2	0.077*	0.238**	0.189**	0.219**	0.087**	0.657**	0.187**	0.303**	0.015	0.047	0.112**	0.206**
SSC2	0.100**	0.111**	0.226**	0.200**	0.355**	0.172**	0.641**	0.142**	0.126**	0.225**	0.164**	0.266**
TSC2	0.034	0.101**	0.119**	0.302**	0.119**	0.223**	0.171**	0.639**	0.162**	0.181**	0.175**	0.192**
PAB2	-0.044	-0.130**	-0.056	-0.059	0.171**	0.009	0.186**	0.264**	0.644**	0.220**	0.241**	0.217**
PER2	0.107**	0.094**	0.060	0.118**	0.144**	0.159**	0.228**	0.120**	0.160**	0.662**	0.153**	0.302**
PAP2	-0.055	-0.010	0.033	0.053	0.063	0.154**	0.135**	0.258**	0.207**	0.193**	0.524**	0.221**
SEF2	0.199**	0.105**	0.148**	0.138**	0.186**	0.216**	0.253**	0.167**	0.139**	0.328**	0.234**	0.694**
MAT3	0.701**	0.521**	0.381**	0.413**	0.143**	0.123**	0.018	-0.074*	-0.140**	0.057	-0.152**	0.074*
ENG3	0.473**	0.724**	0.447**	0.466**	-0.066	0.288**	-0.022	-0.003	-0.251**	-0.033	-0.158**	0.000
SCI3	0.526**	0.593**	0.705**	0.481**	0.170**	0.181**	0.211**	0.043	-0.119**	0.102**	-0.015	0.132**
THA3	0.445**	0.596**	0.492**	0.774**	0.068	0.292**	0.075*	0.163**	-0.100**	0.058	-0.044	0.079*
MSC3	0.335**	0.237**	0.319**	0.256**	0.711**	0.150**	0.298**	0.137**	0.102**	0.081*	-0.025	0.188**
ESC3	0.138**	0.321**	0.232**	0.297**	0.045	0.641**	0.157**	0.180**	-0.032	-0.004	0.035	0.148**
SSC3	0.136**	0.219**	0.303**	0.214**	0.317**	0.230**	0.624**	0.144**	0.064	0.059	0.120**	0.202**
TSC3	0.080*	0.207**	0.191**	0.332**	0.068	0.300**	0.172**	0.624**	0.089*	0.111**	0.142**	0.166**
PAB3	0.016	-0.024	0.018	-0.016	0.151**	0.006	0.155**	0.229**	0.653**	0.149**	0.256**	0.190**
PER3	0.176**	0.184**	0.112**	0.136**	0.124**	0.150**	0.185**	0.115**	0.105**	0.583**	0.103**	0.253**
PAP3	-0.005	0.067	0.081*	0.033	-0.019	0.222**	0.098**	0.200**	0.138**	0.143**	0.526**	0.229**
SEF3	0.229**	0.186**	0.218**	0.204**	0.184**	0.258**	0.255**	0.201**	0.106**	0.242**	0.194**	0.680**
$\bar{x}$	14.617	16.578	19.926	21.266	2.456	2.478	2.695	3.012	2.958	3.101	2.675	2.756
S.D.	4.960	5.911	6.178	6.328	0.753	0.678	0.670	0.773	0.761	0.680	0.677	0.615

Table 3. (continue)

Var.	MAT2	ENG2	SCI2	THA2	MSC2	ESC2	SSC2	TSC2	PAB2	PER2	PAP2	SEF2
MAT2	1.000											
ENG2	0.535**	1.000										
SCI2	0.553**	0.573**	1.000									
THA2	0.459**	0.579**	0.595**	1.000								
MSC2	0.306**	0.039	0.265**	0.171**	1.000							
ESC2	0.129**	0.254**	0.218**	0.298**	0.211**	1.000						
SSC2	0.129**	0.060	0.264**	0.207**	0.361**	0.204**	1.000					
TSC2	0.023	0.121**	0.165**	0.300**	0.221**	0.295**	0.281**	1.000				
PAB2	-0.055	-0.164**	0.015	-0.012	0.169**	0.079*	0.259**	0.279**	1.000			
PER2	0.105**	0.092**	0.147**	0.121**	0.165**	0.142**	0.283**	0.210**	0.239**	1.000		
PAP2	-0.149**	-0.002	0.053	0.073*	0.085*	0.197**	0.209**	0.345**	0.325**	0.242**	1.000	
SEF2	0.178**	0.104**	0.218**	0.140**	0.247**	0.272**	0.374**	0.272**	0.245**	0.421**	0.290**	1.000
MAT3	0.825**	0.573**	0.551**	0.508**	0.272**	0.122**	0.090*	0.027	-0.044	0.130**	-0.127**	0.170**
ENG3	0.542**	0.796**	0.539**	0.572**	0.070*	0.285**	0.089*	0.150**	-0.126**	0.111**	0.031	0.119**
SCI3	0.560**	0.614**	0.811**	0.582**	0.213**	0.132**	0.240**	0.090**	-0.050	0.141**	0.032	0.165**
THA3	0.489**	0.576**	0.575**	0.856**	0.211**	0.279**	0.202**	0.301**	-0.025	0.160**	0.093**	0.181**
MSC3	0.353**	0.161**	0.340**	0.280**	0.819**	0.194**	0.380**	0.147**	0.108**	0.155**	0.069*	0.213**
ESC3	0.195**	0.330**	0.242**	0.367**	0.150**	0.774**	0.176**	0.203**	0.033	0.111**	0.151**	0.221**
SSC3	0.147**	0.117**	0.274**	0.236**	0.299**	0.218**	0.694**	0.148**	0.141**	0.151**	0.154**	0.224**
TSC3	0.076*	0.201**	0.197**	0.357**	0.137**	0.363**	0.233**	0.712**	0.184**	0.182**	0.254**	0.222**
PAB3	-0.021	-0.101**	0.074*	0.000	0.151**	0.056	0.174**	0.170**	0.770**	0.167**	0.263**	0.208**
PER3	0.181**	0.173**	0.198**	0.169**	0.166**	0.141**	0.250**	0.205**	0.186**	0.791**	0.218**	0.367**
PAP3	-0.089*	0.071*	0.080*	0.096**	-0.006	0.240**	0.135**	0.248**	0.205**	0.193**	0.699**	0.279**
SEF3	0.211**	0.182**	0.249**	0.255**	0.228**	0.298**	0.354**	0.237**	0.204**	0.319**	0.263**	0.772**
$\bar{x}$	15.218	17.089	21.648	21.851	2.582	2.624	2.780	3.014	3.014	3.123	2.751	2.753
S.D.	5.997	6.104	6.377	6.896	0.739	0.685	0.657	0.671	0.714	0.662	0.589	0.555
Var.	MAT3	ENG3	SCI3	THA3	MSC3	ESC3	SSC3	TSC3	PAB3	PER3	PAP3	SEF3
MAT3	1.000											
ENG3	0.619**	1.000										
SCI3	0.610**	0.594**	1.000									
THA3	0.558**	0.628**	0.635**	1.000								
MSC3	0.361**	0.192**	0.364**	0.322**	1.000							
ESC3	0.264**	0.471**	0.261**	0.372**	0.263**	1.000						
SSC3	0.140**	0.171**	0.356**	0.248**	0.471**	0.286**	1.000					
TSC3	0.097**	0.249**	0.175**	0.387**	0.200**	0.360**	0.309**	1.000				
PAB3	-0.012	-0.043	0.045	0.027	0.179**	0.069*	0.216**	0.219**	1.000			
PER3	0.219**	0.228**	0.222**	0.234**	0.205**	0.174**	0.227**	0.245**	0.202**	1.000		
PAP3	-0.031	0.107**	0.087**	0.117**	0.030	0.257**	0.181**	0.264**	0.261**	0.287**	1.000	
SEF3	0.267**	0.258**	0.287**	0.294**	0.312**	0.364**	0.357**	0.309**	0.269**	0.412**	0.365**	1.000
$\bar{x}$	17.199	18.780	22.820	23.527	2.688	2.702	2.930	3.125	3.172	3.186	2.891	2.859

S.D.	6.669	6.774	7.257	7.534	0.746	0.746	0.660	0.641	0.703	0.614	0.642	0.582