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Does Athletic Success Come at the Expense of Academic Success?

Daniel H. Bowen*
Jay P. Greene
University of Arkansas

Abstract

Claims are often made about the impact of high school athletics on academic achievement without reference to empirical research on the issue. In this paper we empirically examine the relationship between the extent to which high schools have winning sports teams, offer a variety of sports options, and facilitate student participation in athletics on schools' overall student achievement and attainment. We find that high school athletics do not appear to detract from academic success. In fact, based on the data we examined from Ohio high schools, an emphasis on athletic success and participation is associated with higher scores on standardized tests and higher graduation rates.

Introduction

Do successful high school athletics programs come at the expense of academic success? In this article we attempt to address this question empirically. In particular, we study the relationship between the athletic record of high schools in Ohio and the student achievement in those high schools, controlling for other characteristics.

Our expectations for what we would find are ambiguous. On the one hand, we might think that resources are finite and that investments in producing success in one arena necessarily would have to reduce the investment in success in another. Schools have limited budgets, a limited supply of talented personnel, and a limited capacity to convey priorities to students. If

schools devote those scarce resources to their football or basketball programs, academics would have to suffer.

On the other hand, there is the potential for synergies in education. Perhaps students learn important skills about self-discipline and delayed gratification from athletics that also produce benefits academically. And more broadly, perhaps schools that have successful academic programs are more likely to attract the interest and involvement of parents and the community. As parents gather for sporting events, they also discuss academic issues, which may help them organize and coordinate to pressure schools to improve their academic quality. More parental and community support may also make it easier to pass essential bond initiatives or increase levies so that schools have sufficient fiscal resources for their academic programs.

Collecting and analyzing evidence to adjudicate between these two competing, plausible hypotheses is particular important at this time. High school sports continue to attract more public attention and to consume greater public resources while school budgets have become very tight. Editorial page writers and local activists have been making a more forceful case that the attention and money devoted to high school athletics is a waste and distracts from the primary responsibility of schools to improve academic achievement (see for example Katz, 2010; Weaver, 2011). But supporters of high school athletics respond that critics lack evidence for their arguments and that sports play a critical role in the growth and development of students (see for example Brooks, 2011; Green, 2009; Strauss, 2011).

Bringing more evidence to bear on these debates is important because too many education policy discussions occur in the absence of empirical evidence. The research presented here could help make those discussions be more productive and data-driven.

II. Literature Review

There is a significant body of research that examines how students who participate in high school athletics are affected academically. The general consensus of this literature is that students who are involved in high school athletics tend to have higher academic achievement and better earnings later in life (see for example Broh, 2002; Guest & Schneider, 2003; Lipscomb, 2006; Marsh, 1992; and McNeal, 1995). In these studies, outcome measures included students' grades and standardized test scores, homework completion rates, school dropout rates, and students' stated educational expectations (e.g. intent to enroll in a postsecondary institution).

High school students that participate in sports have higher grades and standardized test scores in mathematics and language arts courses (Broh, 2002). McNeal (1995) found that student athletes were 1.7 times less likely to drop out of school. High school student athletes have also self-reported higher education aspirations, diligence in homework completion, and lower absenteeism, compared to students that do not participate in sports (Marsh, 1992). When applying student fixed effects to measure changes in students' levels of participation, Lipscomb (2006) estimated that athletic participation is associated with a 2% boost in math and science test scores. Meanwhile, student participation in other extracurricular participation (e.g. yearbook, drama club, etc.) was also associated with significant increases, though effect sizes were only half as large. Finally, while associated with positive outcomes across populations, Guest and Schneider (2003) have also found that this positive athletic-academic association was even stronger for students attending schools serving more disadvantaged populations.

While these findings would suggest a positive relationship between successful high school athletic programs and overall academic achievement at those schools, these studies are addressing a slightly different question than the one we are examining here. These studies only tell us about the effects of athletics on students directly involved in high school sports, but it is

quite possible that the larger portion of students who are not on sports teams are harmed academically even if the students on the teams are helped. If this were the case, the overall effect of high school athletic programs on academic achievement could be negative even if participating in sports improves the education of those students who do participate.

Our research question is somewhat different from the one addressed by the bulk of research on high school athletics. We want to know the overall effect of high school athletics on academic success for students who participate as well as those who do not. On this question there is considerably less research and no consensus on the answer. In general, there are two theories about how athletics programs affect academic achievement in high schools: the social capital theory and the resource tradeoff theory.

Strangely, both theories originate from different works by the University of Chicago sociologist, James Coleman. Coleman (1990) helped pioneer the concept of social capital, which refers to the strength of social networks and connections in helping people to achieve their collective goals. While Coleman did not focus on the way in which high school athletics contribute to the formation of social capital, other scholars have extended his work on social capital to that issue. The general hypothesis is that sports provide a medium that can enhance a school's sense of community. In other words, Friday night high school football games are more than just gatherings where spectators watch sports. These games can also serve as venues where parents, students, faculties, staffs, etc. come together, interact, and, subsequently, form tighter social networks (Fritch, 1999). This sense of community, in turn, serves as a source of "social control" or reinforcement of "school/community norms" where stakeholders serve as collaborators in the development of students (Broh, 2002).

Fritch (1999) provides empirical evidence for this hypothesis, finding that a substantial number of high school parents often initially meet other parents at sporting events. Additionally, 76-91% of parents report that they were very likely to discuss what is going on at the school at these events. There is also evidence that the development of social capital positively influences the future community involvement of student athletes. Perks (2007) concludes that participation in athletics strongly correlates with becoming more involved members of one's community. Adults that participated in sports early in life are more likely to volunteer, follow the news, keep up with community affairs, etc. Whether social capital is strengthened by students directly participating in high school sports or by parents and community members gathering at the games, the social capital theory holds that athletics contributes to academics by contributing to the formation of social capital. Parents, students, and other members of the community can more effectively work to improve school quality because of their improved connections to each other (Parcel & Dufur, 2001).

The resource trade-off theory also originated with the work of James Coleman. Schools have a finite amount of money, talented personnel, and ability to establish priorities for students. The more these resources are consumed for athletics, the less there is available for academics. Coleman was most concerned with the limited ability of schools to convey priorities to students. Attention given to high school sports distracts schools from their core mission of improving academic achievement. Mission coherence, according to this view, is an essential part of organization success and athletics diverts schools from having a coherent scholarly mission.

In an extensive case study of ten schools in Chicago, Coleman (1961) observed instances where athletics were possibly responsible for altering or "swamping" the value systems of schools. Coleman argued that athletics and academics seem at odds in a zero-sum game, where

increasing dedication towards one aspect will come at the expense of the other. Even when schools try to strike a balance with their academic and athletic successes, Coleman believed that they would never become "highly academically oriented" (p. 278).

It is interesting that Coleman was so critical of high school athletics given how important he considered social capital in contributing to academic success. Coleman (1988) concluded that higher levels of community and social networking amongst key stakeholders produced greater levels of student academic achievement as well as attainment. And Coleman (1987) attributed the successes of private, religious schools to the fact that shared mission and networking at religious services provided natural venues for the growth of social capital; “In effect, this church-and-school community, with its social networks and its norms about what teenagers should and should not do, constituted social capital beyond the family that aided both family and school in the education of the family’s children” (p. 36). Higher levels of social capital produce greater levels of trust within a community, and a community with greater trust is able to accomplish its mission better than a similar community without that same level of trust (Coleman, 1988). But for some reason Coleman never considered how high school sports, like religious services associated with private schooling, could be significant contributors to social capital formation.

Sporting events actually seem very comparable to the religious services of private, religious schools. Others have observed this similarity. For example, with regard to football in Texas, Glanzer (1998) states, “I do not wish to make the case, although others might like to, that courts should declare football in Texas an unconstitutional establishment of religion” (p. 220). Arnold Mandell (1974) also attested to the view that football is more than just a sporting event: “Football is not a game but a religion, a metaphysical island of fundamental truth in a highly verbalized, disguised society, a throwback of 30,000 generations of anthropological time” (p.

12). More importantly, aside from the possibility of instilling a religious-like fervor in supporters, sporting events can facilitate the development of social capital in a community (Uslaner, 1999). Since public high schools often encompass a broad geographic area and draw their students from a broad diversity of religious and cultural backgrounds, sporting events may provide the only practical venues where parents, faculties, staffs, etc. can congregate, network, and, subsequently, build social capital. Sport may be to public schools what church is to Catholic schools.

III. Data and Methodology

To test these competing theories about the relationship between high school athletics and school-wide academic achievement, we collected information about high schools in Ohio. To measure the emphasis given to athletics, we collected information about the athletic success of high school programs in winning games. Schools that win more often presumably have a culture in which athletics are given a higher priority. In addition, schools that offer more sports or that have more students directly involved in sports teams are also thought to have a greater emphasis on athletics. For academic outcomes we used measures of achievement as well as attainment. In addition, we collected other information about these high schools, such as their per pupil spending, size, and the demographics of their student body, to serve as control variables.

In particular, we run multiple regressions using ordinary least squares (OLS). We examine two different dependent variables over a five year period (2004-05 through 2008-09): percentage proficient or above on the Ohio State standardized test as a measure of achievement and cumulative promotion index (CPI) as a measure of attainment. CPI is an estimate of the high school graduation rate (Swanson & Chaplin, 2003). Since the conditions of this study do not allow for a pure experimental design, we control for other school characteristics that typically

influence educational outcomes. The controls used in the regressions are schools' district per pupil expenditures (PPE), percentage of economically disadvantaged students, percentage minority, percentage male, and average daily memberships (ADM). The independent variables of interest for this study are the schools' five-year cumulative winning percentage and the number of sports offered as a proxy for school-wide participation in sports. Multiple models are designed and tested to assess the robustness of findings.

Data were gathered from three sources: the Ohio Department of Education's (ODE) interactive Local Report Card (iLRC), MaxPreps.com, and the Ohio High School Athletic Association's (OHSAA) membership directory. The ODE data provide school demographics as well as the data needed for both dependent variables for this study. In addition, the ODE determines the percentage proficient for each school through performance on the state's standardized test. CPI, the other dependent variable, is an index that is an average percentage of students promoted to the next grade. A given year's CPI is calculated by dividing the number of students for a year and grade by the enrollment of the preceding grade from the prior year and then multiplying across the four high school cohorts: 10^{th} grade current / 9^{th} grade prior * 11^{th} grade current / 10^{th} grade prior * …. CPI for this study is calculated with the use of ODE's iLRC data.

The final sample size for this study is 657 public high schools in Ohio after excluding schools that did not offer at least one sport. The winning percentages for schools are calculated by going through MaxPreps.com and manually entering the win-loss records for each school's varsity football, boys' basketball, and girls' basketball teams. Almost all high schools offered and had records available on these three sports teams. Information on other high school sports, such as baseball, softball, and golf, was often unavailable, either because the schools did not

offer these sports or the winning records were not provided to MaxPreps. As a result, we confined our analyses to football and boys' and girls' basketball for which we had more complete information.

Schools' sports participation rates were calculated in two ways. The OHSAA maintains a directory of all high schools and the sports that they offer. We manually recorded which sports were offered by each high school. To estimate the total number of students participating in these sports, we weighted each sport according to the OHSAA minimum number of participants required for the school to offer the sport (e.g. basketball = 5; baseball = 9; football = 11; etc.). After controlling for schools' student enrollments, both the number of sports and the minimum number of participants required for a team for all the sports offered at the school were used as proxies for measuring the extent to which the entire school is directly involved with athletics (i.e. weighted sports offered).

All of these measures are averaged over a five year period in order to reduce their volatility. The winning percentage for high school sports teams can vary significantly from year to year. But their average winning percentage over a five year period may better capture the overall priority given to high school athletics at each school. In addition, academic achievement and graduation rates can vary from year to year. Smoothing everything over a five year period should give us a clearer picture of the general relationship between athletic and academic success. See Table 1 for descriptive statistics on all variables used in our analyses.

<<Table 1>>

IV. Results

Controlling for school demographics and characteristics that are normally associated with school performance, a school's commitment to athletics is positively related to academic

performance. This finding is statistically significant and robust to multiple specifications. With regard to attainment, a 10 percentage point increase in a school's overall winning percentage is associated with a 1.3 percentage point improvement in its CPI, which is an estimate of its high school graduation rate (see Table 2). To examine whether a specific sport was driving the results, each sport was examined independently (see Columns (3), (4), and (5)). While football produces the largest impact, each sport independently produces a positive, significant effect (all at $p < 0.01$).

<<Table 2>>

The number of sports offered by a high school as well as the number of students directly involved in sports teams are also positively related to educational attainment. The addition of one sport increases the estimated graduation rate by 0.3 percentage points (an increase of .003 in the CPI). This positive effect on attainment is statistically significant. When high schools have more students directly participating in sports, we also observe a higher CPI score. The addition of 10 students directly involved in sports raises CPI by 0.004, which is a .4 percentage point increase in estimated high school graduation rate (though this effect falls short of statistical significance) (see Table 3).

However, the use of the total number of sports offered or our estimate of the total number of students directly involved on sports teams for the entire year may bias estimates. Since the information on exactly how many students are participating in athletics is not available, this proxy for participation remains susceptible to multi-sport athletes biasing schools' participation rates. Looking at sports offerings and minimum number of participants for a given season helps to reduce this bias by eliminating the possibility that the same students may play on multiple teams during the course of the full year.

Examining a single season does have the advantage of using a school's absolute minimum level of participation. Minimum participation levels in Ohio do however provide the advantage of reflecting a greater variance across school participation levels. The winter sports season was chosen due to the fact that it has the largest number of sports offered of any season, allowing the possibility to increase variance in participation across schools. When we only examine winter sports, an increase of one sport improves CPI by 0.01, which would be a 1 percentage point increase in the high school graduation rate. For the winter, the addition of 10 students directly participating in sports is associated with a 0.015 improvement in CPI, or a 1.5% increase in high school graduation rate (see Table 3).

<<Table 3>>

We observe similar positive and statistically significant relationships between the success and participation in high school sports and student achievement as measured by the Ohio standardized test results. A 10 percentage point increase in overall winning percentage is associated with a 0.25 percentage point increase in the number of students at or above academic proficiency. (See Table 4) When we examine the effect of winning percentage in each sport separately, once again winning in football has the largest effect. Girls' basketball also remains positive and statistically significant (at $p < 0.10$), but boys' basketball is not statistically distinguishable from a null effect.

<<Table 4>>

As for participation and achievement, the addition of one sport increases the number of students at or above academic proficiency by 0.2 of a percentage point. The addition of 10 students directly participating in a sports team improves the proportion of students at or above proficient by 0.4 of a percentage point. Both of these results are statistically significant at $p <$

0.01. (See Table 5) When examining just the winter season, adding one winter sport increases the percentage of students performing proficiently by 0.4 of a percentage point, while an additional 10 student able to directly participate in sports during the winter season relates to a 0.6 percentage point increase in students at or above proficiency (see Table 5).

<<Table 5>>

V. Conclusion

Based on these analyses of Ohio high schools, it appears that there is no necessary trade-off between emphasizing high school athletics and producing academic success. In fact, the more that a high school produces winning teams, offers more sports, and expands the number of students who can participate in athletics, the better a school does academically. These conclusions hold true across multiple ways of measuring academic success and across multiple measures of school devotion to its athletic programs.

The addition of these findings to the discussion about high school athletics under tight budget conditions is especially important because, without these findings, local policy discussions could take place with little or no empirical evidence to inform them. Without evidence, advocates for or against high school athletics could rely primarily on competing theories to make their cases and simply assume that their own plausible theories must be correct.

But the only way to adjudicate among competing plausible theories is with evidence, like the kind we present here. The fact that theories for and against an emphasis on high school athletics can both be derived from the work of James Coleman makes our expectations in the absence of evidence even more uncertain. If we give credence to Coleman's view that social capital is the key to successful schools and if we recognize how high school sports contribute to social capital formation in public schools (like church is to Catholic schools), then we would

expect an emphasis on athletics to increase student achievement. However, if we believe Coleman's argument that schools need to have a mission focused on academics in order to succeed and that athletics divert schools from that focused mission, then we would expect an emphasis on athletics to hurt student achievement. The evidence produced in this study supports the former theory.

Of course, it is difficult for us to be completely certain of the causal relationship between success in high school athletics and academics. While we control for a number of school and student characteristics, we cannot be sure that schools with larger and more successful athletic programs do not also tend to have some other quality that is actually the cause of their academic success. For example, it is possible that schools with greater organizational competence and more effective leadership are able to produce both athletic and academic success. If that were true, organizational competence and effective leadership would be the real causes of higher student achievement, not athletics. Our control variables allow us to say that, even for schools that spend the same amount of money per pupil, have similar student demographics, and are of the same size, having a larger and more successful sports program is associated with higher academic achievement. But we cannot observe or control for other possible explanations for success in both athletics and academics.

Additional research could help solidify a causal understanding of the relationship between athletics and academics. Some areas for future research could include deeper explorations into the specific roles that sports play within schools. For example, how might schools channel social capital, accumulated from sports, into higher academic outcomes? Other opportunities for more rigorous studies could also come about if school budget constraints become more severe. If budgeting constraints lead to more widespread cuts of school sports

programs, then examining the impacts of these discontinuities could make it possible to get a better grasp of the causal relationship between academic and athletic successes.

Even if we cannot be absolutely certain of the causal relationship between sports and academics, our study provides useful descriptive information on this matter. In general, schools that are struggling academically are not the ones with the largest and most successful sports programs. Winning on the field and winning in the classroom tend to go hand in hand. Since we can be confident that this is an accurate description, it is very unlikely that high school sports are a major detriment to academic success.

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Table 1 - Ohio High School Descriptive Statistics (5 year averages)

Variable	Observations	Mean	Std. Dev.	Min.	Max.
Cumulative Promotion Index (CPI)	657	0.82	0.17	0.17	1.24
% Proficient	657	0.87	0.07	0.52	0.95*
Overall Sports Winning %	650	0.49	0.14	0.00	0.87
Football Winning %	600	0.48	0.19	0.00	0.95
Basketball (F) Winning %	649	0.48	0.22	0.00	0.92
Basketball (M) Winning %	650	0.48	0.18	0.00	0.92
Total Sports Offered	657	16.7	3.96	4	24
Weighted Total Sports	657	116	25.6	18	163
Winter Sports Offered	645	4.89	2.05	2	9
Weighted Winter Sports Offered	657	28.6	12.3	10	51
District Per Pupil Expenditure	657	9,225	1,684	6,787	18,789
% Economic Disadvantaged	628	0.24	0.19	0.00	0.97
% Minority	657	0.11	0.23	0.00	1.00
% Male	657	0.51	0.03	0.29	0.76
Average Daily Membership (ADM)	657	757	484	73	2,884

* - Maximum reported % Proficient is capped at 95% by the Ohio Department of Education

Table 2 – Winning Percentages and Academic Attainment

CPI[†]	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
Overall[±] Winning%	0.1320				
	(0.0330)***				
Football Winning%		0.0608	0.0768		
		(0.0258)**	(0.0250)***		
Basketball (F) Winning%		0.0391		0.0581	
		(0.0235)*		(0.0214)***	
Basketball (M) Winning%		0.0438			0.0681
		(0.0286)			(0.0261)***
District PPE (x $1,000)	0.0047	0.0049	0.0039	0.0037	0.0034
	(0.0038)	(0.0040)	(0.0040)	(0.0038)	(0.0038)
% Economic Disadvantaged	-0.3764	-0.3767	-0.3935	-0.3873	-0.3932
	(0.0353)***	(0.0371)***	(0.0366)***	(0.0355)***	(0.0351)***
% Minority	-0.2640	-0.2676	-0.2523	-0.2532	-0.2550
	(0.0345)***	(0.0361)***	(0.0357)***	(0.0345)***	(0.0346)***
% Male	0.0322	0.0405	0.0383	0.0292	0.0267
	(0.0390)	(0.0401)	(0.0402)	(0.0393)	(0.0392)
ADM (x100 students)	0.0005	0.0005	0.0008	0.0007	0.0008
	(0.0010)	(0.0011)	(0.0011)	(0.0010)	(0.0010)
Constant	0.8060	0.7953	0.8384	0.8527	0.8532
	(0.0447)***	(0.0475)***	(0.0443)***	(0.0421)***	(0.0423)***
N	621	579	580	620	621
R^2	0.5222	0.5202	0.5168	0.5155	0.5152

* - p-value significant at $p < 0.10$; ** - p-value significant at $p < 0.05$; *** - p-value significant at $p < 0.01$

[†] - CPI restricted to CPI < 1.25 due to outliers (e.g. one case where school has a recorded CPI of 497.17); 17 observations are dropped due to this restriction.

[±] - Cumulative winning percentage for football and boys' and girls' basketball

Table 3 – Sports Participation and Academic Attainment

CPI[†]	**(1)**	**(2)**	**(3)**	**(4)**
Total Sports	0.0034		0.0105	
	(0.0016)**		(0.0030)***	
Weighted Total Sports		0.0004		0.0015
		(0.0002)		(0.0005)***
District PPE (x $1,000)	0.0017	0.0018	0.0010	0.0013
	(0.0038)	(0.0038)	(0.0038)	(0.0038)
% Economic Disadvantaged	-0.4119	-0.4122	-0.4054	-0.4070
	(0.0350)***	(0.0351)***	(0.0348)***	(0.0349)***
% Minority	-0.2266	-0.2299	-0.2302	-0.2319
	(0.0342)***	(0.0342)***	(0.0337)***	(0.0337)***
% Male	0.0281	0.0262	0.0274	0.0259
	(0.0396)	(0.0396)	(0.0393)	(0.0394)
ADM (x100 students)	-0.0008	-0.0003	-0.0018	-0.0013
	(0.0014)	(0.0014)	(0.0013)	(0.0013)
Constant	0.8581	0.8641	0.8751	0.8792
	(0.0439)***	(0.0448)***	(0.0398)***	(0.0399)***
Winter Season Only	NO	NO	YES	YES
N	628	628	628	628
R^2	0.5347	0.5334	0.5406	0.5383

* - p-value significant at $p < 0.10$; ** - p-value significant at $p < 0.05$; *** - p-value significant at $p < 0.01$

Table 4 – Winning Percentages and Academic Achievement

% Proficient	(1)	(2)	(3)	(4)	(5)
Overall[±] Winning%	0.0248				
	(0.0104)**				
Football Winning%		0.0157	0.0195		
		(0.0078)**	(0.0076)***		
Basketball (F) Winning%		0.0129		0.0121	
		(0.0071)*		(0.0067)*	
Basketball (M) Winning%		0.0053			0.0096
		(0.0086)			(0.0082)
District PPE (x $1,000)	0.0027	0.0041	0.0038	0.0031	0.0025
	(0.0012)**	(0.0012)***	(0.0012)***	(0.0012)***	(0.0012)**
% Economic Disadvantaged	-0.2246	-0.2181	-0.2222	-0.2278	-0.2283
	(0.0112)***	(0.0112)***	(0.0110)***	(0.0111)***	(0.0111)***
% Minority	-0.1168	-0.1347	-0.1314	-0.1162	-0.1146
	(0.0108)***	(0.0109)***	(0.0108)***	(0.0107)***	(0.0109)***
% Male	-0.0299	-0.0253	-0.0260	-0.0307	-0.0309
	(0.0125)**	(0.0122)**	(0.0122)**	(0.0124)**	(0.0125)**
ADM (x100 students)	0.0020	0.0020	0.0020	0.0020	0.0021
	(0.0003)***	(0.0003)***	(0.0003)***	(0.0003)***	(0.0003)***
Constant	0.8957	0.8774	0.8873	0.9002	0.9063
	(0.0140)***	(0.0143)***	(0.0133)***	(0.0130)***	(0.0132)***
N	636	592	593	634	636
R^2	0.7376	0.7617	0.7606	0.7417	0.7358

* - p-value significant at $p < 0.10$; ** - p-value significant at $p < 0.05$; *** - p-value significant at $p < 0.01$

[±] - Cumulative winning percentage for football and boys' and girls' basketball

Table 5 – Sports Participation and Academic Achievement

% Proficient	(1)	(2)	(3)	(4)
Total Sports	0.0023		0.0040	
	(0.0005)***		(0.0010)***	
Weighted Total Sports		0.0004		0.0006
		(0.0001)***		(0.0002)***
District PPE (x $1,000)	0.0019	0.0019	0.0019	0.0020
	(0.0012)*	(0.0012)	(0.0012)	(0.0012)*
% Economic Disadvantaged	-0.2320	-0.2306	-0.2310	-0.2310
	(0.0111)***	(0.0111)***	(0.0112)***	(0.0112)***
% Minority	-0.1015	-0.1014	-0.1069	-0.1071
	(0.0108)***	(0.0107)***	(0.0107)***	(0.0107)***
% Male	-0.0297	-0.0309	-0.0308	-0.0314
	(0.0127)**	(0.0127)**	(0.0127)**	(0.0127)**
ADM (x100 students)	0.0007	0.0007	0.0010	0.0010
	(0.0004)*	(0.0004)	(0.0004)**	(0.0004)**
Constant	0.8855	0.8802	0.9043	0.9050
	(0.0139)***	(0.0141)***	(0.0127)***	(0.0127)***
Winter Season Only	NO	NO	YES	YES
N	645	645	645	645
R^2	0.7508	0.7523	0.7494	0.7491

* - p-value significant at p < 0.10; ** - p-value significant at p < 0.05; *** - p-value significant at p < 0.01

Correspondence concerning this article should be addressed to:
* Daniel H. Bowen University of Arkansas, Department of Education Reform, 201 Graduate Education Building, Fayetteville, AR 72701. Corresponding email: dhbowen@uark.edu

Powerful Voices and Pens: Developing Critical Stance with Adolescent Literacy in Content-Area Pre-Service Teacher Education

Dr. Lina B. Soares

Georgia Southern University

Abstract

This practitioner-research study investigated the effect critical literacy has on content area pre-service teachers' abilities (N=14) to perceive the sociocultural influences in text. The study further investigated how content area pre-service teachers engage in critical stance during situated reading practices that centered on discussions of young adult literature. Quantitative data were collected on a pre- and post Literary Response Questionnaire (LRQ). Qualitative data collection included videotaped and audiotaped recordings, interviews, and dialogue journals. Results from a paired samples *t test* found there was a statistically significant difference between the LRQ pre- and post survey. Informed by grounded theory, reading young adult literature engaged content area pre-service teachers in critical stance through powerful voices in discussion and pens through dialogue journaling.

Brown and Knowles (2007) offer that the period of adolescence is roughly defined as a period between the ages ten and twenty and is a time of rapid intellectual, psychological, and social growth in students' lives. During these years, students develop a greater sense of what is right and what is wrong, the ability to inquire, reason, and problem solve, and students begin to grapple with their feelings and identity. These developmental changes are noteworthy because each one can and does influence adolescents' literacy practices in varying degrees.

Problem Statement

Although the topic of adolescent literacy should be a school-wide issue in all middle schools, there is still reluctance on the part of content area teachers to endorse the literacy needs of young adolescents as a goal for their course objectives. Faced with national pressure toward standardization and constraints imposed by state and local policies, content area teachers are increasingly pressed for time to deliver instruction focused

solely on the subjects they teach. As a result, content is increasingly taught in isolation and for the most part, content has been distilled down to what students are expected to know on state-mandated tests (Au, 2007). In addition, content area teachers still place a heavy emphasis on the textbook; contemporary young adult literature is frequently not considered when content area teachers choose reading materials (Bean, 1997). A further view that is often found in content are classrooms is that the development of critical reading skills should be left to language arts teachers (Alger, 2007; Spencer, Carter, Boon, & Simpson-Garcia, 2008). However, the reluctance to address adolescent literacy in content area middle grade classrooms can be approached in teacher education courses.

As an assistant professor of education, I have restructured my curriculum to move my content area pre-service teachers' thinking beyond content to address the literacy needs of the young adolescents they will one day teach in middle school. My goal is for my students to understand that literacy for young adolescents is both pedagogy and an instrument to address relevant themes and issues found in content studies. To do so, I challenge my students to expand their thinking and to deliberately challenge their own implicit beliefs, actions, and cultural practices while reading prominent and challenging themes in young adult literature (Walker & Bean, 2005).

What follows is a report of the findings of one practitioner-research study that examined: (1) What effect does critical literacy have on content area pre-service teachers' abilities to perceive the sociocultural influences in text?; and (2) How do content area pre-service teachers engage in critical stance during situated reading practices that centered on discussions of young adult literature?

The theoretical framework that laid the foundation for this study was pragmatism (Johnson & Onwuegbuzie, 2004; Tashakkori & Teddlie, 2003). Johnson and Onwuegbuzie note that pragmatism permits researchers to select methods that will address the totality of the study to arrive at the most complete answers to the research questions. Due to the mixed nature of this research study, pragmatism was an appropriate theoretical lens to support both quantitative and qualitative elements in this study.

Perspectives from Literature

In recognition that adolescence is a period of rapid change, researchers and educators alike recognize the literacy needs for these students are uniquely different than the needs of very young children who are learning to read (Alvermann, 2004; Bean & Harper, 2006). While adolescent literacy is a messy and multifacted concept to define, roughly speaking it refers to the set of skills and abilities that students need during the middle and secondary years to read, write, think, and to understand all forms of texts to succeed in school, work, and life (King-Shaver, & Hunter, 2009). These sets of skills are needed in all content area disciplines (e.g. social studies, math, science, and language arts), and all forms of texts include print, digital, informational, and communication technologies (Vacca, Vacca, & Mraz, 2010). Adolescent literacy further recognizes the sociocultural perspective that reading and writing are social activities that reflect the culture and community in which students live (Pradl, 1996). The sociocultural perspective acknowledges that literacy is not an isolated cognitive skill (Vygotsky, 1978), but rather it is influenced by the social, cultural, historical, and linguistic processes that relate to students' literacy development and life experiences (Gee, 1992; Scribner & Cole, 1981; Vygotsky). As a result, adolescents need opportunities to talk about texts and to bring their own personal experiences to discussions in order to make sense of the textual world and their own world.

Moreover, adolescent literacy recognizes that students in both middle and secondary grades need to develop necessary dispositions to think as social scientists and examine all evidence, develop abilities to take a critical stance toward content by challenging the author's intent, and become discerning readers of text who examine both sides of an issue. Subsequently, adolescent literacy promotes critical literacy; reading the world in order to understand the words (Freire, 1970).

The term critical literacy describes a pedagogical approach to reading that focuses on the political, sociocultural, historical, and economic forces that shape students' lives. It is an approach that teaches readers to become critically conscious of their own values and responsibilities in society (Ciardiello, 2004). Accordingly, the goal of critical literacy is to raise students' responsiveness toward societal problems in their world and to prompt students to ask why and for what reason are things the way they are, to question who profits the most, and then to act on making the world a better place (Beck, McKeown, Hamilton, & Kucan, 1997; Comber & Nixon, 1999). To do so, readers assume a critical stance; they read in opposition to texts and they challenge the author's purpose for writing (Bean & Moni, 2003). Questioning the author's intent helps students understand the sociocultural influences in their lives (Vygotsky, 1978; Wertsch, 1991), realize their role in society and others around them, and raise questions that delineate who is not represented and who is not heard (Luke & Freebody, 1997). Furthermore, critical literacy allows students to bring their owned lived experiences into discussions, offering them the opportunity for participation, engagement in higher levels of reading and discussion, and to understand the power of language.

For young adolescents in the middle grade years to read the "world as the word" (Freire, 1970), they need opportunities to engage in critical discussions across multiple content areas that center on relevant issues in their lives, time to critique and reflect on those issues, and relate

the issues to the world at-large. Literature can be the powerful motivator to engage students in thoughtful and critical thinking. In fact, Smith and Johnson (1994) offered, “Literature can become the lens through which content is viewed. This lens holds the young reader’s attention while connecting content with the variety of human experiences” (p. 198). One such valuable lens is young adult literature.

The genre known as young adult literature supports the lives of young adolescent readers in multiple ways (Alvermann; 2004; Harper & Bean, 2007). Young adult literature enables middle school readers to relate to their immediate world as struggles with identity, peer pressure, and conflicts within the family are universal themes that appeal to these students (Walker & Ben, 2005). Through young adult literature, students build a greater understanding of an historical period, as well as the cultural and economic concepts that comprise that period of time (George & Stix, 2000). Moreover, research has shown that young adult literature is a valuable tool to teach critical literacy in all content areas in middle school (Bean & Harper, 2006; Bean & Moni, 2003; Behrman, 2006; Wolk, 2009). When young adolescents are taught strategic practices in critical literacy, they know how to unpack different layers of meaning, interrogate texts to determine author biases, examine alternative perspectives, and to negotiate real-world experiences that engages response, inquiry, and social action (Harste, Breau, Leland, Lewison, Ociepka, & Vasquez, 2000).

As with middle grade students, pre-service teachers can benefit when given opportunities to analyze books that explore the social, cultural, and political dimensions that influence their lives (Bean & Harper, 2004; Lewison, Leland, & Harste, 2008). Young adult literature can offer reading alternatives for pre-service content area teachers and open the door to develop the ability

to read from a critical stance by engaging in textual criticism, inquiry and reflection, and exploring the many ways of being in the world through critical literacy (Cheu, 2011).

Methods

Participants

The study was conducted over the course of one university semester in the Southeastern region of the United States. The participants (N = 14) consisted of five males and nine females who attended the university and were enrolled in my Language Arts and Social Studies instructional methods class. The class met twice a week for a four hour period each class meeting.

Instruction

Instructional time was twofold: (1) the fourteen participants received research-based methods to effectively teach Language Arts and Social Studies, and (2) literature circles were implemented to provide opportunities for the content area pre-service teachers to experience a literature-based instructional strategy to use in their own teaching. Literature-based instruction was implemented through the application of reader response (Rosenblatt, 1978) and critical literacy (Luke & Freebody, 1997; Ciardiello, 2004; Paul, 2005). Subsequently, emphasis was placed on the social context of learning (Wells, 1999) which was viewed as a space for constructing critical conversations and interpretations as it was important for my students to collaboratively work together to make meaning (Lave & Wenger, 1991).

During literature study, I began each class period in a whole class setting to lay the groundwork for the fourteen participants to engage in criticality. I introduced the concept of critical literacy following Paul's (2005) perspective that reality and knowledge are constructed, but driven by power and power relations, and the inquirer attempts to uncover the dynamics of

the ideology and power. Correspondingly, I wanted the participants to understand that inquiry involves social and cultural criticism, as well as personal examinations into the sociocultural influences (social, cultural, historical, and political) (Vygotsky, 1978; Wertsch, 1991) that have impacted their lives. The purpose was for the participants to begin to critically examine their own implicit beliefs, actions, and cultural practices that would be needed while reading young adult literature during literature circle activity.

To demonstrate critical literacy in practice, I introduced read aloud using diverse children's literature that focused on social issues, such as discrimination, racial and gender bias, and culture and power differentials. By modeling for the participants critical questions to be asked during read aloud (see Table 1), my students learned how to interrogate texts, to unpack different layers of meaning (Luke & Freebody, 1997), and to become critically conscious of their own sociocultural values and their responsibilities to society (Ciardiello, 2004). During the community meetings, emphasis was placed on the participants' voices as dialogue was crucial for literature circle discussions.

Literature discussions were implemented using the common procedures that are typical for literature circles (Daniels, 1994, 2002). At the beginning of the study, I explicitly taught and modeled the various literature circle roles that

Table 1. *Questions to Promote Critical Literacy*

• What kind of person, and with what interests and values, composed this text?
• Whose view of the world is put forth?
• What kinds of social realities does the text portray?
• How far do you accept the text's/author's position?
• What other positions might there be?

- Who has a voice in the text?
- What are the gaps and silences in the text?
- Who benefits from the text?
- How many interpretations of the text are possible?
- How else could the text have been written?

Note. Questions to promote critical literacy have been adapted from two sources, (Bean & Moni, 2003; McLaughlin & DeVoogd, 2004).

included: *Discussion Director, Literary Illuminator, Wordsmith, Connector, Character Investigator, and Critical Profiler*. While the first four roles are common to literature circles (Daniels, 1994), two new roles were implemented to provide strategic practices in critical literacy. First, the role of *Character Investigator* (Author, 2010) required the participants to analyze characters' physical, intellectual, and socioeconomic profiles, and then evaluate how the author had positioned the characters in relation to their profiles. This role required the participants to analyze if the characters' profiles were related to characters that were favored, silenced, and even rejected by the author. The role of *Critical Profiler* (Author, 2010) required the participants to examine the author's version of reality, to profile the imbalance of power found in the institutions and societies in texts, and to provide an alternative reality that would better the lives of the characters in the story.

Data Collection

Due to the mixed nature of this research study, I collected data through sequential explanatory procedures that included both quantitative and qualitative data collection methods. Quantitative data were collected to address the effect of critical literacy on content area pre-service teachers' abilities to perceive the sociocultural influences in text. In conjunction, qualitative data were collected to understand how content area pre-service teachers engage in

critical stance during situated reading practices that centered on discussion of young adult literature.

Quantitative Data Collection

Quantitative data were collected on pre- and post-study participant responses from the Literary Response Questionnaire (LRQ) (Miall & Kuiken, 1995). The survey was administered the first and last weeks of the semester and provided a measurement of the effect of critical literacy on the fourteen participants' abilities to perceive the sociocultural influences in texts.

Survey instrument. The LRQ (Miall & Kuiken, 1995) is a survey that is oriented for readers to determine their implicit sociocultural beliefs, values, and attitudes that are frequently drawn upon while reading. The survey provides Likert scale items that range from "Not at All True" to "Extremely True." For purposes of this research, the survey was modified to shorten the instrument to 20 positively worded items that required the fourteen participants to examine their own sociocultural, beliefs, values, and attitudes in relation to the sociocultural influences in texts when responding to the survey items. The internal consistency reliability for the 20 survey items was determined by computing the alpha coefficient which was found to be .714.

Qualitative Data Collection

Qualitative data were gathered in order to interpret how the fourteen participants engaged in critical stance during situated reading practices that centered on discussions of young adult literature. The qualitative data collection procedures included: (1) videotaping and audiotaping literature circle discussions, (2) student-produced artifacts, such as participant reading journals, (3) formal and informal conversations through interviews, and (4) field notes.

Data Analysis

Quantitative Data Analysis

Quantitative data were analyzed using Statistical Package for the Social Sciences (SPSS) version 19 to determine the effect of critical literacy on the content-area pre-service teachers' abilities to perceive the sociocultural influences in text. Means and standard deviations were calculated for the pre-and post survey on the LRQ (Miall & Kuiken, 1995). A statistical analysis using a paired sample t test was conducted to determine if there was a statistically significant difference between the pre- and post survey means.

Qualitative Data Analysis

To understand how the content-area pre-service teachers engaged in critical stance during situated reading practices that centered on discussions of young adult literature, I relied upon the prescribed coding methods that follow the typical protocol of grounded theory (Strauss & Corbin, 1997). First, the audiotaped interviews were transcribed and coded. I then met with each participant to perform a member check (Merriam, 1998) to gain clarification when responses were confusing, to probe further into the participants' responses, and to verify if the transcribed data reflected what the participants had actually said during the interview process.

Following this procedure, I then transcribed all videotaped and audiotaped literature circle discussions and began the process of generating theory from data using a three-level process of open coding, axial coding, and selective coding to identify patterns, categories, and themes of the data (Strauss & Corbin, 1997). Using transcripts from literature circle discussions and student interviews, pertinent words, phrases, and sentences were openly coded in the margins, and memos were made in reference to possible emerging categories and themes. As new data were integrated (student reading journals and field notes), I began to think comparatively in terms of properties that would permit further analysis between the data. For example, on the initial perusal of the data, various broad codes were applied to the data including

what the participants did (social interaction), what the participants said (oral responses), and what the participants produced (written responses). However, during the process of axial coding, I refined and renamed the codes and searched for possible relations among the categories and across the data sources. As patterns emerged during this phase, I scrutinized the data more closely and applied specific codes to signify how the participants assumed a critical stance. Such internal codes were not limited to but included: IDV = identified the dominant voices, GV = gave voice to the voiceless, CAP = challenged the author's position, OA = opposed the author's point-of-view, CPB = challenged personal beliefs, and QP = questioned power. By continually asking questions of the data on how the participants assumed a critical stance, the "how" became clearer and two themes emerged.

Results

Quantitative Results

Results from the paired samples *t test* found there was a statistically significant difference between the LRQ pre-test (M = 2.45, SD = .25) and the LRQ posttest (M = 2.90, SD = .30); t(13) = -4.72, $p < .001$, $d = -1.17$. These results suggest that critical literacy does have an effect on content area pre-service teachers' abilities to perceive the sociocultural influences in texts. In addition, the effect size ($d = -1.17$) indicates that the difference in the two means was larger than one standard deviation.

Qualitative Results

From qualitative data analysis informed by grounded theory (Strauss & Corbin, 1997), two themes emerged. The content area pre-service teachers used practices in critical literacy to assume a critical stance in two ways: (1) powerful voices in collaborative discussions and (2) powerful pens in written responses. The presentation of themes in this instance uses *The Hunger*

Games (Collins, 2008) and *The Breadwinner* (Ellis, 2000) to illustrate how the fourteen participants engaged in critical stance while reading young adult literature. A composite of student responses have been taken from transcripts to highlight the findings. Student responses are labeled Student 1 (S1), Student 2 (S2), and Student 3 (S3).

Theme 1: Powerful voices. From data analysis, the findings consistently showed that verbal participation was significant in the context of social interaction, since the social interaction put into use the critical literacy practices associated with reading from a critical stance. For example, the fourteen participants' responses often challenged the author's purpose for writing, identified voices that had been silenced, and questioned the balance of power when power benefitted the dominant voices and points-of-view. Further, the findings show the participants recognized that books often position readers in relation to their own social and cultural beliefs such that some of the participants were observed to reposition to accept or reject the author's point-of-view as they grappled to understand the textual world in relation to their world. This required the participants to suspend and even challenge their own sociocultural beliefs and assumptions while reading and discussing the texts. In these instances, data analysis determined that reading young adult literature situated the participants in both implicit and explicit ideologies, such that connections were made and feelings such as sympathy were evoked. Based on this finding, I was able to conclude that a combination of the social learning environment and young adult literature promoted inquiry and critical discussions as the content area pre-service teachers continually used practices in critical literacy to assume a critical stance. By using their voices through the power of discussion, three domains or categories emerged: (1) positioning, (2) power and its effect on citizens, and (3) the nature of agency.

Following a brief synopsis of *The Hunger Games* (Collins, 2008), the three categories are explicitly represented in three supporting episodes.

Sixteen year old Katniss lives in the poorest district of Panem; a district located in the former United States. When the districts tried to overthrow the Capitol and were defeated, the terms of surrender required each district to send one boy and one girl once a year to compete in "The Hunger Games;" a competition where the rules were kill or be killed. When her younger sister is chosen to compete, Katniss goes in her place.

Episode 1: Positioning in *The Hunger Games*

S1: The author has presumably chosen to tell this story from an impoverished people's point-of-view, possibly to exaggerate what happens when the government turns on its people. The author's interest in this story is to lead readers to view the social class stratification that exist in the text world is similar to the real world. Society consists of the haves and the have-nots. I believe the author wanted us to sympathize with the have-nots to understand their daily struggles to survive. The fact that Panem is divided into districts by class is to remind readers that our neighborhoods are divided by social class much the same way. The author has positioned readers to accept that society is distorted when members of the lower class are weak and when they disobey, they can be destroyed through competitive games.

S2: The author has also positioned men to be strong and aggressive and women are positioned to be weak in this book. I reject this assumption. Like Katniss, I would make same the decision to fight for her younger sister. She put herself in a dangerous battle in order for her younger sister to survive. Katniss represents a girl who will fight for her own survival against many obstacles that stand in her way. She represents many women and girls in the real world who are underestimated. I have a hard time with the mental image of children killing each other. I prefer to think of the children as the ones who are innocent to believe that their society can be changed.

S3: As a reader, I have learned to sympathize with Katniss, Peeta, and Rue; all characters from the very poor districts and whose lives are controlled by the Capitol. In the games, you win, you live . . . you lose; you die. If I were in the games, I would be conflicted, but I would certainly want to win, and if I did win and live, I would have to learn to live with myself the rest of my life. In today's world, the same standard would and should exist and might be expected. I would definitely feel obligated to take someone's place for whom I cared in such an evil event. We have all been there when we have to make a choice, a choice that means we may lose or we may gain; a choice that has both wrong and right outcomes, such as killing to live or be killed.

Positioning is referred to the manner from which authors purposely frame the content from a certain point-of-view and represent characters in such a way in order to put forth their intended point-of-view (Bean & Harper, 2006). The composite of the fourteen participants'

responses in Episode 1 serve to illustrate how the content area pre-service teachers used the power of discussion to critically voice their positions from which they made sense of the dysfunctional world in the text. For example composites of S1 state, “The author has presumably chosen to tell this story from an impoverished people’s point-of-view . . .” and “The author’s interest in this story is to lead readers to view the social class stratification that exist in the text world . . .” demonstrate an understanding that the participants acknowledge the author’s message and the author’s view of the world is influenced by political, social, and economic factors. The composites further illustrate the participants’ abilities to analyze how the characters are positioned based on the author’s representation. For example composites in S2 state, “The author has also positioned men to be strong and aggressive and women are positioned to be weak in this book. I reject this position.” These remarks indicate that some of the content area pre-service teachers resisted the author’s positioning of characters. It is noteworthy to mention that a review of the transcripts found all female participants in this study rejected the author’s representation of women. However, a further scrutiny of the transcripts revealed that all fourteen participants did sympathize with characters from the marginalized districts in the book, indicating the content area pre-service teachers positioned themselves to agree with the author’s intended purpose. An example in composite S3 is “As a reader, I have learned to sympathize with Katniss, Peeta, and Rue; all characters from the very poor districts and whose lives are controlled by the Capitol.”

Episode 2: Power and Its Effect on People

S1: The Capitol in this book has the power, the ultimate control and uses its power to inflict unfair practices on its people. People on the outside of the Capitol and who are outside the power are poor, unrepresented, and their lives are impoverished. They are silenced and have no voice in decisions that affect their daily lives. Instead, their lives are manipulated by those in power.

S2: As an American, I do see some similarities in our society and the book’s society that are cause for concern. Mush of our history has dealt with the class system and slavery, hunger, famine, the rich and their extravagant lifestyles vs. the poor and their deplorable living

conditions that have all been permitted by our government. The very existence of poverty in America is real and cannot be ignored. I, myself, am slightly empowered by the idea of rebellion against those forces that control some of my actions.

S3: The Capitol in this book is reminiscent of the many authoritarian governments of the past, and the dictatorships of today. In both examples, the power is in the hands of a very few, while the masses of people live in squalor, have no sense of self, have no voice in decision making, and are often abused or killed for speaking out against the government.

Ciardiello (2004) posits that critical literacy is a "set of practices and civic competencies that help the learner develop a critical awareness that texts represent particular points of view while often silencing others" (p.138). In this study, the process of recognizing that not all voices are heard or accepted and that some voices are more privileged than others, required the content area pre-service student teachers to examine the question of power in relation to voice and to critically examine their texts to understand how the language of power benefits dominant voices and points-of-view, while silencing others. The fourteen participants learned that while characters and people are individually different, each is also part of a society and membership in that society often defines opportunities or a lack thereof. For example the composites in Episode 2 reveal how critical literacy enabled the participants to explore the ideological and power relationships that exist in texts, to tie the power differentials in texts to the real world, and then determine that power in the hands of a very few often results in unfair and inhumane practices. This finding is made explicitly clear in composite S3 which states, ". . . the power is in the hands of a very few, while the masses of people live in squalor, have no sense of self, have no voice in decision making, and are often abused or killed for speaking out against the government."

Episode 3: The Nature of Agency

S1: The mocking jay in this book is the symbol of rebellion. The bird represents the inability of the Capitol to enforce their power over all living things. The mocking jay represents a government project that failed and was weakened, and the bird empowers others to take a stand against the power and control. The true voice in the story is Katniss. Having the "voice to make

change" and oppose those in power is difficult, but it began with bravery, determination, and her passion for the cause.

S2: Katniss finds her voice from being the leader, for fighting for her life, and for starting to change her poor conditions. Katniss is like the 800 pound gorilla in the room that cannot be ignored. While her voice is the one that is finally heard, her voice represents the many who have been marginalized and silenced in this story.

S3: Making a change is rarely an easy feat and does impose danger. In our own American history, many voices have stood up to power to bring about change, such as the Civil Rights movement. As a student, I know it takes all of our voices to bring about changes that we see are unfair and bring attention to those who have power. I know through student protest, our voices can be heard, but it begins with one voice connecting to many. As a future teacher, I see the power of voice now to give to my future students. Each voice in the classroom must be heard and each student must be recognized as a valuable member of the classroom.

According to Freire (1970), agency refers to people or individuals who intentionally act on the world to bring about social change. From data analysis, the fourteen participants' responses in this category signify an understanding that agency centers on who can and does take action, the nature and consequence of that action, and what that means in relation to the imbalance of power in society.

For example, the composites in S1 recognize that Katniss finds her voice and her voice allows her to ". . . oppose those in power. . .". Composites in S2 take it a step further by stating, "Katniss finds her voice from being the leader, for fighting for her life, and for starting to change her poor conditions," and "her voice represents the many who have been marginalized and silenced in this story." These composite responses imply the content area pre-service teachers have developed an understanding that voice is a manifestation of agency, specifically when voice represents opposition to a system that defines some members as inferior. From data analysis, the findings consistently showed that as the fourteen participants begin to question who has power and who benefits from the power in a socially stratified world, they learned to understand the

nature of agency in relation to the imbalance of power in both the textual world and the real world.

Theme 2: Powerful pens. From data analysis, I found that dialogue journaling was a continuum of the type of talk that emerged from literature circle interactions and paralleled the developing critical stance over the course of the study that permitted the fourteen participants to examine their own sociocultural, beliefs, values, and attitudes in relation to the sociocultural influences in texts. As a result of this process, analysis of the dialogue journals revealed how critical literacy further enabled the participants to examine the power differential between the dominant and non-dominant groups and then position to accept or reject how both groups were situated within the text's power structure. In addition, the findings consistently showed that as the participants read and discussed their texts through different points-of-view, they positioned to resist the dominant voices and recognize the voiceless, and they gave agency to the characters who intentionally acted on their world to fight the social injustices in the textual world.

Following a brief synopsis of *The Breadwinner* (Ellis, 2000), the manner in which the fourteen participants positioned while writing, recorded power and its effect on citizens, and described the nature of agency are represented in one episode.

Episode 4: Positioning, Power, and Agency in *The Breadwinner*

Parvana is a young Afghan girl who lives her family during the Taliban rule of Afghanistan. Her parents were once rich and highly educated but under the Taliban regime, all that was taken away from her, including her father who was taken to jail. Because girls were not allowed to go to school or even outside without wearing a burqa and having a male escort, Parvana cut her hair and wore her deceased brother's clothes to sell goods in the market in order to help her family survive.

S1: Parvana's mother continues to write the underground newspaper. An underground newspaper defies the Taliban law, and this perspective cannot be overlooked because there were instances in

this book where women would not be silenced. Women are often portrayed to be the weaker sex, but from reading the book, I find it was the women and girls who fought the power of the Taliban in their own way, such as Parvana cutting her hair and dressing as a boy, the mother and her newspaper, and the sister and her school. Parvana's sister deliberately holds school for girls and her action reveals there were people who individually went against the rule of the Taliban. I applaud what the women and girls did behind-the-scenes to fight the oppression. I have never sold bones to survive, but I see Parvana's fight for survival as her means to fight for freedom. Freedom is a human right.

The composites in Episode 4 further reveal how the fourteen participants engaged in critical stance through journal writing. For example, written composites from S1 state, ". . . I find it was the women and girls who fought the power of the Taliban. . ." and "Parvana's sister deliberately holds school for girls and her action reveals there were people who individually went against the rule of the Taliban." Implicitly stated in these two examples is an understanding that membership in a non-dominant group often translates into a lack of privilege. From this stance, the composites reveal the fourteen participants positioned to promote non-dominant characters, honor their voices, and to foreground agentive behavior for social change. In addition, data analysis found the participants frequently took on the characters' experiences and feelings such that empathy was endorsed but the imbalance of power in the text was not diminished. For example, the example from composite S1 states, "I have never sold bones to survive, but I see Parvana's fight for survival as her means to fight for freedom."

Discussion of Findings

The fact that the fourteen participants came into this study to acquire effective methods for teaching content required a different approach if I was to move my content area pre-service teachers' thinking beyond content to address the literacy needs of the young adolescents they will one day teach. None of the fourteen participants thought of themselves as literacy teachers. Literacy was second to the needs of content instruction. However, all fourteen of my students were committed to the social, psychological, and academic development of middle grade

students. With a focus on adolescent literacy, I engaged my content area pre-service teachers in a literature-based instructional strategy that used a sociocultural and critical approach to reading. To bring awareness to the sociocultural influences found in text, I introduced my students to young adult literature and the important themes that cross many content areas (Walker & Ben, 2005). I taught my students to engage in critical response and inquiry by developing critical literacy practices that would permit my students to challenge and question the author's purpose, to read in opposition to texts, and to strip away the different layers of power found in the textual world (Bean & Moni, 2003). These were the tools needed to read from a critical stance. This decision to do so was significant as research has shown that pre-service content area student teachers need to understand strategic practices in critical literacy before implementing critical literacy approaches to learning in their classrooms (Dozier, Johnston, & Rogers, 2006; Leland & Harste, 2005).

First, the findings suggest that critical literacy does have an effect on content area pre-service teachers' abilities to perceive the sociocultural influences in texts. This finding parallels other research that found the implementation of critical literacy in a social studies classroom provided pre-service teachers a greater understanding of the social, cultural, and historical context of a particular time period (Marshall & Klein, 2009). Secondly, the findings of this study imply that discussion that centered on young adult literature became a powerful tool for pre-service teachers to assume a critical stance. As the pre-service teachers engaged in reading, discussing, and writing about texts that were heavily-laden with issues of power, gender inequity, poverty, and death, critical conversations were voiced and captured in dialogue journals. This finding is in keeping with other research that found young adult literature can open the door for content area pre-service teachers to develop the ability to read from a

critical stance by engaging in textual criticism, inquiry and reflection, and exploring the many ways of being in the world (Cheu, 2011).

As with all practitioner research, this study was subject to limitations. First, the fact that only one cohort of fourteen content area pre-service teachers relates to any appeal of trying to generalize from the experiences of one cohort. In addition, my dual role as the practitioner and researcher presented the potential of bias and required me to confront the question of objective distance. Guba and Lincoln (1989) offer that objective distance is considered to be a safeguard against bias by acknowledging the assumption that in a classroom environment there is an ". . . intrinsic and ineluctable interconnectedness of all phenomena, human or otherwise" (p. 66). In this study, my immediacy and interconnectedness to the fourteen participants was unavoidable; therefore, it is important to acknowledge the potential for bias. However, the findings of this study increase an awareness level that teacher preparation programs can infuse adolescent literacy with content area instruction to stimulate critical thinking and invite content area pre-service teachers to question, dispute, and take a stance on important issues and themes they will one day teach in their content disciplines. It is my hope that further research be conducted to increase content area pre-service teachers' understanding of adolescent literacy development.

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Correspondence concerning this article should be addressed to:
Dr. Lina B. Soares, Georgia Southern University, Department of Teaching and Learning, 275 Forest Drive, PO Box 8134, Statesboro, Georgia 30460, 912-478-7644, lbsoares@georgiasourthern.edu

Social Stories™ for Children with Autism: A Review of the Literature

Jessica L. Bucholz
University of West Georgia

Abstract

Social Stories™ were developed as an intervention to help individuals with autism better handle unfamiliar, stressful, or difficult situations. The popularity of this intervention has grown although there is still a relatively limited amount of research to support the effectiveness of this type of intervention. For this article, research published between 1993 and May 2011 was examined to determine the strengths and weaknesses of the current research that explores the use of social stories™ as the only intervention rather than as part of a treatment package.

Introduction

Children diagnosed with autism spectrum disorders (ASD) display unique characteristics that distinguish them from their peers with other types of challenges. Characteristics of persons with ASD include difficulty relating to other individuals and situations, delayed communication skills, and displays of repetitive or self-stimulatory behaviors (Simpson & Myles, 1998). Children with ASD may engage in repetitive behaviors, exhibit hyperactivity or inattention, have difficulty with social situations, dislike changes in their environment, have issues with communication and language, experience difficulty generalizing learned skills to new situations, and they may display aggressive or disruptive behaviors (Simpson & Myles, 1998). In recent years there has been an increase in the number of children diagnosed with ASD. In 2006 the average total prevalence of children with ASD was one in 110 children (Center for Disease Control and Prevention, 2010). Over 220,000 children and students, ages 3-21, diagnosed with ASD nationwide are receiving special education services (U.S. Department of Education, 2006). The increasing numbers of students being diagnosed with ASD has increased the necessity of school districts to provide interventions to help these students make academic and social gains. There are a number of interventions available that promote learning and address the needs of

students with ASD however there is no one intervention or method that is effective for all individuals with ASD. In the literature, some of these interventions include visual or picture schedules (Bryan & Gast, 2000), video modeling (Banda, Matuszny, & Turkan, 2007; Nikopoulos & Keenan, 2007), and self-monitoring (Ganz & Sigafoos, 2005). Simpson (2005) identified a number of evidence-based interventions for individuals with autism spectrum disorders including applied behavior analysis, discrete trial teaching, and pivotal response training.

A social story™ is another intervention that has been used with individuals with ASD. Social stories™ (Gray & Garand, 1993) were created to provide individuals with ASD the information they may need to learn new information or to understand and function appropriately in different social situations. Gray (1995) described four basic types of sentences to be used in the creation of a social story ™: descriptive, perspective, affirmative, and directive. Descriptive sentences are opinion-free statements of fact. According to Gray this is the only required sentence in a social story™. Perspective sentences attempt to describe a person's feelings, beliefs, or thoughts. Affirmative sentences stress an important point or refer to a rule or law. Finally, directive sentences provide suggestions for how to handle a specific situation. Gray proposed that a directive sentence is not necessary in all social stories™. Gray additionally suggested that each type of sentence should be used in a story based upon a specific ratio; specifically a basic social story™ should have a ratio of two to five descriptive, perspective, and/or affirmative sentences for every zero to one directive sentence.

There are some reviews of the literature on social stories™ for students with ASD. Reynhout and Carter (2006) and Sansosti, Powell-Smith, and Kincaid (2004) found that the effects of social stories™ are highly variable, have limited experimental control, and are

frequently confounded by concurrent use of other interventions. Ali and Frederickson (2006) discuss how the popularity of social stories continues to grow despite the limited research base. Their review focused on case study and single subject designs that had positive effects from a practitioner standpoint. Test, Richter, Knight, and Spooner (2011) indicated that there was a need for additional research that examines the impact of social stories™ only. Their review of the research included a number of articles that used social stories™ as a part of a treatment package. In order to better isolate the effects of social stories™ on the targeted skill sets, this review focused on studies in which the independent variable was a social story™ alone and not part of a treatment package. The purpose of this review was to summarize empirical studies published in the past 18 years that evaluated the use of social story™ interventions with children with autism spectrum disorders. The following research questions were addressed:

1. What are the characteristics of the students for whom social stories™ were being written and what settings were described in the studies?
2. Were the social stories™ used in the research written to follow the protocol developed by Gray (2000)?
3. What types of dependent variables were used?
4. What types of single subject research designs were employed? Were data collected on maintenance and/or generalization?
5. How effective were the social story™ interventions in changing the skills and/or behaviors of the individuals with autism?

Method

Search Procedures

An electronic search of the Educational Resources Information Center (ERIC), Psychology and Behavioral Sciences Collection of EBSCO Host, and ProQuest Education Journals databases was conducted for the years 1993 – May 2011. Keywords used in the search were social stories™, story interventions, and social skills interventions. Relevant studies cited in each article were read to locate additional articles.

Selection Criteria

Articles selected for this review had to meet several criteria. First, articles were published in a peer-reviewed journal between 1993 and May 2011. Second, articles described an experimental investigation in which an investigator manipulated and controlled one or more independent variables to determine the effects on the dependent variable. Case studies, studies without quantitative data and pre-experimental studies (e.g., AB single subject designs) were excluded. Third, the participants in the study were identified as having autism spectrum disorders (e.g. autism, Asperger syndrome, Pervasive Developmental Disorder-Not Otherwise Specified). Fourth, the independent variable was a social story™. Research studies that included social stories™ as part of a treatment package (e.g., social story™ and video models) were excluded in order to examine the effects of only the social story as the independent variable. Research studies that compared the effectiveness of the social story™ intervention alone to a social story™ as part of package were included (e.g., a social story™ alone compared to a social story™ combined with verbal prompts).

Results

An initial pool of 55 possible articles was located through the search. Application of the inclusion criteria identified 24 studies that used a single-subject research design for inclusion in this review.

Participant Characteristics and Setting Descriptions

Five females and 51 males (N=56) with an autism spectrum disorder participated in the 24 studies reviewed. Eleven of these 24 studies involved three participants and eight of the investigations involved only one participant. Twenty-two of the 24 investigations involved fewer than four participants. Participants in all 24 studies ranged in age from 3 years 9 months to 15 years of age. Forty-four of the participants were considered to be of elementary school age (i.e., between the ages of 5 and 10). Eight of the participants were between the ages of 11 and 13 or considered to be of middle school age. Only one participant was considered to be of high school age (age 15). Some researchers (Bledsoe, Myles, & Simpson, 2003; Dodd, Hupp, Jewell, & Krohn, 2008; Ozdemir, 2008; Scattone, Tingstrom, & Wilczynski, 2006; Scattone, Wilczynski, Edwards, & Rabian, 2002) included IQ scores for the participants. Scores ranged from 107 (Dodd et al., 2008) to a score of 40 (Scattone et al., 2002). Some researchers gave no information on the IQ scores for their participants (Brownell, 2002; Crozier & Tincani, 2005). Hagiwara and Myles (1999) included the developmental ages of their participants which ranged from 26 months to 40 months. Mancil, Haydon, and Whitby (2009) provided the mental age for their participants. The mental age for all three of their participants was approximately 2 years below their chronological age. Other researchers gave a general description of the participants' cognitive abilities, for example Lorimer, Simpson, Myles, and Ganz (2002) indicated that their participant had above average cognitive ability. Hanley-Hochdorder, Bray, Kehle, & Elinoff (2010) provided a general description of the participants' cognitive functioning. The cognitive functioning level of their participants ranged from low average to high average. Agosta, Graetz, Mastropieri, and Scruggs (2004) indicated that the participants in their study were developmentally delayed in all areas and had limited communication skills. Where discussed, all

researchers indicated that the participants were capable of at least limited verbal communication, however for some participants' verbal communication was limited to repeating one-word utterances (Agosta et al., 2004) and echolalia (Barry & Burlew, 2004).

For 11 of the participants, data were taken while the students were in a self-contained classroom for students with disabilities. For 23 of the participants in the studies reviewed data were collected in an inclusive setting (e.g., inclusive lunchroom, general education classroom, recess). In one study researchers collected data on three children in a hospital setting at the speech clinic and in another study the researchers took data on one student in a residential special education facility. For one participant the research was conducted at his separate public alternative school in a classroom for children with emotional disabilities. The social story™ intervention was implemented with seven students in a home setting.

Gray's Social Story™ Protocol

The majority (83%) of the studies reviewed evaluated the effectiveness of a social story™ written following the sentence types and ratio suggested by Gray (2000). Two studies (Barry & Burlew, 2004; Sansosti & Powell-Smith, 2006) did not indicate whether or not the stories that were written followed Gray's suggestions for sentence type or ratio. Sansosti and Powell-Smith (2006) did state that they used a journal to assess whether the social story™ implementation followed the guidelines provided by Gray and Garand (1993). Crozier and Tincani (2005) specifically stated that they altered the sentence ratio that had been suggested by Gray and included sentences that were more directive although they used her sentence types. Adams (2004) followed Gray's sentence types and ratio but targeted four behaviors with one story which deviates from Gray's recommendation of addressing only one behavior per story. Researchers in one of the studies reviewed followed Gray's guidelines, but wrote a multimedia

story which is a story presented in a computer-based format, (Hagiwara & Myles, 1999) a presentation format that varied from that suggested by Gray. Mancil, Haydon, and Whitby (2009) followed Gray's sentence types and ratios but only one story was written for all three participants so the story was not an individualized story. Mancil and colleagues used a paper story and a story created on a PowerPoint. Like Hagiwara and Myles they were examining the usefulness of a technology based story. Hagiwara and Myles (1999), Quilty (2007), and Scattone (2006) examined the validity of the stories that were written in their research studies by having at least one person with experience in creating social stories™ ensure they were written to contain specific components and were within each participants' functioning level.

Types of Dependent Measures

Six of the studies reviewed compared the effectiveness of a social story™ alone to either a social story™ variation (e.g., musically presented story, computer assisted) or a social story™ combined with an additional intervention (e.g., reinforcement system). Brownell (2002) compared the use of a traditional social story™ with a musically presented story for 4 males who ranged in age from 6 to 9. Target behaviors included echolalia of television shows and movies, difficulty following directions, and use of a loud voice. For all four participants, introduction of either form of the social story™ was successful in reducing the target behavior. Mancil and colleagues (2009) compared the effectiveness of social stories™ presented in two different formats. The target behavior for the three participants was pushing during the transition to lunch and the transition to recess. The researchers used an ABABCBC multicomponent reversal design to compare the PowerPoint social story™ to the paper format social story™. The rate of pushing decreased for each participant although the results were slightly better for the story presented using PowerPoint. Kuoch and Mirenda (2003) used an ABA design for two of the participants in

their study. However, for the third participant they used an ACABA design with the C phase serving as a book plus reminder condition and the B phase consisting of the social story™ alone. The book plus reminder condition consisted of the student being read a book unrelated to the target behavior. The goal was to compare the impact of adult attention (C phase) with the actual effectiveness of the social story (B phase). Results of this study indicated that the book plus reminder had no effect on the target behavior while the social story™ alone did in fact decrease the third participant's negative behaviors. Agosta and colleagues (2004) used an ABCA design to compare the use of a social story with a reinforcement system with the use of a social story alone to decrease the disruptive behavior of a young boy with autism. The authors indicated that the change in behavior was not solely dependent upon the reinforcement system as the decrease in behavior was continued when the reinforcement was removed as part of the intervention in the C phase. Crozier and Tincani (2005) compared the effectiveness of a social story™ alone and a social story™ paired with a verbal prompt. In this study they used a modified social story™ to decrease the disruptive behavior of an 8-year-old boy with autism. The results indicated that the introduction of the social story™ alone decreased his disruptive behavior. After a return to baseline, a greater reduction in behavior was seen when the social story™ was combined with verbal prompts. These researchers conducted a second study (2007), which compared the use of a social story™ alone to a social story™ that was paired with verbal prompts when the initial intervention (e.g., social story™ alone) proved to be ineffective for the third participant in their study. For this participant social stories™ alone were not sufficient to change the target behavior. Teacher prompts were needed in combination with the social story™ to see the desired change in behavior for this participant. The researchers hypothesized two possible explanations for the lack of success with the social story™ intervention alone. This participant had poor communication

and social skills and little motivation to interact with his peers. However, this participant was very motivated to please adults which could account for the increase in talking to peers with the addition of an adult prompt to the social story™ intervention.

Methodological Components

Research Designs. The 24 studies reviewed used a single-subject research design. Thirteen of the investigations used a reversal design, ten used a multiple baseline design, and one study used a multiple probe across participants design (Delano & Snell, 2006).

Interobserver Agreement. Twenty-three of the 24 studies included in this review reported data on interobserver agreement. Fifteen of the studies reported mean levels of interobserver agreement of 90% or higher. Seven of the other studies reported interobserver agreement at mean levels of 80% or higher. One study (Dodd, 2008) reported interobserver agreement for the behavior of giving directions to be at a mean of 65.1%. Interobserver agreement for the second behavior of giving compliments was reported to be at 100%. Interobserver agreement data for all 24 studies were taken on average of a low of 20% to a high of 73% of the data collection sessions.

Treatment Integrity. Twelve of the studies provided a measure of treatment integrity for the implementation of the social story™. In 11 of these studies the researchers used a checklist to indicate whether the participant read or was read the social story™. Treatment integrity ranged from 91% to 100% in these 11 studies. In one study (Sansosti & Powell-Smith, 2006), a journal was kept by the participants' care givers indicating that the story was read at home each day at the specified time. Treatment integrity for two of the participants was 88% and 92%. The third participant's family failed to complete the journal so integrity could not be calculated.

Social Validity. Nine of the studies provided some measure of social validity for the social story™ intervention. Crozier and Tincani (2005) interviewed their participants' teachers about what they thought of the modified social stories™. All the teachers reported favorable impressions about the modified social stories. Crozier and Tincani (2007) used a questionnaire and interviewed the teachers about their impressions of social stories™. The feedback on the intervention was positive. The participant's parents and teacher were asked to complete a survey regarding the social story™ intervention in the study completed by Adams, Gouvousis, VanLue, and Waldron (2004). Mancil and colleagues (2009) determined teachers' opinions of the intervention by using a social validity scale. Additionally, the teachers were asked which form of the story, paper or Power Point, they liked the best. All teachers reported that the stories were not time consuming to use but that they liked the story created with PowerPoint better than the paper format. Dodd and colleagues (2008) interviewed both the participants and their mothers as to their reactions to the social story™ intervention. The participants indicated that they "somewhat liked" the social story™. Both mothers reported favorable impressions of the intervention. Researchers in four studies (Hanley-Hochdorfer et al., 2010; Ozdemir, 2008; Scattone et al., 2006; Scattone et al., 2002) indicated that they used the Intervention Rating Profile (IRP-15) to evaluate intervention acceptability. Results for these investigations returned scores within the acceptable range which signifies that the intervention was seen as socially valid.

Story implementation. In 12 of the studies the researchers specifically stated that the story was read to the participant just prior to the data collection period. Hanley-Hochdorfer and colleagues (2010) indicated that the participants in their study were read the story no more than 15-minutes before the data collection period. Agosta and colleagues (2004) stated that their participant was shown the story just prior to and during the data collection period. The

researchers in one study (Scattone et al., 2005) indicated that the participants had access to the stories throughout the day in addition to reading the story just prior to the data collection period. In two of the studies (Barry & Burlew, 2004; Bledsoe et al., 2003) the participants were instructed by the teacher to look at the story at other times other than just prior to data collection. Two of the participants in the Ozdemir (2008) study were shown the story twice a day while the third participant only saw his story one time per day prior to the data collection period. Sansosti and Powell-Smith (2006) stated that the participants in their study were shown their story twice a day, once prior to leaving for school in the morning and once upon returning home after school at the end of the day. Mancil and colleagues (2009) reported that their participants were shown either format of the story as the same time each day in the participants' classrooms. Three of the studies reviewed did not indicated when or how often the social story™ intervention was read to or by the participants (Adams et al., 2004; Delano & Snell, 2006; Quilty, 2007).

In 16 of the research studies the intervention was read or sung to the participants by an adult (e.g., parent, teacher, paraprofessional, researcher). In the study by Hagiwara and Myles (1999) the story was read through a computer program. In the study by Ozdemir (2008) the story was read to two of the participants while the third participant read the story aloud with the teacher's help. In four of the research studies (Dodd et al., 2008; Mancil et al., 2009; Reichow & Sabornie, 2009; Sansosti & Powell-Smith, 2006) the participant was responsible for reading the story. In two of the studies the authors do not indicate who was responsible for reading the story interventions (Adams et al., 2004; Quilty, 2007).

Types of Dependent Measures

Three general areas were selected for intervention in the studies that were selected. These areas include prosocial behaviors, functional skills (e.g., hand washing, following directions), and disruptive behaviors (e.g., tantrums, crying, making disruptive noises).

Prosocial behaviors were targeted in nine investigations. Specifically, these behaviors included how to make activity choices, play appropriately with materials, and play appropriately with peers (Barry & Burlew, 2004; Crozier & Tincani, 2007; Dodd, Hupp, Jewell, & Krohn, 2008; Sansosti & Powell-Smith, 2006; Scattone, Tingstrom, & Wilczynski, 2006), sit appropriately during circle (Crozier & Tincani, 2007), talk appropriately to peers (Crozier & Tincani, 2007; Delano & Snell, 2006; Reichow & Sabornie, 2009; Sansosti & Powell-Smith, 2006), seek attention, initiating responses, and making contingent responses (Delano & Snell, 2006; Dodd et al., 2008; Hanley-Hochdorfer et al., 2010; Soenksen & Alper, 2006). Four of the investigations attempted to examine the participants' social interactions with peers with and without disabilities (Crozier & Tincani, 2007; Delano & Snell, 2006; Reichow & Sabornie, 2009; Sansosti & Powell-Smith, 2006; Scattone, Tingstrom, & Wilczynski, 2006). Barry and Burlew used the social story™ intervention to teach two children with autism to make activity choices and play appropriately with peers in a special education classroom.

Five investigations examined the use of social stories™ to address functional skills. Hagiwara and Myles (1999) used a multimedia story to teach hand washing and on task behavior to students with autism. Another study, (Bledsoe, Myles, & Simpson, 2003) targeted eating skills (e.g., using a napkin, not spilling food or drink). Brownell (2002) compared the use of a traditional story to a musically adapted story to teach one of his four study participants how to follow directions. Pasiali (2004) used therapeutic songs or social stories™ that were song to teach one of their participants to properly use a VCR to watch a video tape. Finally, Ivey, Heflin,

and Alberto (2004) used social stories™ to prepare children with PDD-NOS for novel events that required functional skills such as being on task, appropriately using the necessary materials, and following directions or the rules of the game.

The majority of the studies (N=12) used social stories™ to reduce disruptive behaviors in children with autism spectrum disorders. Behaviors included inappropriate vocalizations such as shouting or echolalia of violent or aggressive words and phrases from TV and movies (Adams et al., 2004; Agosta et al., 2004; Brownell, 2002; Kuoch & Mirenda, 2003; Kuttler et al., 1998; Lorimer et al., 2002; Pasiali, 2004; Scattone et al., 2002), dropping to the floor (Adams et al., 2004; Kuttler et al., 1998; Quilty, 2007), staring inappropriately at females (Scattone et al., 2002), tipping a chair (Ozdemir, 2008; Scattone et al., 2002), aggression towards others (Adams et al., 2004; Kuoch & Mirenda, 2003; Ozdemir, 2008; Quilty, 2007; Mancil et al., 2009) throwing up while eating (Kuoch & Mirenda, 2003), crying (Adams et al., 2004; Agosta et al., 2004; Kuoch & Mirenda, 2003), and talking out during class (Crozier & Tincani, 2005; Quilty, 2007).

Effectiveness of Social Story Interventions

Overall, the data in the 24 studies reviewed suggest that social story™ interventions resulted in positive changes in prosocial skills, functional skills, and disruptive behaviors. However, five of the research teams (Crozier & Tincani, 2007; Dodd et al., 2008; Hanley-Hochdorfer et al., 2010; Sansosti & Powell-Smith, 2006; Scattone et al., 2006) reported mixed results. Crozier and Tincani (2007) found positive changes in behavior for two of their three participants with the social story™ alone. The third participant's behavior did not change until the introduction of adult prompting in combination with the social story™ intervention. Sansosti and Powell-Smith (2006) also reported positive changes in behavior as a result of the social

story™ intervention for two of their three participants. A marked change in behavior was not seen for their third participant. One participant showed a marked positive change, one participant demonstrated a modest positive change, and one participant demonstrated no change in appropriate social interactions in the study conducted by Scattone and colleagues (2006). The first participant in the study conducted by Dodd and her colleagues showed a positive change in behavior with the introduction of the social story™. The second participant in this study demonstrated a dramatic positive change in behavior the first day the social story™ was read. However, this trend declined to baseline rates with the continued use of the social story™ for the next 3 days of the study.

There are several explanations as to the lack of effectiveness seen in these investigations. First, social stories™ alone may not always provide enough instruction or motivation to change the target behaviors. Social stories™ may need to be combined with another intervention to positively change behavior. This was demonstrated by Crozier and Tincani (2007) when they included a prompt by an adult to the social story™ intervention for the one student for whom the social story™ alone was ineffective. This explanation is further supported by the first study done by Crozier and Tincani (2005) when they compared the impact of a social story™ alone to a social story™ combined with verbal prompts on the disruptive behavior of a boy with autism. While the social story™ alone decreased the disruptive behaviors the behavior was decreased to a greater degree when the social story™ was paired with the verbal prompting. Second, the ineffectiveness may be due to a lack of treatment integrity. For example, Sansosti and Powell-Smith (2006) indicated that the parents of the third participant, whose behavior did not change with the use of the social story™ intervention, did not use the treatment journal for making sure the participant was read his social story™. Third, researchers who reported mixed results

indicated that personality traits (e.g., lack of motivation, poor communication skills, wide range of intellectual abilities) of the individual participants could be related to the variability in effectiveness. Hanley-Hochdorfer and colleagues (2010) indicated that limited increase in social engagement as a result of the social story™ intervention could be due to the fact the intervention was used in a "natural school setting" rather than in a controlled setting. Finally, another possible explanation for the variability in results seen by these researchers could be related to what extent researchers followed Gray's suggested protocol. Specifically, the possibility of a story not being written to adequately address the target behavior or not being written to the cognitive level of the student could impact the effectiveness of the social story™ intervention.

A further analysis of the articles revealed that four of the seven studies that examined the use of social stories™ to target prosocial behaviors showed positive results (Barry & Burlew, 2004; Crozier & Tincani, 2007; Delano & Snell, 2006; Reichow & Sabornie, 2009). Three of the four studies that targeted functional skills reported positive changes in behavior as a result of the social story™ intervention (Bledsoe et al., 2003; Brownell, 2002; Ivey et al., 2004). Finally, only one of the 11 studies that examined the use of social stories™ to address disruptive behaviors reported a lack of change in behavior for three of the four behaviors targeted with the social story intervention (Adams et al., 2004).

Generalization and Maintenance. Eleven of the studies reported data on just while both generalization and maintenance were assessed in two studies. Positive yet variable results were reported in one study by Delano and Snell (2006). Mancil et al. (2009) collected data on both generalization and maintenance but results were mixed with respect to maintenance and the behaviors for all three participants did not generalize to recess. In the 11 studies where maintenance probes alone were conducted the data do not indicate clear long-term success.

Positive maintenance results were found in the two studies conducted by Crozier and Tincani (2005, 2007), in the study by Reichow and Sabornie (2009), and in the study by Dodd and colleagues (2008). Participants in the study by Ozdemir (2008) maintained levels of the disruptive behavior that were lower than during baseline after the social story intervention had been withdrawn. Quilty (2007) demonstrated positive initial maintenance results but for two of the study participants the levels in which the negative behaviors were being displayed were increasing during the additional maintenance probes. The initial maintenance probe in the study by Sansosti and Powell-Smith (2006) demonstrated positive results, however, the next probes revealed a decrease in the desired behaviors for all three participants. Generalization was studied by Hagiwara and Myles (1999), but only one participant in the study demonstrated generalization of skills to other settings.

Discussion

This review examined the research studies that used social stories™ as an intervention for children with autism spectrum disorders. Specifically, the review of the literature included the following findings:

1. Fifty-one of the 56 total participants were males. Twenty-two of the studies included fewer than four participants. The majority of the participants were of elementary school age (5-10 years of age).
2. Eighty-four percent of the articles included in this review specified that they used the sentence types and ratios suggested by Gray (2000). Crozier and Tincani (2005) specifically stated that they altered the sentence ratio that had been suggested by Gray and included sentences that did not use words such as usually or sometimes. Two studies (Barry & Burlew, 2004; Sansosti & Powell-Smith,

2006) did not indicate whether the stories that were written followed Gray's suggestions for sentence type or ratio.

3. Prosocial behaviors were the focus of nine of the research studies. Five of the reviewed studies used social stories™ to teach functional skills to students with autism spectrum disorders. The majority of the research studies (N=12) reviewed for this paper examined the use of social stories™ to decrease disruptive behaviors.
4. Single subject research designs were used in all of the studies in this review. All but one (Agosta et al., 2004) of the studies collected data on interobserver agreement. Treatment integrity for the implementation of the social story™ intervention was measured in 12 of the studies. Only nine of the 24 studies measured the social validity of the intervention.
5. The data in the 24 studies reviewed suggest that social story™ interventions resulted in mostly positive short-term changes in prosocial skills, functional skills, and disruptive behaviors. Due to the minimal amount of maintenance data there is little evidence to support the long-term success of these interventions. Forty-six of the 56 participants experienced positive changes in one or more of the targeted behaviors. Six research teams reported positive results for some but not all of the participants in their studies (Crozier & Tincani, 2007; Dodd et al., 2008; Hagiwara & Myles, 1999; Ivey et al., 2004; Sansosti & Powell-Smith, 2006; Scattone et al., 2006). Only 11 studies examined maintenance of the behaviors and eight of those researchers reported that behaviors were maintained after the removal of the intervention for at least one of their participants or in at least one

setting. For example, Mancil and colleagues (2009) reported that the frequency during the maintenance phase increased while all three participants were at recess but remained low while in the classroom. It is not clear whether social stories™ change behavior successfully for the long-term.

Recommendations for Future Research

While the results of the 24 studies reviewed are promising, there is a need for additional research to further evaluate the use of social story™ interventions for children with autism spectrum disorders. First, future researchers should consider the type of research design used to evaluate the effectiveness of the social story™ intervention. Approximately half of the studies in this investigation employed a single subject reversal design. However, the purpose of a social story™ is to teach new behaviors or skills (Gray, 2000), which should make a reversal to baseline levels of behavior after the withdrawal of the intervention difficult. If social stories™ do in fact teach new behaviors, then alternate research designs (e.g., multiple baseline single subject design) may be more appropriate to examine their effectiveness. For example, Adams, Gouvousis, VanLue, and Waldron (2004) used a reversal design to decrease the disruptive behavior; falling, hitting, crying, and screaming, of a boy with Asperger syndrome. In this study, the participant's rate of behavior initially increased with the introduction of the social story™ for three of the four target behaviors. When the social story™ was removed the rate of his behavior decreased for two of the target behaviors, increased for one of the target behaviors, and stayed the same for the final target behavior. Only when the social story™ intervention was again introduced was a reduction seen in all four target behaviors. Cooper, Heron, and Heward (1987) noted, "When an investigator can and does reliably turn the target behavior on and off by presenting and withdrawing a specified variable, a clear and convincing demonstration of the

experimental control is made" (p. 177). Adams and colleagues were not successful at turning on and off the target behavior making the choice of an ABAB design questionable. Furthermore, it leads to the need for future research to focus on determining how many sessions are required for the participant to achieve mastery of the target behavior. In this study, a decrease in rate of behavior was seen only from the first baseline phase to the second intervention phase.

Second, researchers should explore both the maintenance and generalization of newly acquired skills. Individuals with autism typically have difficulty with maintaining new skills and then generalizing those skills to new situations. Lifelong social difficulties also are characteristic of individuals with autism. Researchers need to examine the impact the social story™ intervention has to continue to affect a change in behavior over an extended period of time. Of the 24 studies reviewed only two (Delano & Snell, 2006; Mancil et al., 2009) examined both maintenance and generalization of the identified target behaviors for the study participants with mixed results in the study by Delano and Snell.

Third, future studies should examine the population used to determine the effectiveness of the social story™ intervention. Investigations with a greater number of participants will add weight to the research base supporting the use of these interventions. Ninety-two percent of the investigations reviewed included fewer than four participants and eight included only one participant. Research involving female participants is also needed. Only five of the 56 participants were females. While this investigation reviewed only those studies which examined the effectiveness of a social story™ intervention for individuals with autism spectrum disorder, additional research is needed to explore the usefulness of this intervention for individuals with other types of disabling conditions and for children who are typically developing. Additionally,

given the wide range within the autism spectrum, future studies should attempt to better delineate the characteristics of the subjects.

Fourth, while half of the studies reviewed provided a measure of treatment integrity, future researchers should also include this measure in their investigations. This measure can help to determine how often the social story™ intervention needs to be implemented (e.g., once a day, just before the observation period, every hour) in order to effectively change behavior. Evaluating the integrity of the social story™ would ensure that the intervention is developed and implemented as planned for all study participants.

Fifth, only three of the studies (Hagiwara & Myles, 1999; Quilty, 2007; Scattone et al., 2006) included an examination of the use of Gray's protocol, specifically taking steps to ensure that the intervention was created to follow the sentence ratio and types suggested by Gray while also being written to the cognitive level of the participant. To date there are no research studies published which validate the social story™ sentence types and ratios suggested by Gray (2000). This suggests the need for future research to examine the effectiveness and necessity of the sentence types and ratio guidelines. While only one study (Crozier & Tincani, 2005) examined the effectiveness of a story not written to the sentence ratio guidelines specified by Gray, their results were positive. Such research will help to ensure that the specific components used to create each story are the most effective.

Finally, according to Gray (2000) social stories™ can be used for a large number of topics from how to handle a distressing situation to learning a new skill. However, much of the research on social stories™ has used the intervention for decreasing disruptive behaviors rather than in teaching replacement behaviors or new skills. This investigation identified only five studies that used the intervention to effectively teach functional skills (Bledsoe et al., 2003;

Brownell, 2002; Hagiwara & Myles, 1999; Ivey et al., 2004). Social stories™ were created with an instructional focus, to describe a situation or activity and the behaviors associated with that situation or activity. Future research should examine the benefit of this type of intervention as in instructional tool and not just as a tool to decrease aggressive or disruptive behaviors.

Conclusion

Researchers have used social story™ interventions with children with ASD to improve social skills, change disruptive behaviors, and teach functional skills. While most researchers have used social stories™ to decrease disruptive behaviors, researchers are beginning to examine the use of this type of intervention as a positive behavior support strategy in which acceptable behaviors are taught to and practiced by children with ASD. This review of the research indicates that social stories™ are one method for instructing students with ASD. Social stories™ may be an effective intervention for children with autism because it allows information to be described explicitly while providing a visual representation (e.g., photographs, line drawings) of the skills being addressed in the story. Social stories™ have potential to be successful interventions when practitioners consider the cognitive level, age, and language ability of the student for whom the story is being written.

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Correspondence concerning this article should be addressed to**:**
Jessica L. Bucholz, University of West Georgia, 1601 Maple Street,
EA 228, Carrollton, Georgia 30118, jbucholz@westga.edu

Teacher Leaders and Equity-Centered Pedagogy: Empowerment and Development through Action Research

Jennifer Jacobs

University of South Florida

Abstract

This qualitative research study examined the experiences of five teacher leaders enrolled in an instructional leadership master's degree cohort who engaged in equity-focused action research. Specifically, the study focused on *How do teacher leaders describe their development as equity-centered leaders after engaging in action research?*

Findings point to how teacher leaders became empowered and increased in their confidence to advocate for change. The teacher leaders also discussed the development of an equity-centered teacher leadership pedagogy that included: focusing on beliefs before pedagogy, using an asset-based view of teachers, and valuing voices of color.

Across the nation, school districts are responding to changing demographics as well as achievement gaps for students of color, English language learners, and low-income students. Deficit thinking, defined as blaming educational gaps on "the students or their families, not in the social ecology of the school, grade, or classroom" (Weiner, 2006, p. 42), exists as families and children are blamed for achievement disparities rather than looking at teaching practice, curriculum, or organizational structures that may be leading to these inequities (Valencia, 1997). Nieto and Bode (2012) explain that an equitable education means "all students must be given the real possibility of an equality of outcomes" (p. 9). Rather than providing an equal education, or

giving all students the same thing, an equitable education focuses on providing students what they need to be successful or achieve equality.

Schools need leaders committed to working toward greater equity. In the educational leadership literature, Theoharis (2007) describes leaders committed to equity or social justice as those who "make issues of race, class, gender, disability, sexual orientation, and other historically and currently marginalizing conditions in the United States central to their advocacy, leadership practice, and vision" (p. 223). While Theoharis' (2007) work mainly points to principals who take a prominent role in developing equitable educational environments, schools must also begin to capitalize upon the expertise of teacher leaders (TLs) in this capacity. Rodriguez, Mantle-Bromley, Bailey, and Paccione (2003) share, "If change for underserved students is to occur, teachers who are committed to issues of equity must become active leaders in their schools" (p.229).

Teacher leaders are those who "lead within and beyond the classroom, identify with and contribute to a community of teacher learners and leaders, and influence other toward improved educational practice" (Katzenmeyer & Moller, 2001, p. 5). Teacher leaders often move away from a sole focus on their classroom to collaborating, mentoring, and supporting the professional development of their fellow teachers (Lieberman & Miller, 2004). Silva, Gimbert, and Nolan (2000) found that the work of TLs can include navigating school structures, developing and nurturing relationships, modeling professional growth, helping other TLs with change, and challenging the status quo as advocates for children.

The literature focused on TLs who attend to equity issues has highlighted successful culturally responsive teachers as those who form relationships with students, challenge deficit views of diverse populations, understand the assets found within diverse communities, and

connect content and pedagogy to students' lives (Gay, 2010; Gonzalez, Moll, & Amanti, 2005; Ladson-Billings, 2009). Interestingly, these descriptions are often found in the literature on cultural responsiveness, but not within the teacher leadership literature. For example, in York-Barr and Duke's (2004) comprehensive literature review on teacher leadership, there was not one reference to issues of equity or supporting culturally and linguistically diverse students

Building upon Theoharis' (2007) work, I use the term equity-centered teacher leadership to describe TLs who make issues of race, class, culture, gender, disability, sexual orientation, etc. central to their practice and vision both inside and outside of the classroom in order to facilitate educational contexts where all students have equal opportunity for success.

The purpose of this qualitative study focused on understanding how TLs within a graduate teacher leadership Master's program describe their development as equity-centered TLs after engaging in action research where they facilitated a small learning community of teachers focused on promoting change related to an equity issue.

Literature Review

The literature serving as the theoretical basis for this study is connected to several key areas. One relates to the literature connected to the components and influence of graduate teacher leadership programs. Another area focuses on leadership for equity in regard to principals and teachers. Finally, this literature review discusses types of teacher knowledge that teachers can construct within professional learning.

Teacher Leadership and Graduate Education

In the research literature, studies on the influence of formal teacher leadership graduate programs are lacking, with a greater focus on teacher leadership development within school settings (Taylor, Goeke, Klein, Onore, & Geist, 2011). The small amount of literature about

graduate teacher leadership programs often lacks information about the impact of these programs (Ross et al., 2011).

Within the small amount of studies focused on the influence of teacher leadership graduate programs, several themes emerge. Taylor et al. (2011) engaged in a three-year qualitative study of their graduate teacher leadership program. They found that as a result of participation within the program, teachers were able to find and use their professional voice. Teacher leaders also felt empowered as they moved outside of their classrooms to work as agents of change. This included working with other teachers, other schools, and the community. Ross et al. (2011) looked at the impact of their teacher leadership graduate program on teachers, their colleagues, and school improvement efforts in relation to teaching, instructional problem solving, leadership within the school, and other teachers in the school. The authors found that as a result of the program, teachers adopted an inquiry stance and began viewing themselves as autonomous professionals. The teachers also adopted a leadership stance and began to view student learning as a collective responsibility.

Discussions of equity and teacher leadership are often non-exist in the graduate teacher leadership literature (Jacobs, Beck, & Crowell, 2011). Leonard, Petta, and Porter (2012) looked across 21teacher leader graduate programs to examine how they conceptualize teacher leadership. In their analysis of the vision, missions, goals, description, and curriculum of the programs, there was not one mention of anything connected to social justice and equity.

Action research and teacher leadership programs. Action research is a key element of many graduate TL programs (Phillips & Hollingsworth, 2005; Taylor, et. al., 2011). In their study of effective school leadership programs, Darling-Hammond, LaPointe, Meyerson, and Orr (2010) found the existence of action research as a key pedagogical tool for graduate students to

make theory to practice connections. Specifically this process includes identifying an issue or problem within a school context, reviewing literature related to the issue, collecting data on that issue (often both quantitatively and qualitatively), analyzing the data, planning for change, and enacting change (Glanz, 2003; Stringer, 2007). While there are many different models of action research, key tenets include: context specificity, addressing real life dilemmas, stakeholder input and collaboration, reflection and action, and a commitment to improve practice (Glanz, 2003; Stringer, 2007). While traditional research may have a specified beginning and end, the action research process is a continuous cycle of reflection and action (Stringer, 2007).

Phillips and Hollingsworth (2005) examine the use of action research with literacy teachers as a method of moving these teachers toward greater activism in their schools. They had mixed reviews in how the teachers saw the importance of the action research process. Some teachers found this process to be a waste of time since they had no control of the curriculum they were teaching in their schools. Teachers also struggled with action research because many lacked research skills. Taylor et al. (2011) emphasize the importance of praxis (reflection and action) in teacher leadership development connected to action research. This Cycle of Praxis involves teacher leaders "simultaneously constructing and applying new knowledge and understandings which led, in turn, to new initiatives" (p. 926). The authors found that engaging in action research influenced the teacher leaders to feel ownership of their learning and view themselves as knowledge creators. Perez, Uline, Johnson, James-Ward, and Basom (2011) found that graduate students that engaged in a reflective, inquiry-based approach to learning became skilled at formulating problems, convening stakeholders, using data to show the needs for change, and increased confidence in improving student learning.

Leadership and Equity

While many issues of inequity and racism are connected to larger systemic and macro conditions, the work of TLs on the ground level can make a difference in the lives and success of students (Nieto, 2007). While the literature contains a great deal of description in relation to teachers who are culturally responsive or equity-minded (see Gay, 2010; Ladson-Billings, 2009), there is a lack of literature about what happens when these TLs move beyond their classroom and begin to work with other teachers. These TLs must not only have culturally responsive practices in their classrooms, but leadership skills to move beyond their classrooms (Nieto, 2007). "They embody particular behaviors and attitudes that help them teach their students, while at the same time challenging inequities both in their schools, and more broadly, in their communities as well" (p.308). Nieto (2007) describes TLs committed to equity as confronting and challenging "regimes of truth" (p.304) that are often invisible but serve to perpetuate inequities. This involves not remaining silent when seeing injustice and questioning colleagues even if it is uncomfortable.

The educational leadership literature has spent more time on this topic in the area leadership and equity or social justice. This literature describes these leaders (often referring to principals) as those who engage in critical self-reflection to recognize their own sociopolitical identities (Brown, 2006; Kose, 2007), identify systems and structures that lead to inequities, promote inclusive practices and equitable access to curriculum (Kose, 2009; McKenzie et al., 2008; Theoharis, 2007), and support teachers through professional development in developing curriculum and pedagogy that include multiple perspectives and experiences (Kose; McKenzie et al.). The reform efforts of TLs could connect to many of these characteristics described for principals.

Kose (2007) studied how leaders committed to equity promote professional development among teachers. Often referring to the role of principals, these studies also have implications for TLs. Kose (2007) found that professional development content to support teachers in understanding equity must attend to two integrated strands of professional learning. This includes professional learning in content areas to develop subject matter expertise as well as learning in the area of social identity development. Social identity development includes helping teachers understand their own personal diversity awareness, gaining affirming views of diversity, and understanding the concept of cultural capital. When these two areas were intertwined, this then leads to professional learning in differentiating instruction for diverse learns as well as teaching students about equity and social justice.

Types of Teacher Knowledge

Graduate teacher leadership programs as well as action research are two tools that promote teacher learning. Cochran-Smith and Lytle (1999) identify three types of knowledge that teachers build when engaged in professional learning. These three types of teacher knowledge include: knowledge *for* practice, knowledge *in* practice, and knowledge *of* practice.

Knowledge *for* practice connects to the formal domain of knowledge. Specifically, this often includes knowledge provided to teachers from those outside of the specific school context. This is often knowledge associated with formal theory and research that is often disseminated through publications, graduate programs, or outside experts. As teachers engage in action research they may build upon knowledge *for* practice as they begin to understand an issue in their context by reading the professional literature.

Knowledge *in* practice refers to knowledge that is often constructed by those within the classroom through practice and experience in the field. When teachers engage in action research

they are able to engage in professional learning that allows them to study their own practice and in turn generate context specific knowledge in practice.

The third type of knowledge generated by teachers is knowledge *of* practice. Not a combination of knowledge *for* and *in* practice, this third type of knowledge is generated when teachers "make problematic their own knowledge and practice as well as the knowledge and practice of others and thus stand in a different relationship to knowledge" (Cochran-Smith & Lytle, 1999, p. 273-274). In this view of knowledge, teachers do not necessarily just rely on knowledge from the outside or simply on their own teaching practice. In this conception of knowledge, "teachers learn when they generate local knowledge *of* practice by working within the contexts of inquiry communities to theorize and construct their work and to connect it to larger social, cultural, and political issues" (Cochran-Smith & Lytle, 1999, p. 25). Action research serves as a professional development tool by helping teachers develop knowledge *in* and *of* practice.

Context

This educational leadership program, located in a southwestern public university, affords students the opportunity to pursue a Masters in Education with principal certification or a Master of Arts in instructional leadership. In an effort to increase the relevancy of the role graduate education plays in improving instruction within schools, the department sought to revive the instructional leadership track. To these ends, two years ago we began a partnership with a local district to recruit potential students to become a part of an instructional leadership cohort. This cohort provides the district an opportunity to grow a group of in-house teacher leaders. This work was especially timely as over the past several years this district has shifted from having a predominantly White student population to including greater amounts of students of color as well

as English language learners. Given the unique orientation of the program focused on equity, the districts' need to support an increasingly diverse student population aligned with our focus on developing culturally responsive, equity-focused TLs.

The instructional leadership curriculum begins with critical self-reflection on beliefs about leadership and education. Subsequent courses focus on professional development, supervision, community engagement, curriculum design, and instructional models. In the culminating courses, students are asked to develop an action research project. Since this master's program has a specific focus on equity, most projects link to topics such as race, class, gender, ability, etc. Also, since this master's program is focused on leadership, their action research must move beyond their individual classroom to influence the larger school community. For example, TLs work with grade levels, curriculum departments, the community, or teachers from across the school.

For the action research, TLs collaboratively work with a group of school staff to identify an instructional concern. From there they often work individually to write a literature review, and collect a variety of data. At that point they work with a group of interested colleagues at their school to analyze the data and develop an action plan. For many students, this action plan involves the TL leading a small learning community of interested teachers on their campus to engage in professional learning related to their topic. Before actually implementing their decided plan of change, the TLs present their action research to a panel of graduate program faculty members as part of the final capstone of the program. The TLs receive feedback about their action research report and also feedback about their plan of action. The TLs then enroll in one of their final courses in the program focused on school change. The main project during this course is actually implementing their change effort. As part of this course, the TLs write weekly

reflections on the progress of their action plan as well as systemically collect and analyze data related to their work leading the learning community. The final evaluation for this course consists of a report outlining the themes that emerged during their action plan implementation. The professors within both of these courses supervise the action research process.

Methodology

The purpose of this qualitative study focused on addressing the question: *How do teacher leaders describe their development as equity-centered leaders after engaging in action research?* Given the focus of this research question, this study is epistemologically grounded in constructivism (Crotty, 1998). The goal is to understand the experience of the TLs' from their perspectives and how they make meaning.

Within this research, sampling was purposeful in contacting TLs who recently graduated from this instructional leadership cohort who designed and implemented an action research project focused on an equity issue (Miles & Huberman,1994; Patton, 2002). An equity issue is defined as focusing on race, class, gender, sexual orientation, ability, or language. Out of the cohort of fifteen, ten action research projects fit the criteria. Five of the TLs elected to participate. All participants were female (one Latina, four White). Three TLs were classroom teachers and two held the position of instructional coach. This was a district position where the TLs worked with teachers across several schools specifically on math instruction. The following table provides information on all participants.

Insert Table 1 Here

As seen within the table, the TLs focused on a variety of issues from equity for girls in mathematics, Latino student achievement, equity for novice teachers, and equitable achievement for African American students in mathematics. All five of the TLs implemented an action plan

on their campuses that involved convening a small study group or learning community of teachers who volunteered to be part of the process. The groups met approximately four to eight times over the spring semester. Activities within groups included: reading articles, critical dialogue to unpack beliefs, analysis of achievement data, reflective writing, simulation activities, and case study. As a faculty member in this leadership program, I have taught both action research courses and also served as program coordinator. For these particular participants, I taught their class focused on action plan implementation and understanding processes of school change.

A variety of data collection techniques were used in order to understand the TLs development. Archival documents consisted of two assignments from the school change class. This included a 30-50 page academic paper the TLs wrote after their change effort was complete. This paper consisted of a technical description of their action research, themes synthesized from their work over the semester, and reflections on what they learned. Other documents included eight reflective journals the TLs wrote throughout the school change class that chronicled their feelings about taking action on their campuses. Finally, data collection involved an in-depth interview (Kvale, 1996) that took place at the beginning of the semester immediately following action research completion. The interview guide consisted of questions focused on prompting TLs to reflect on what they learned during the process of implementing their action plans including the challenges they faced, successes, and how they negotiated this process. Interviews were transcribed verbatim.

Data analysis began with open coding of all archival documents and interview transcripts by individual participant (Creswell, 2007; Merriam, 2009). Within each participant, similar open codes were grouped to make initial themes or patterns (Yin, 2003). For example, for Mary these

initial themes included facing resistance, feeling empowered, and purposefulness in dialogue. For Lisa, these included confronting deficit thinking, building relationships, finding a voice, and changing pedagogy. After themes were developed for each TL, then analysis moved to looking across all the TLs. This began by looking at the individual themes within each teacher leader and using these as beginning open codes to re-code all of the data. Analysis then moved to identifying overarching themes about common elements or processes of development across all TLs. As can be seen in Mary and Lisa's examples, individual TL themes such as feeling empowered and finding a voice were connected into a larger overarching theme of empowerment. The larger theme of developing an equity-centered pedagogy began by first bringing all the initial themes connected to pedagogy together and looking for commonalities across. Looking across these themes related to the TLs learning, the theme of the uniqueness of equity change emerged as a common thread. These instances of pedagogy were then analyzed further to develop the three sub-themes related to beliefs before pedagogy, approaching deficit thinking, and the voices of color.

Trustworthiness was built through the use of multiple method triangulation (report, reflections, and interviews). In addition, themes were shared with each of the participants to allow for member checking (Patton, 2002). At this point, participants had the opportunity to comment on the findings. To add to this trustworthiness, since I was not only the researcher, but co-coordinator of the instructional leadership cohort, I made sure to share the data and analysis with a critical friend not associated with the program to gain another perspective.

Findings

The participants all discussed their development as equity-centered TLs as they engaged in the process of action research. An overarching theme was that the TLs felt empowered. They

explained that they were able to move their change effort forward and advocate for change. The TLs also began to develop their pedagogy as equity-centered TLs as they named various key elements that guided their work with teachers.

Becoming Empowered as Equity-Centered Teacher Leaders

All the TLs shared that as they engaged in action research, they developed feelings of empowerment in their role as equity-centered TLs. They began to feel that they could make a difference in schools. Short (2003) defines teacher empowerment as a "process whereby school participants develop the competence to take charge of their own growth and resolve their own problems" (p.488). Erica shared in her interview,

> We saw this need, we thought it was a problem, we collected the data, we saw that it *was* a problem, and then put a plan in place to maybe effect some change. That was exciting!

Action research became a process that provided them with direction when faced with inequities on their campus. Mary shared in the final reflection of her action research report:

> And we [the school] need to be more culturally responsive to our kids. Now I have a place to go. It's not just floating out there somewhere. There's something that needs to be changed. What is it? There's a focus. There's something that I know I can do. There is a jumping off point to go forward. And it, it gave me a sense of purpose. To say, I see this. I want to make a change.

The TLs also discussed how they developed confidence in standing up for equity issues. Mary talked about being less willing to accept the status quo in her reflective journal.

> Because before I thought if people give it to you, you just do it. I guess that's how I was raised. If your boss tells you this is what you do, you just do it. Now I look at things differently. Now I would ask why…

Isabel shared in her reflective journal, “I’ve always stood up for students, for what I feel is right for a student, but not necessarily with my colleagues.” She talked about standing up to a colleague in her action research group who wanted to refer an African American boy for special education testing because the boy’s parents were not helping him at home. Isabel questioned the teacher by asking, “What have you tried in the classroom?” Lisa talked about being empowered to stand up for students as well. She said in her interview, “I want to be part of the change agent for students. I want all students to be treated with respect and for them to be given access to the education all students deserve.” Many TLs discussed how they felt empowered due to all of the data they had collected from both stakeholders and the research literature. Erica said in her interview, “We are speaking up probably more than we ever would have before, just cause we are armed with more information.”

The TLs who held district positions explained how they felt empowered to advocate for change at the district level. In her interview, Erica talked about a meeting with the district professional development coordinator and curriculum director where she advocated for equity of support for novice math teachers. She was able to draw upon her research to push for change.

> When I asked,
>
> ‘What can we do to be sure the novice teachers have sufficient support to start the school year?’ both ladies began to speak about mentors and I could not help but interrupt! I began rattling off all the reasons why the mentors have not been successful in supporting novices during the first week: some mentors have not even committed to being a mentor yet, mentors on growth plans and second year teachers are not equipped to handle their classrooms much less help another teacher, etc. They both agreed that the mentoring program has some issues. First and foremost, anyone breathing qualifies to be a mentor

under our current system! When I suggested that we come up with some requirements to guide the administrators, the PD Director jumped on board. In fact, she wants to create an application process.

Erica felt compelled to raise her voice on the issue. “If I do not push back on the system, who will?” Not only did the TLs began to feel empowered to speak up and work for change, but they began to build professional knowledge about the type of pedagogy they needed to enact in order to work for change.

Developing an Equity-Centered Teacher Leadership Pedagogy

One overarching theme across the TLs related to the unique nature of change focused on issues of equity and therefore, how their pedagogy must be unique. The TLs shared that they all engaged in professional learning while engaging in action research that prompted the development of an equity-centered teacher leadership pedagogy guiding their work with teachers. The elements of this unique pedagogy included: attending to beliefs before pedagogy, using an asset-based view of teachers, and valuing the voices of teachers of color.

Concentrating on beliefs before pedagogy. The focus of the master’s program was *instructional* leadership, but many of the TLs began to realize that before a focus on instruction, there needed to be a focus on beliefs. Trying to “fix” teachers or “tell” them how to be equitable would not work. Change would not occur with generic discussions of pedagogy or content. The TLs discussed how educators must understand their own beliefs and biases in order to reflect on their interactions with students. Sara shared in her interview:

> At first I really questioned where to start in this process. I wanted to go right to classroom pedagogy and classroom management strategies. However, understanding yourself and your own culture has to be the first step or the other information is meaningless. I am

> unsure how effective four meetings will be in moving all participants towards an understanding of their personal culture. My hope is that it will start the process for these participants and influence them to involve others in the start of a process.

Sara further reflected on how she brought into question her prior practice in working with teachers. She explained, "I guess I just realized that this is my third year in the job, and I've been concentrating on pedagogy all this time, and there is still achievement gap."

All the TLs talked about being extremely reflective and purposeful in having to include a major focus on beliefs within their change effort. For example, Mary shared in her interview:

> You have to think about their attitudes and their beliefs before you can throw change at them. How are they going to react to this change, and how do they feel about change? Not just about how they are going to react to it. But why are they reacting this way? What is it about this change that affects them and the way they're going to work?

This focus on beliefs influenced where Lisa began her work with teachers around achievement for girls in mathematics. In her reflective journal, Lisa described having teachers write a "mathography" reflecting on their experiences throughout their lives connected to becoming a math teacher and how this influenced their beliefs about teaching mathematics. The TLs talked about how change in relation to understanding issues of equity and diversity was especially difficult because of the time needed to focus on beliefs.

Using an asset-based view of teachers. The TLs discussed how they often confronted with resistance and specifically deficit thinking (Valenica, 1997) when working with teachers about issues of equity. The TLs became surprised by the extent of the deficit thinking. For example, Mary shared in her reflective journal:

> I didn't want to believe that it was true about my campus because I always thought of my campus as such a friendly place. You know, you don't want to believe that about the people you work with. I don't want to think that the teachers at my campus are not culturally responsive.

The TLs began to recognize deficit thinking in others and acknowledge the detrimental effects this view could have on students both socially and academically. While the TLs repeatedly talked about the need for teachers to reframe deficit thinking, they also discussed their responsive approach to confronting teacher's deficit thinking. Sara shared in her reflective journal:

> I don't know if it's [deficit thinking] as purposeful as I think I might have originally thought. I think it's more unintentional than overt. I think what I saw was just a group of people not knowing what to do or what they were doing. And even just misconceptions on their part...

The TLs explained trying not to view the teachers in a deficit manner. They were cognizant of not turning around and blaming teachers for their deficit thinking, just as the teachers had blamed students and parents. Instead, the TLs spoke about believing most teachers were not purposeful in their deficit thinking, but lacked experiences with diversity or building knowledge about equity.

Isabel talked in her interview about trying to understand the teachers in terms of their beliefs. "I have to understand where they are coming from…" Mary discussed her belief in teachers' ability to grow and move forward. She referenced her own growth in relation to deficit thinking throughout the master's program. Mary explained in the final reflection of her action research report,

> I know that at some point in my life, I felt that way. And it's taken me a long time to unpack what I believe and change a lot of the ways that I feel and realize that yes we all have deficit thinking, and …sometimes you don't even realize it's deficit until you've learned what deficit thinking is… And when you first realize you have deficit thinking, sometimes you're blindsided and it hits you in the face and you're like, 'I can't believe I thought that way. All those years I did that.' If they [teachers] haven't been taught any different, they don't know. I had some of those same beliefs. If you had interviewed me four years ago, before I had diversity training or anything, I would have had some of the same answers.

Instead of using a deficit lens to view teachers, the TLs used a lens of possibility.While the TLs did not blame the teachers for deficit thinking, they also did not ignore this type of thinking. Several TLs talked about feeling compelled and confident to respond to teachers who spoke in a deficit nature about parents and children. Sara explained that in the past she would shy away from responding to deficit thinking, but was afraid of engaging in conflict. She shared in her interview,

> I can remember talking to Dr. G in the supervision class about comments that people made that were just really out of line and not knowing what to do or how to handle it. But now I say, 'Is that really what you meant?' and 'Is that what you meant to say?' It's almost like I can't just let things slide at all.

Valuing voices of color. Each of the TLs specifically discussed how building relationships with teachers of color became a key piece of the equity-centered teacher leadership pedagogy. Most of the TLs did not have teachers of color in their learning communities and talked about wishing this was not the case. Lisa and Erica, who both lacked racial diversity in

their group, lamented in their interview about what this meant for their change efforts. Erica shared in her interview, “I wished I had some more diversity with the new teachers, especially thinking about the campus they were on and trying to connect. I think some of them had a hard time connecting with their diverse populations.”

Sara was the only teacher leader to have teachers/administrators of color in her learning community. She specifically talked about how the presence of voices of color was invaluable. In her final action research report, Sara shared:

> When we read the *Unpacking the Knapsack* article, the first teacher started off, ‘The article is 20 years old and these things don’t happen anymore.’ It wouldn’t have had the same effect for me to say, ‘Yes, they still do!’ What happened was that other people in the group said, ‘Yes, they still do. And here is the example of this happening to me personally.’ It made it personal instead of theoretical.

Sara called this a “light bulb” moment when “you know someone thought of something one way and now their thinking was totally changed”. Sara did not want one person to have the position of speaking for an entire race, but did think multiple perspectives really made a difference.

While many of the TLs discussed the need for voices of color within their groups, the only teacher leader of color, Isabel, a Latina, discussed the struggles she faced engaging in action research. As the only voice of color in her learning community she often was fearful that teachers thought she was making up the information about inequities for Latinos. She felt the pressure of being a Latina focused on Latino student achievement in a predominantly White school. She explained in her reflective journal, “Personally, I felt because I did relate to the topic so well, I didn’t want people to think I was making up this data.” Isabel would bring data that

had not yet been analyzed or disaggregated and have the group do their analysis together. She went on to clarify in her interview, “I just wanted them to see it and make their own judgments, because I didn’t want them to think I was skewing it in any way.” Isabel also used the research literature as a way to add validity to her topic. She shared in the interview,

> And I always wanted them to know – here’s the literature read it yourself – it wasn’t my opinion, and I’m just thinking up things in my head, and although I was deeply related to the topic, it was something that our whole campus needed to be just as passionate about. Not just because I was.

Isabel utilized a White ally, who had also been a part of the instructional leadership program to support her during meetings. When Isabel would bring up ideas, such as White privilege, the White colleague would show support and add to the dialogue. Isabel explained, “That was really helpful because everyone was White and I was the only person of color.” As a Latina, Isabel had unique challenges negotiating equity work. She often felt that her voice was not necessarily valued, and unlike the other TLs she struggled most getting her group to buy into the inequities at her campus. This influenced the level of empowerment she felt within her role as an equity-centered TL.

While engaged in the process of action research, these TLs were able to develop new knowledge that resulted in a pedagogical approach to teacher leadership connected to equity issues.

Discussion

As the TLs engaged in the process of action research, they began to develop as equity-centered teacher leaders. Part of this development involved becoming empowered and feeling confident that they could indeed work toward change and stand up for inequities they noticed

within their school and the district. In addition, the TLs began to develop their pedagogy so they could work toward change in a way that was responsive to the unique nature of equity issues. This pedagogy included: addressing personal beliefs before pedagogy, viewing the assets of teachers, and valuing the voices of teachers of color. The findings from this research not only help us learn about the specific ways in which TLs developed or the content of their development, but also learn about the process of how they developed.

The Content of Development

In terms of the content of development, the TLs began to name specific elements related to their pedagogy of equity-centered teacher leadership. Within the action research process, the TLs began to see the unique route they needed to take as they enact this equity-centered TL pedagogy.

One component of this pedagogy connected to the centrality of beliefs. For many of the TLs, their first instinct was to work with teachers on the technical or changing pedagogy, but quickly saw the extensive time that would be needed for reflection on beliefs. Focusing simply on the technical dimension (Oakes, 1992) of change is not enough. In her research on tracking, Oakes (1992) highlights the need for technical, normative, and political dimensions of change in equity-centered reform. The normative dimension involves “a critical and unsettling rethinking of the most common and fundamental educational beliefs and values” (p.19). Another unique element of the TLs pedagogy connected to valuing the voices of color. Within the change literature, relationships are highlighted (Fullan, 2007). However, within the TLs equity change efforts, there was also the inclusion of voices of color that may have been marginalized in the past. This also includes examining the unique experiences of TLs of color.

Looking at educational change in a neutral manner can be detrimental to the change. Durden (2008) discusses how Comprehensive School Reform models specifically targeted at schools with large populations of culturally and linguistically diverse often lack attention to culture and the experiences of children. Ladson-Billings (1995) makes a similar argument in how culturally relevant teaching goes beyond what some teachers might say as "That's just good teaching!" A unique lens must be employed to understand change in relation to equity issues. This has significant implications for graduate leadership preparation programs. Graduate programs must not only support TLs in their development of knowledge related to understanding issues of equity, but also must support the development of a leadership pedagogy that has unique elements connected to equity. If not, we may be setting TLs up for failure as they try to support teacher professional learning about issues of equity.

While the other TLs became empowered as part of their development, Isabel still struggled with feelings of disempowerment. As the only TL of color, Isabel had a unique experience. This is an area in need of further research. What are the unique experiences of TLs of color in implementing equity-focused change? How are teacher education and educational leadership programs supporting TLs of color? Are we setting these students up for failure when we do not discuss the unique challenges they will face in leadership situations?

The Process of Development

Often issues of equity are seen as impossible to change when viewed as being connected to macro issues of discrimination, inequitable systems, and oppression (Nieto, 2007). However, TLs were able to make change at a micro level using action research as a tool. The TLs were able to speak up about equity issues and work to make real change on their campuses as well as in the district. Nieto (2007) describes one of the roles of TLs committed to equity and social justice is

that they do not remain silent when they hear deficit thinking. TLs grew in their confidence and knowledge to speak up for equity issues as they engaged in the process of action research. The TLs were able to move their practice beyond the individual classroom to the larger school and district context.

While engaged in the process of action research, the TLs not only developed in their feelings of empowerment to make change, but engaged in professional learning about how to enact this change by developing an equity-centered teacher leadership pedagogy. While in the earlier classes of the master's program, the TLs developed knowledge *for* practice (Cochran-Smith & Lytle, 1999) as they engaged in discussion, read articles, developed projects, etc. connected to equity and social justice. These TLs spent two years within their master's program exploring their own beliefs about issues of equity and building a knowledge base. This knowledge *for* practice was formal and delivered through the master's program. However, at the final point of the program while engaged in action research, the TLs were able to develop knowledge *in* and *of* practice as they learned about their specific context and worked with other teachers to interrogate and change practice. The TLs not only learned through outside sources, but were able to study, question, and dialogue about their own practice and beliefs as well as colleagues. During this engagement in action research, the TLs were able to begin to build knowledge *in* and *of* practice related to enacting equity-centered teacher leadership pedagogy.

Therefore, TLs developed as equity-centered teacher leaders in their ability to make change within and beyond their classroom as well as develop pedagogy to enact this change. In terms of leadership preparation, programs cannot simply include action research and hope that their graduates become equity-centered teacher leaders. At the same time, programs cannot assume that if they provide knowledge *for* practice related to equity issues that TLs will be able

to enact change. These findings point to the need for a combination of both knowledge *for* practice, plus the opportunity to develop knowledge *in* and *of* practice. Action research became a tool to build this knowledge *in* and *of* practice.

These findings prompt reflection on areas for further research. One area would be looking at how this process of development as equity-centered TLs could occur within graduate programs with another area of focus. For example, if a literacy graduate program wanted to develop TLs in the area of literacy, they would need to help TLs construct knowledge *for* practice related to literacy and leadership through coursework. However, they would then need to provide students with opportunity to use action research in order to become empowered to make change and develop pedagogy for literacy teacher leadership. Another area of research would be to follow up with these TLs to see if they are able to continue enacting this equity-centered teacher leadership. Do the TLs continue to use action research as a process for change? How do they negotiate this work after they have graduated from the program? What challenges do they face? It would also be interesting to study the knowledge constructed by the other teachers that were involved in their action research. How did they grow and develop as equity-centered teacher leaders? Another focus would be to look at the principals in these schools. How did they support or hinder the development of this TL pedagogy?

Our schools need to move toward change in order to support the development of equitable school contexts where there is a greater opportunity for all students to succeed. This task is too enormous for school principals to take on alone. Teacher leaders have the potential to support grassroots change related to equity. This study points to the importance and potential of teacher leadership development in this area.

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Table 1

Teacher Leader	Race	Years Experience	Position	Context for Action Research	Action Research Topic
Mary	White	8	Third grade teacher	8% African American 2% Asian 74% Hispanic 17% White 65% Low SES	Latino student achievement in reading
Isabel	***Participant Information*** Latina	10	First grade teacher	18% African American 8% Asian 26% Hispanic 50% White 22% Low SES	Latino student achievement
Erica	White	20	Secondary math instructional coach	17% African American 4% Asian 32% Hispanic 47% White 30% Low SES	Equity in mentoring novice math teachers
Lisa	White	25	Secondary math instructional coach	10% African American 11% Asian 16% Hispanic 63% White 12% Low SES	Equity for girls in secondary mathematics
Sara	White	18	Middle school math instructional coach	13% African American 10% Asian 21% Hispanic 56% White 23% Low SES	African American student achievement in math

Correspondence concerning this article should be addressed to**:**
Jennifer Jacobs, University of South Florida, Childhood Education and Literacy Studies
4202 E. Fowler Ave., Tampa, FL 33620, Jjacobs8@usf.edu

Chinese College Students' Self Regulated Learning Strategies and Self-Efficacy Beliefs in Learning English as a Foreign Language

Chuang Wang,
University of North Carolina at Charlotte

Jiyue Hu
Guoying Zhang
Yan Chang
Second Military Medical University, Shanghai, P.R. China

Yongjin Xu
The Coca-Cola Company, Beijing, P.R. China

Abstract

Chinese college students majoring in medicine participated in this study by completing two questionnaires about their use of self-regulated learning (SRL) strategies and self-efficacy beliefs in studying English as a foreign language. Data on participants' performance on two English written exams and one oral English test were also collected. Statistically significant relationships between the use of SRL strategies, self-efficacy beliefs, and achievement in learning English were noted, providing additional validity information for the scores from the two questionnaires developed in a previous study (Wang & Pape, 2005). Participants' self-ratings of self-efficacy and use of SRL strategies; however, were not high. Students who read articles before reading questions had better performance on English written exams than their counterparts. Implications of the results in a Chinese English instruction context are also discussed.

Keywords: self-regulated learning, self-efficacy, learning English as a foreign language

Introduction

In China, college students spend more time studying English than any other university subject in their spare time. Although they are required to take four hours of English courses each week during their first two years in a university, Chinese undergraduate students usually spend about 10 hours every week in after-class English learning. That is to say, these college students spend more than twice as much time studying English on their own than in learning English with their teachers. As a result, it is important to study these students' self-regulated learning (SRL) strategies learning English as a foreign language inside and outside of the classroom.

Students' academic performance is influenced by classroom teaching approaches (Delucchi, 2007; Diseth, 2007; Doherty, & Hilberg, 2007; Farkas, 2003; Malouff, Rooke, Schutte, Foster, & Bhullar, 2008; Trimble & Irvin, 2003), students' SRL strategies (Ainley & Patrick, 2006; Pape & Wang, 2003; Paris & Paris, 2001; Schunk, 1996; Schunk & Ertmer, 2000; Wood, Bandura, & Bailey, 1990; Zimmerman, 1998), and students' self efficacy beliefs (Pajares & Graham, 1999; Pajares & Valiante, 1997; Schunk, 1994; Shih & Alexander, 2000; Voss, 2001; Wang, Wang, Li, 2007). While teacher education researchers have investigated extensively on curriculum and instruction, the constructs of self-efficacy beliefs and SRL strategies have been the foci of educational psychologists (Zimmerman, 2008).

Self-efficacy and SRL strategies are closely related to each other and are predictive of students' academic achievement (Ellis, 1989; Schunk, 1990; Zimmerman & Martinez-Pons, 1990). Asian students are more accurate at calibrating their efficacy beliefs with subsequent performance in academic settings in comparison to students of western culture (Earley, 1999; Eaton & Dembo, 1997; Salili, Chiu, & Lai, 2001; Scholz, Gutierrez-Dona, Sud, & Schwarzer, 2002; Schwarzer & Born, 1997). The subject areas in previous studies about self-efficacy and self-regulation were mostly in the fields of mathematics and literacy (e.g., first language reading

and writing). Studies investigating these constructs in the context of studying English as a foreign language, however, are limited (Huang, Lloyd, & Mikulecky, 1999). Enhancing students' self-efficacy beliefs and SRL strategies may be crucial to their language learning process and should be included in classroom teaching approaches. This study therefore was designed to provide a description of the current levels of Chinese college students' self-efficacy beliefs and SRL strategies and to examine how these constructs are related to Chinese college students' achievement in learning of English as a foreign language.

Self-Regulation

SRL strategies are measures that students use to develop study habits, to monitor or regulate their learning process, and to make adjustments to their own strategies based upon feedback. Zimmerman and Martinez-Pons (1986) reported that students' self-reported SRL strategies were positively correlated with their standardized testing performance. In another study, Zimmerman and Martinez-Pons (1988) noted that high achieving students used more learning strategies and were more likely to seek help from instructors than low achieving students. Students who needed help the most were least likely to seek help. Zimmerman and Martinez-Pons (1988) concluded that successful students tend to be aware of how well they have done on a test even before getting it back from the instructor, indicating their tendency to self-monitor performance.

Self-regulated learners also implement various motivational strategies, including orienting oneself before working on an assignment, collecting relevant resources, integrating various theoretical viewpoints, monitoring comprehension, and assessing progress (Boekaerts & Cascallar, 2006). Motivation strategies "set the scene for learning and assign value to the learning activity" (Boekaerts & Cascallar, 2006, p. 201). According to social cognitive theorists

(e.g., Schunk, 1994), students' learning behavior is closely related to their social experiences and to interactions with teachers. More specifically, students' past learning experiences "trigger expectations and beliefs, which might have a profound impact on their current perceptions, choices they make, and effort they are prepared to invest" (Boekaerts & Cascallar, 2006, p. 204). Students are more inclined to self-regulate if teachers promote student-centered learning (Abdullah, Bakar, Roslan, Luan & Rahman, 2006).

Chamot and El-Dinary (1999) investigated elementary school children's strategy use while learning a foreign language and noted a significant difference in the use of strategies depending on the context of learning tasks. The number of strategies used to complete reading tasks was twice as many as that used to complete writing tasks. Strategies favored in the context of reading were making inferences, predictions, elaborations, language knowledge, translating, and summarizing. The only strategy favored in the context of writing was planning.

Students who are less self-regulated have "difficulty gauging their learning strengths and weaknesses and how these interact with the demands of particular tasks" (Perry, Hutchinson, & Thauberger, 2007, p. 27). In response to the difficulty of regulating their learning, these students will "avoid failure and damage their self-esteem by seeking easy tasks, procrastinating, or avoiding work altogether" (Perry et al., 2007, p. 27). As a result, teachers should consider how to help students develop SRL strategies as a part of classroom instruction.

SRL strategies can easily be incorporated into classroom instruction (Zimmerman, 1998). Previous studies have shown that instructional methods, including the type of task in which teachers ask students to engage, influence the motivational goals that students adopt for their learning as well as their SRL strategies (Ames, 1992; Cohen, 1994; Doyle, 1983; Maehr & Midgley, 1991; Meece, Blumenfeld & Hoyle, 1988; Wolters & Pintrich, 1998). Boekaerts and

Cascallar (2006) posit that a teacher's clarity and pace of instruction, degree of structure, autonomy granted, enthusiasm, humor, fairness, and expectations have an effect on students' SRL.

Zimmerman (1998) argued that successful learners maintain motivation and intrinsic interest as they control their choosing and planning of academic tasks. Earlier studies had shown that students who realized the importance of the assigned tasks were prepared to use effective learning strategies (e.g., Pintrich & DeGroot, 1990) and were more likely to have strong self-efficacy beliefs (e.g., Schunk, 1990; Zimmerman & Martinez-Pons, 1990).

Self-Efficacy

Self-efficacy is defined as a person's judgment of his/her capabilities to complete a specific task with the skills he/she possesses (Bandura, 1997) and is usually described as being task-specific (Bandura, 1986; Schunk, 1989, 1991). Self-efficacy is a vital process involved in self-regulation and is affected by the features of the classroom (Schunk, 1994). Students generate self-efficacy judgments for specific classroom tasks, and these beliefs vary as a function of tasks or classroom features (Pintrich & Schunk, 1996). Salili and Lai's (2003) study of Chinese students' learning and motivation noted that the implementation of a variety of instructional strategies was correlated with higher levels of self-efficacy.

Test-Taking Strategies

College students in Chinese universities are required to take English courses for two years. The instruction time amounts to 280 hours, which is a large number of hours compared to other subjects. The Chinese Ministry of Education requires that all undergraduates pass the College English Test Band 4 (CET-4) in order to get their diplomas. English is therefore

regarded as one of the most important subjects in the university. Under a pressure to pass CET-4, Chinese college students are very interested in test-taking strategies.

One of the test-taking strategies is whether to read a passage before answering questions about the passage or to read the questions and then find the answer in the passage. In a study of test-taking strategies in the United States, 210 fourth grade students were randomly put into two groups and given the Level 9 reading Comprehension Test of the Iowa Test of Basic Skills (Perlman, Borger, Gonzalez, & Junker, 1998). Students in one group were advised to read the test questions before reading the passage while students in another group were advised to read the passage before reading the test questions. No statistically significant difference was noticed in their performance; however, higher ability students performed better on generalization items in the group who read the passage first, and lower ability students did worse using this test-taking strategy (Perlman et al., 1998).

Some qualitative studies of college students' test-taking strategies have noted that in order to save time, some students read the test questions before reading the passage while other students read the passage before reading the test questions. These studies did not report statistically significant differences in the students' performance on the tests (Farr, Pritchard, & Smitten, 1990; Rupp, Ferne, & Choi, 2006).

In order to help students pass CET-4, English teachers in Chinese universities divide their instruction time into four parts: intensive reading (50%), listening (15%), extensive reading (20%), and writing (15%). Intensive reading aims to help students increase their recognition of vocabulary and phrases that appear in the textbook. The instruction is mainly teacher-centered. Teachers teach vocabulary, phrases, and grammar, and provide cultural notes related to the texts. Students are asked to do several exercises designed based on the text. Listening aims to help

students understand major listening tasks such as daily conversations, functional dialogues, and short lectures. Teachers teach some listening strategies or note-taking skills to help students understand the materials. Extensive reading aims to help students comprehend the general idea of an article. In teaching extensive reading, teachers do not focus on explaining each word or phrase; instead, they help students develop skills in grasping the main idea of an article. The major task is to understand the context and structure of the article. Writing aims to teach skills to organize thoughts. Students are often asked to write a short article (about 150 words) in class. All these teaching methods focus on knowledge mastery as well as the development of language skills.

The literature review suggests that it is important to examine Chinese students' SRL strategies and self-efficacy beliefs as factors that may influence their English language learning and performance on English tests. Therefore, this study was designed to answer the following research questions:

1. At what level do Chinese college students endorse specific SRL strategies and self-efficacy beliefs?
2. Are Chinese college students' SRL strategies and self-efficacy beliefs related to each other? Are they related to these students' performance on standardized tests in English and oral English test?
3. Are there significant differences in reading achievement between Chinese college students who read a passage before answering questions about the passage or their counterparts who read the questions and then find the answer in the passage?

Method

Participants

Participants in the study were 517 sophomore students in a Chinese university in the southeastern region of China. All of the participants were majoring in medicine. Unlike the case in the United States, medical school students are representative of college students in other academic areas with respect to academic achievement and demographic background. The participants were mostly (81%) males, and their ages ranged from 17 to 25 years, with an overall mean age of 20.6 years and a standard deviation of 1.08 years.

Measures

In order to investigate whether or not these strategies apply to second language learning and to students with Chinese cultural background, Wang and Pape (2005) developed two surveys to measure Chinese students' self-efficacy beliefs and their use of SRL strategies studying English as a second language in American classrooms through multiple interviews and observations. When developing these scales, Wang and Pape (2005) referenced Bandura's (1997) theoretical framework of self-efficacy, Zimmerman and Martinez-Pons' (1986) self-regulated learning interview scale, and Oxford's (1990) Strategy Inventory for Language Learning (SILL). During the structured interview in Zimmerman and Martinez-Pons' (1986) study, middle school students were asked to respond to six problem contexts such as preparing for a test or writing an essay. Responses to these open-ended questions were transcribed and coded into 14 SRL categories that focused on motivation, metacognition, and behavior. The motivation category includes SRL strategies such as self-evaluation and self-consequences. The metacognitive category includes SRL strategies such as goal-setting and planning, organizing and transforming, seeking information, and rehearsing and memorizing. The behavioral category includes SRL strategies such as environmental structuring, keeping records and monitoring, reviewing records, and seeking social assistance.

The Questionnaire of English Self-regulated Learning Strategies (QESRLS) includes 68 items (Appendix A). Each item describes an SRL strategy commonly used in studying English. Based upon the 11 categories of SRL strategies in the context of mathematical problem solving (Pape & Wang, 2003), 11 categories of SRL strategies in the context of learning English as a foreign language were used in the study: (1) Self-evaluation (Items 8, 30, 58, and 66); (b) Organization and transformation (Items 2, 13, 16, 18, 26, 33, 38, 40, 41, 44, 45, 47, 49, 55, 60, and 68); (c) Rehearsal and memorization (Items 14, 22, 24, 28, 42, and 43); (d) Seeking social assistance (Items 6 and 19); (e) Persistence when faced with challenges (Items 5, 9, 12, and 20); (f) Seeking opportunities to practice English (Items 23, 29, 39, 46, 48, 52, 54, and 67); (g) Record keeping and monitoring (Items 1 and 4); (h) Self-consequences (Items 15 and 53); (i) Goal setting and planning (Items 7, 10, 11, and 17); (J) Review of records (Items 3 and 51); and (k) Interpretation skills (Items 21, 25, 27, 32, 34, 35, 36, 37, 50, 56, 57, 59, 64, and 65). Items 31, 61, 62, and 63 did not fall into any of these categories in factor analysis, so they were treated separately in the data analyses.

Validity ensures that the interpretation of a survey outcome is accurate, the intended theoretical constructs are supported, and conclusions drawn from the survey are accurate and reliable (Messick, 1995). According to Wang et al., (2007), internal consistency (Cronbach's alpha) was .96, test-retest reliability was .88 (the interval between the two measurements was three weeks), concurrent validity was .62, with SILL developed by Oxford (1990), and predictive validity was .57 (for English proficiency test performance). Students were asked to respond by circling one of the choices that matched their use of these strategies the most: 0 = "I never use it," 1 = "I seldom use it," 2 = "I sometimes use it," and 3 = "I often use it."

The Questionnaire of English Self-Efficacy (QESE) includes 32 items (Appendix B). Each item asks students to make judgments about their capabilities to accomplish certain tasks using English as a foreign language. Four subscales were also analyzed: (a) Self-efficacy for listening (Items 1, 3, 9, 10, 15, 22, 24, and 27); (b) self-efficacy for speaking (Items 4, 6, 8, 17, 19, 20, 23, and 30); (c) self-efficacy for reading (Items 2, 12, 16, 21, 25, 26, 29, and 32); and (d) self-efficacy for writing (Items 5, 7, 11, 13, 14, 18, 28, and 31). According to Wang et al. (2007), the internal consistency (Cronbach's alpha) was .96, test-retest reliability was .82 (the interval between the two measurements was three weeks), the concurrent validity was .55, with the scale of "Self-Efficacy for Learning and Performance" which consisted of eight items from Motivated Strategies for Learning Questionnaire developed by Pintrich and DeGroot (1990), and the predictive validity was .41 (for English proficiency test performance). Students were asked to rate their capabilities on a 7-point Likert scale from 1 (I cannot do it at all) to 7 (I can do it very well).

In order to make sure that students understand the items correctly, both questionnaires were in English and Chinese. An iterative process of repeated independent translation and blind back-translation recommended by Brislin (1970) was used to ensure the congruence of meaning between the English and Chinese versions of items in the questionnaires.

Two English written examinations (Exam 1 and Exam 2) and one oral English test were also used as outcome measures. Both English written examinations were combinations of criterion-referenced tests and aptitude tests, each of which consists of 60% of what was covered in the English class and 40% of English proficiency skills. Each of these two English written examinations included listening comprehension (20%), reading comprehension (35%), vocabulary and grammar (30%), and writing (15%). Due to the concern over the validity of

responses to multiple-choice questions, the ratio between multiple choice items and opened-ended questions changed from the traditional 7:3 to 4:6. Scores from both exams can be interpreted with a high degree of validity. The scores range from 0 to 100. A score below 60 is considered failure to master the skills, a score between 60 and 69 is considered "pass," a score between 70 and 79 is considered "good," a score between 80 and 89 is considered "very good," and a score between 90 and 100 is considered "excellent." The raw scores were used in this study, and the variable to represent students' performance on these two English examinations was treated as an interval scale of measurement in the data analyses.

The procedure for administering the oral English test was as follows: (1) Groups of three or four students were created (2) Two teachers conducted an interview with each of the groups (3) The groups participated in a discussion on a particular topic related to their studies or daily life (4) the teachers followed the discussion by questioning students one by one. The four steps of this procedure were completed in 10-15 minutes. The two teachers evaluated the students' participation in the procedure and from their evaluation the students received an A, B, C, or D. The mean score of the scores provided by both teachers was used as the final grade for each student. The topics and preparation guidelines were given to students beforehand; however a substantial amount of effort was exerted to ensure the administered activities elicited spontaneous responses rather than prepared recited responses. The objective of the exam was to test how well students could speak English spontaneously. The letter grades were converted to numerical values (1=D, 2=C, 3=B, and 4=A) for data analysis.

Procedures

Participants completed two questionnaires, QESRLS and QESE, at the beginning of the semester. Participants took two English written examinations at the end of the semester in Year

One and Year Two, respectively. In addition, one oral examination record was also included. A letter-grading system (A, B, C, D) was used to grade each student according to their oral English competence. Descriptive statistics were employed to report the participants' levels for the use of SRL strategies and self-efficacy beliefs. Pearson product-moment correlation was employed to examine possible relationships between self-efficacy, SRL strategies, and students' performance on two English exams as well as the oral English test. Since there are 51 possible relationships to be tested (3 tests by 17 constructs and sub-constructs of self-efficacy and SRL strategies), a Bonferroni type adjustment was made for inflated Type I error. The significance level for these Pearson product-moment correlation tests was adjusted to .001.

In addition, participants were put into two groups by one of their SRL strategies (Items 62-63) about whether they read questions before reading articles or read articles before reading questions during English reading comprehension examinations. Only students who reported using this strategy often were selected for this analysis (n = 245). Of these students, 86 (35%) often read articles before reading questions and 159 (65%) often read questions before reading articles. Two-way repeated measures analysis of variance (ANOVA) was used to examine the interaction effect of time (two English written exams) and group membership as well as the main effect of time and group membership.

Results

Responses to both questionnaires were found to be reliable using total scores. Cronbach's alpha (internal consistency) was .94 for QESRLS and .97 for QESE. Descriptive statistics and inter-correlation coefficients between the outcome measures were presented in Table 1 as follows:

Insert Table 1 about here

Participants' performance on the two English exams were comparable (M = 66.56, SD = 8.65 for Exam1 and M = 66.58, SD = 12.90 for Exam 2) except that their scores were more spread out in Exam 2, suggesting that students' overall achievement in English remained the same from Year One to Year Two but the range of scores was larger. On average, participants' use of SRL strategies was 1.76 with a standard deviation of 0.38, indicating that most participants only occasionally use these strategies. Participants' mean self-efficacy in completing English tasks (M = 4.62, SD = 0.85) was not very strong.

Statistically significant relationships were identified between participants' use of SRL strategies and self-efficacy beliefs for completing English language tasks (r = .52). Furthermore, a statistically significant positive relationship was noticed between students' self-efficacy beliefs and all subscales of SRL strategies: self-evaluation (r = .37), organizing and transforming (r = .32); rehearsing and memorizing (r = .28); seeking social assistance (r = .22); persistence when faced with challenges (r = .46), seeking opportunities to practice English (r = .48), keeping records and monitoring (r = .32), self-consequences (r = .24), goal-setting and planning (r = .39), reviewing records (r = .29), and interpreting skills (r = .51). Student's self-efficacy beliefs were also significantly related to their performance on English exams, and significant relationships were also noted between participants' performance on English written exams and their oral English proficiency (See Table 1). Participants' use of SRL strategies, however, was not statistically significantly related to their performance on English exams.

When participants' responses to each subscale of the self-efficacy questionnaire and the SRL strategies questionnaire were correlated to their performance on the three English exams, findings were mixed (See Table 2). Participants' responses to all four self-efficacy subscales were significantly correlated with their performance on all three English exams, suggesting a

strong correlation between self-efficacy beliefs in English listening, speaking, reading, and writing tasks and English achievement. As for SRL strategies, self-evaluation, persistence when faced with challenges, and interpretation skills were all significantly correlated with students' performance on the three English exams. Keeping records and monitoring was significantly correlated with students' performance on oral English test, and reviewing records was significantly correlated with students' performance on the first English written exam. Other Subcategories of SRL strategies (organizing and transforming; rehearsing and memorizing; seeking social assistance; seeking opportunities to practice English, self-consequences, and goal-setting and planning) were not statistically significantly correlated with any one of the three English exams.

Insert Table 2 about here

The 2x2 ANOVA suggested that the interaction effect between time and group membership was insignificant, F (1, 241) = 0.01, p = .92, partial η^2 < .001. The main effect of time was also minimal, F (1, 241) = 0.02, p = .90, partial η^2 < .001, indicating no significant change of students' performance on English exams from Year One to Year Two. The main effect of group membership, however, was significant, F (1, 241) = 12.591, p < .001, partial η^2 = .05. This means that the students who read articles before reading questions had significantly higher scores on the average of the two English exams (M = 70.97, SD = 15.87) than students who read questions before reading articles (M = 66.49, SD = 11.65). Specifically, the students who read articles before reading questions did better than students who read questions before reading articles on English Exam 1 (M = 70.66 and SD = 8.41 versus M = 66.51 and SD = 8.02) and English Exam 2 (M = 70.90 and SD = 10.89 versus M = 65.78 and SD = 14.42).

Discussion

Many of the findings from this study in the domain of learning English as a foreign language are consistent with the results from previous studies in the domain of first language English reading and writing and mathematics education. For example, self-efficacy, SRL strategies, and academic achievement were positively correlated with each other (Ainley & Patrick, 2006; Pape & Wang, 2003; Shih & Alexander, 2000; Wang et al., 2007). Specifically, students who had strong self-efficacy beliefs were persistent when faced with challenges and were more successful in academic achievement (Schunk, 1990; Wang et al., 2007).

The average use of SRL strategies by participants in this study was not satisfactory, indicating a lack of integration of SRL strategies in Chinese college English instruction context. Learning is influenced by a variety of contexts, one of which includes a societal level of learning established by cultural values and societal norms which is reflected in students' socialization and parents' expectations (Salili & Lai, 2003).

School and classroom environment impacts student learning (Maehr & Midgley, 1996). The dominant English classroom instruction pedagogy in China is still teacher-centered where students are not encouraged to develop their own strategies but instead to follow teacher’s words. This way of pedagogy might be beneficial for students to gain knowledge and have good performance on English examinations which focus on content knowledge (e.g., vocabulary, grammar, and sentence structure); however, it is not good for students to discover the freedom they might have in developing their own ways of learning. This could also explain the small effect sizes of the relationships between participants’ use of SRL strategies and their performance on English exams. Although a trend was noted that the more SRL strategies were used the higher scores participants gained in English exams, this connection was weak. This was because, on average, these participants only used these SRL strategies occasionally. The

distinction of the use of SRL strategies among the participants was small. This was also reflected by the small variance (0.14 on a four-point response key) of SRL strategies.

Students' SRL strategies are very important to their acquisition of the competence and knowledge in general and their acquisition of the English language in particular. This study suggests that English teachers should consider incorporating SRL strategies in classroom teaching and facilitate the student's development of their own SRL strategies. One example is to have more group work instead of lectures since small group collaboration and a social constructivist's learning environment enhance students' use of SRL strategies (Boekaerts & Cascallar, 2006).

It was not surprising that participants' report of self-efficacy beliefs were not strong either. This might be partially due to the humble Chinese culture. Chinese students were, generally speaking, more likely to report lower self-efficacy beliefs in comparison to students from European and American cultures (Earley, 1999; Eaton & Dembo, 1997; Salili et al., 2001; Scholz et al., 2002; Schwarzer & Born, 1997). Some researchers claimed that complying with societies' demands involves the restriction of student's personal wishes, interests, and expectations (Kuhl, 2000). Chinese classroom instructional context may also explain the participants' report of self-efficacy to complete English language tasks. There was such a strong focus on passing CET-4 in college English curriculum that most teachers only teach students knowledge and skills to do well in this test and ignore the practical use of English as a communication tool. As a result, participants in this study did not feel that they could use English well in real-life situations, as reflected in the self-efficacy questionnaires.

Students who read the articles before reading questions did better than students who read the questions before reading articles on English exams. Although many other factors could

influence this result, for example, students' IQ, confidence in memory, and ability to avoid being distracted by misleading information, these results reinforced the argument for teaching practical reading skills versus teaching for the tests. Some students in China thought reading the questions before reading the article could save them time in the test because they would only have to locate the answers to the questions in the article. This study suggests that reading questions before reading the article might not help the students to get a better understanding of the article and to obtain more accurate answers to the questions.

Although this study is significant in that it reports the current levels of Chinese college students' use of SRL strategies and self-efficacy beliefs in studying English and extended previous findings that these constructs are related to each other and to academic achievement in the context of learning English as a foreign language (Ainley & Patrick, 2006; Paris & Paris, 2001; Schunk, 1996; Shih & Alexander, 2000; Zimmerman, 1998), generalizations to the population of Chinese college students are limited. Participants in this study were all majored in medicine and were predominantly male. In China, medicine studies are open to college students of all ability levels, and the tuition is also the same as in other fields of study. As a result, college students majoring in medicine are not different from college students majoring in other fields with regard to IQ, family background, ability level, and so for. In addition, college graduates majoring in medicine can work as doctors in hospitals immediately after their graduation. Their income is also comparable to other college graduates majoring in other subject areas. However, gender is not balanced in this field as more males than females choose medicine as their major. Future studies should recruit college students in other fields of study and use random sampling method to find a closer match between research participants and the target population.

Another contribution of this study is that it provided further reliability and validity information about the two questionnaires developed in a previous study (Wang & Pape, 2005). The significant relationships between self-efficacy, SRL strategy use, and achievement in learning English are indicators of construct validity for the scores obtained from these questionnaires. QESRLS was designed to measure the total number of SRL strategies used by students (Wang & Pape, 2005). The reliability of scores from some subscales of this measure (e.g., Seeking Social Assistance) was low, which might be related to non-significant findings related to these subscales. Future research should consider validating the scores from subscales of QESRLS.

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Table 1

Descriptive Statistics and Intercorrelation Coefficients of Outcome Measures

	Exam 1	Exam 2	Oral English	SRL Strategies	Self-efficacy
Exam 1 (*n* = 474)	--	.58*	.62*	.13	.38*
Exam 2 (*n* = 505)		--	.45*	.11	.26*
Oral English (*n* = 476)			--	.14	.36*
SRL Strategies (*n* = 501)				--	.52*
Self-Efficacy (*n* = 501)					--
M (*SD)*	66.56 (8.65)	66.58 (12.90)	2.44 (0.99)	1.76 (0.38)	4.62 (0.84)
Range	0-100	0-100	1-4	0-3	1-7

Note. Numbers in parentheses are standard deviations; * $p < .001$.Table 2

Means and Standard Deviations of Each Subscale of Self-Efficacy and SRL Strategies and the Relationships between these Subscales to English Exam Scores

	Alpha	*M*	*SD*	Exam 1	Exam 2	Oral English
Self-Efficacy for Listening	.88	4.33	0.87	.27*	.18*	.29*
Self-Efficacy for Speaking	.92	4.76	0.94	.35*	.26*	.37*
Self-Efficacy for Reading	.88	4.70	0.85	.37*	.26*	.36*
Self-Efficacy for Writing	.89	4.67	0.93	.38*	.24*	.34*
Self-Evaluation	.69	1.86	0.64	.21*	.16*	.21*
Organizing and Transforming	.81	1.61	0.45	-.06	-.06	-.03
Rehearsing and memorizing	.62	1.67	0.50	-.06	-.04	.01
Seeking Social Assistance	.43	1.67	0.62	.08	.04	.06
Persistence with challenges	.64	2.15	0.55	.28*	.24*	.24*
Seeking Opportunities	.81	1.37	0.58	.13	.14	.13
Keeping Records and Monitoring	.34	1.71	0.67	.15	.12	.16*
Self-Consequences	.37	1.85	0.70	.06	-.04	.07
Goal-Setting and Planning	.62	1.80	0.62	.11	.09	.12
Reviewing Records	.48	1.83	0.74	.17*	.07	.14
Interpretation Skills	.86	2.03	0.50	.22*	.20*	.21*

Note. * $p < .001$.

Appendix A: Questionnaire of English Self-regulated Learning Strategies

Notes: Please choose answers from the following study methods according to your actual situation. Please notice that this is not a test, so there are no right or wrong answers. Not all the methods listed here are good methods, and everyone has his/her own methods. We intend to know which methods are those you actually use and the frequency of using them. Please do not write your name, but you should answer all of the questions and write down your student number.

0	1	2	3
I never use it.	I seldom use it.	I use it sometimes.	I often use it.

The Statement of Self-Regulated Learning Strategies				
1. Write down the mistakes I often make in the process of studying English.	0	1	2	3
2. Write an outline before writing English compositions.	0	1	2	3
3. Review English texts I have learned.	0	1	2	3
4. Take notes in English classes.	0	1	2	3
5. Keep reading when I encounter difficulties in English reading.	0	1	2	3
6. Consult teachers when I encounter difficulties in the process of studying English.	0	1	2	3
7. When a friend wants to play with me but I have not finished my homework yet, I do not play until I finish my homework.	0	1	2	3
8. Check my English homework before turning them in.	0	1	2	3
9. I read an English article several times if I don’t understand it at the first time.	0	1	2	3
10. Make a study plan in the process of studying English	0	1	2	3
11. Set a goal to study English.	0	1	2	3
12. I search related documents when I have difficulties in the process of studying English.	0	1	2	3
13. Write an outline after reading an English article.	0	1	2	3
14. Recite English texts in the process of studying English.	0	1	2	3
15. Reward myself when I make a progress in studying English.	0	1	2	3

16. Summarize the main idea of each paragraph when reading.	0	1	2	3
17. Find a quiet place when the environment is disturbing.	0	1	2	3
18. Summarize the theme of an English article when I read it.	0	1	2	3
19. Ask classmates when I have questions in my English study.	0	1	2	3
20. I listen to tape-recorded English several times if I cannot understand it for the first time.	0	1	2	3
21. Pay attention to what pronouns refer to during reading.	0	1	2	3
22. Review the cards of new words in order to memorize them.	0	1	2	3
23. Listen to American or British broadcasts to improve my pronunciation.	0	1	2	3
24. Read texts I have learnt again and again in order to recite them.	0	1	2	3
25. Guess the meaning of new words by considering their contexts.	0	1	2	3
26. Classify news words in order to memorize them.	0	1	2	3
27. Guess what people mean by reading their expressions and movements when watching an English movie.	0	1	2	3
28. Write new words many times in order to memorize the spellings.	0	1	2	3
29. Use sentence patterns just learned to make new sentences for practice.	0	1	2	3
30. Proofread my English composition when I completed writing.	0	1	2	3
31. When I come across a new word which doesn’t hinder my comprehension, I will skip it.	0	1	2	3
32. When I listen to English, I pay attention to the stressed words or phrases in order to comprehend the sentence.	0	1	2	3
33. Use Chinese phrases which are similar to English words in pronunciation to memorize the pronunciation of these words.	0	1	2	3
34. Use the title of an English article to help understand that article.	0	1	2	3
35. When somebody speaks English, I guess what he/she will say according to what he/ she has said.	0	1	2	3
36. When I talk with somebody in English, I pay attention to his/ her expressions to check if he/she can follow me.	0	1	2	3

37. When I read an English article, I imagine the scene described in the article in order to memorize what I have read.	0	1	2	3
38. Make a chart to summarize the grammatical points learned.	0	1	2	3
39. Send emails to friends in English on my initiative.	0	1	2	3
40. Recite similar words altogether.	0	1	2	3
41. Compare the similarities and differences between English and Chinese.	0	1	2	3
42. If I cannot follow somebody's English, I let him speak slowly.	0	1	2	3
43. Read new words repeatedly in order to memorize them.	0	1	2	3
44. Memorize English words whose pronunciations are similar.	0	1	2	3
45. Memorize a new word by memorizing where I learn it.	0	1	2	3
46. Try my best to find opportunities to practice my oral English.	0	1	2	3
47. Consider how to say something in English in my mind before saying it out loud.	0	1	2	3
48. Watch English TV programs on my initiative.	0	1	2	3
49. When I listen to English, I translate it into Chinese to help me understand it.	0	1	2	3
50. Memorize meanings of words by using prefixes and suffixes.	0	1	2	3
51. Review my notes of English class before examinations.	0	1	2	3
52. Listen to English radio programs on my initiative.	0	1	2	3
53. Have a break when I am tired during my English study.	0	1	2	3
54. Try to use various English expressions to express the same meaning.	0	1	2	3
55. Translate what I have read in English into Chinese to help me understand it.	0	1	2	3
56. Pay attention to English speaker's tones.	0	1	2	3
57. Pay attention to the beginning and end of each paragraph in my English reading.	0	1	2	3
58. Adjust my reading speed according to the difficulty of the article.	0	1	2	3

59. Use my background knowledge to comprehend English articles.	0	1	2	3
60. Underline key points during my English reading.	0	1	2	3
61. Point at what I am reading with figures or pens.	0	1	2	3
62. Read questions before reading articles during English reading comprehension examinations.	0	1	2	3
63. Read articles before reading questions during English reading comprehension examinations.	0	1	2	3
64. Make sure to write a topic sentence in each paragraph in writing.	0	1	2	3
65. Make sure that the content of each paragraph supports its topic sentence in English writing.	0	1	2	3
66. When I finish my English composition, I have a rest and then read it again to check whether it should be revised.	0	1	2	3
67. Use words just learned to make new sentences on my initiative.	0	1	2	3
68. Think out a composition in Chinese before writing it in English.	0	1	2	3

Appendix B: English Self-Efficacy Questionnaire

Notes: Please read the following questions carefully and make an accurate evaluation of your current command of English no matter whether you are doing it or not. These questions are designed to measure your judgment of your capabilities, so there are no right or wrong answers. Please do not write your name, but you should answer all of the questions and write down your student number.

Please use the following scales to answer these questions accordingly. Please choose the number accurately representing your capabilities.						
1	2	3	4	5	6	7
I cannot do it at all	I cannot do it.	Maybe I cannot do it.	Maybe I can do it.	I basically can do it.	I can do it.	I can do it well.

1. Can you understand stories told in English?	1	2	3	4	5	6	7
2. Can you finish your homework of English reading independently?	1	2	3	4	5	6	7
3. Can you understand American English TV programs?	1	2	3	4	5	6	7
4. Can you introduce your school in English?	1	2	3	4	5	6	7
5. Can you compose messages in English on the internet (face book, twitter, blogs, etc.)?	1	2	3	4	5	6	7
6. Can you give directions from your classroom to your home in English?	1	2	3	4	5	6	7
7. Can you write English compositions assigned by your teachers?	1	2	3	4	5	6	7
8. Can you tell a story in English?	1	2	3	4	5	6	7
9. Can you understand radio programs in English speaking countries?	1	2	3	4	5	6	7
10. Can you understand English TV programs made in China?	1	2	3	4	5	6	7
11. Can you leave a message to your classmates in English?	1	2	3	4	5	6	7
12. When you read English articles, can you guess the meaning of unknown words?	1	2	3	4	5	6	7
13. Can you make new sentences with the words just learned?	1	2	3	4	5	6	7
14. Can you write email messages in English?	1	2	3	4	5	6	7

15. If your teacher gives you a tape-recorded English dialogue about school life, can you understand it?	1	2	3	4	5	6	7
16. Can you understand the English news on the Internet?	1	2	3	4	5	6	7
17. Can you ask questions to your teachers in English?	1	2	3	4	5	6	7
18. Can you make sentences with English phrases?	1	2	3	4	5	6	7
19. Can you introduce your English teacher in English?	1	2	3	4	5	6	7
20. Can you discuss in English with your classmates some topics in which all of you are interested?	1	2	3	4	5	6	7
21. Can you read English short novels?	1	2	3	4	5	6	7
22. Can you understand English movies without Chinese subtitles?	1	2	3	4	5	6	7
23. Can you answer your teachers' questions in English?	1	2	3	4	5	6	7
24. Can you understand English songs?	1	2	3	4	5	6	7
25. Can you read English newspapers?	1	2	3	4	5	6	7
26. Can you find the meaning of new words by using English-English dictionaries?	1	2	3	4	5	6	7
27. Can you understand numbers spoken in English?	1	2	3	4	5	6	7
28. Can you write diaries in English?	1	2	3	4	5	6	7
29. Can you understand English articles about Chinese culture?	1	2	3	4	5	6	7
30. Can you introduce yourself in English?	1	2	3	4	5	6	7
31. Can you write an article about your English teacher in English?	1	2	3	4	5	6	7
32. Can you understand new lessons in your English book?	1	2	3	4	5	6	7

Correspondence concerning this article should be addressed to: Dr. Chuang Wang, Associate Professor of Educational Research, University of North Carolina at Charlotte; 9201 University City Blvd, Charlotte, NC, 28223, USA. Phone: (704) 687-8708; email: cwang15@uncc.ed

Examining the Relationships Among Classroom Goal Structure, Achievement Goal Orientation, Motivation and Self-regulated Learning for Ethnically Diverse Learners

David Shannon
Jill Salisbury-Glennon
Auburn University

Melanie Shores
University of Alabama at Birmingham

Abstract

The purpose of this study was to explore the learning strategies used by ethnically diverse learners and to investigate the relationships among the constructs of classroom goal structure, achievement goal orientation, motivation and self-regulated learning in an ethnically diverse population of fourth and fifth grade learners (n=396). Goal setting, environmental restructuring, and seeking assistance from adults were described most frequently by this sample of African American and Hispanic elementary students. Correlational analyses revealed moderate positive relationships among the constructs of classroom goal structure, achievement goal orientation, motivation, and self-regulated learning. Further analyses by means of structural equation modeling supported a model depicting positive relationships between classroom goal structure and achievement goal orientation, achievement goal orientation and motivation, and achievement goal orientation and self-regulated learning. Finally, Hispanic students reported higher levels of task structure and task orientation, compared to African American students.

Introduction

Educational reform has mandated that every child be granted the educational opportunities that s/he needs to succeed academically. An unprecedented amount of funding has been allocated through the American Recovery and Reinvestment Act of 2009 (see http://www2.ed.gov/policy/gen/leg/recovery/index.html). This funding sought to encourage competition among states, and to forge partnerships with the private sector to improve the quality of education across our nation. The challenges that today's schools face are immense, and these challenges are especially evident in urban schools. Urban schools serve different demographic student populations than other schools. These ethnically diverse schools include over one-fourth

of all minority students and the largest percentages of non-English speaking students from low-income families. (Council for the Great City Schools, 2010).

While the percentage of students in urban schools who score at or above state proficiency levels has increased in both Reading and Math from 2006 to 2009, this percentage still lags behind state and national averages (Council of the Great City Schools, 2010). Furthermore, the achievement gap between racial and economic groups remains a serious concern in urban schools. The Council of Great City Schools, a coalition of 66 of the nation's largest urban school systems, has demonstrated some success in closing these achievement gaps. Since 2006, the majority of these urban schools (67% in grade 4 and 62% in grade 8) have narrowed the gap between African-American and White students in Math; while 49% and 53% of the urban schools studied narrowed this gap in Reading in grades 4 and 8, respectively (Council of the Great City Schools, 2010). During the same time period, the majority of these urban schools (66% in grades 4 and 69% in grades 8) have also narrowed the gap between Hispanic and White students in Math while 57% and 53% of the urban schools studied narrowed this gap in Reading (Council of the Great City Schools, 2010).

While preliminary research has suggested that there has been some decrease in the achievement gaps among racial and ethnic groups, further inquiry into the factors that contribute to improved performance, particularly among ethnically diverse learners in urban schools is critical to our success as a nation. Prior research into academic learning and achievement suggests that the individual learner variables of achievement goal orientation, personal motivational variables and self-regulated learning can significantly impact academic achievement (Ames & Archer, 1988; Greene & Miller, 1996; Pintrich & De Groot, 1990; Zimmerman & Martinez-Pons, 1990). On a broader level, it has also been demonstrated that the

classroom goal structure may serve to influence individual achievement goal orientation (Greene & Miller, 1996; Author b, 1999; Maehr & Midgley, 1996).

Despite the importance of these findings, much of this research has been conducted with college, high school, or middle school-aged learners and predominantly with subject populations of limited ethnic diversity. Significantly less is known regarding the relationship of these variables to the academic achievement of elementary school learners from ethnically diverse backgrounds in urban educational settings. Thus, the present study sought to provide a model of the complex relations among the factors of classroom goal structure, achievement goal orientation, motivation and self-regulated learning among an ethnically diverse sample of fourth and fifth grade learners. Furthermore, this study explored the strategies used by diverse learners as they approach different learning tasks.

Theoretical Framework

Self-Regulated Learning

The social cognitive theoretical perspectives of self-regulated learning and the achievement goal orientation theories of motivation guided this exploration. Self-regulated learning has been defined and modeled from a variety of theoretical perspectives and frameworks (e.g., Carver & Scheier, 1981; Pintrich, 2000a; Zimmerman, 1989). One of the most commonly used definitions of self-regulated learning identifies the self-regulated learner as one who is behaviorally, metacognitively, and motivationally active in his or her own learning (Zimmerman, 1986; Zimmerman & Martinez-Pons, 1988). Pintrich (2000a) offers a fairly comprehensive definition of self-regulated learning which states that, "self-regulated learning is an active, constructive process by which learners set goals, monitor their learning, control their

cognition, motivation, and behavior, while taking into consideration the relevant features of their learning context and/or environment."

Over the course of the last 15 years, numerous studies have demonstrated the benefits of self-regulated learning to academic performance. Self-regulated learning has been found to be a significant predictor of achievement track [high or low] (Zimmerman and Martinez-Pons, 1986), gifted education (Zimmerman and Martinez-Pons, 1990), college students' assignment to developmental/remedial or regular college admission (Ley & Young, 1998), GPA (Van Zile-Tamsen & Livingston, 1999), academic achievement (Zimmerman and Martinez-Pons, 1988), and academic success (Zimmerman, Bandura, & Martinez-Pons, 1992).

Zimmerman & Martinez-Pons (1990) found that the use of self-regulated learning strategies distinguished highly academically successful (gifted) learners from regular (non-gifted) learners in the fifth, eighth and eleventh grades. In a prior study, Zimmerman and Martinez-Pons (1986) developed a structured interview to assess tenth grade students' use of self-regulated learning strategies. This research demonstrated that tenth grade students from a high achievement track and students from a low achievement track could be distinguished on the basis of their self-regulated learning strategies. More specifically, high achieving students indicated a significantly greater use of 13 out of 14 categories of self-regulated learning strategies. Thus, achievement track could be predicted with a 93% level of accuracy based on the use of self-regulated learning strategies. Somewhat similarly, Pintrich and De Groot (1990) demonstrated that seventh-grade students who were achieving high grades were more likely to report using self-regulated learning strategies than were low achieving students. Thus, the importance of self-regulated learning strategies to academic achievement has been fairly well

established, and has been modeled by a variety of theorists (e.g., Schunk, 1989; Zimmerman, 1989; Zimmerman, 1998).

Achievement Goal Orientation Theories of Motivation

While the use of self-regulated learning strategies is an important variable for academic success, research has further emphasized the importance of motivation to self-regulated learning. For example, in the Zimmerman and Martinez-Pons (1990) study, students' self-efficacy perceptions were related to their use of self-regulated learning strategies. Pintrich and De Groot (1990) demonstrated that students who were high in self-efficacy and intrinsic value were more likely to report the use of cognitive and self-regulatory strategies. In addition to their relationship to strategy use, motivational variables such as intrinsic motivation, self-efficacy, task value, and expectancy for success have also been shown to be positively related to academic achievement. These results provide evidence for the importance of considering both motivational and self-regulated learning variables in models of classroom academic performance (Pintrich and De Groot, 1990).

One group of motivational theories in particular that has been demonstrated to affect students' motivation, cognitive strategy use and self-regulated learning is the achievement goal theories of motivation. Achievement goal orientation theories offer an explanation of the reasons why students engage in academic tasks (see Pintrich, 2000a). The type of goal orientation that the learner has is likely to affect the students' motivation and self-regulated learning strategies. A students' achievement goal orientation may be the result of prior learning experiences, the teacher's goal structure in the classroom, or a combination of these two factors (e.g., Pintrich, 2000a).

While different theorists tend to refer to goal orientations using somewhat different nomenclature, traditionally, most research into achievement goal orientation has suggested two major types: learning or mastery goal orientation, and a performance goal orientation. Students who have a learning, task, or mastery achievement goal orientation are motivated to learn the material because they genuinely want to develop an understanding of the material. These students desire to obtain competence and mastery of the information. In contrast, students who have a performance goal orientation are motivated to perform better than others and to demonstrate their ability to others. Perhaps not surprisingly, research into the effects of these achievement goal orientations has demonstrated many relationships between these goal orientations and affective, motivational, cognitive, and self-regulatory behaviors. Generally, a learning goal orientation has been shown to be positively related to the use of deep-level cognitive strategies, and self-regulated learning, which in turn, may be related to achievement (Greene & Miller, 1996). In contrast, a performance goal orientation may be related to shallow-level cognitive processing, which is negatively related to academic achievement (Greene & Miller, 1996).

The effects of achievement goal orientation on motivation.

Previous research into the effects of achievement goal orientation on motivation and self-regulated learning suggests that adopting mastery or learning goal orientation has positive implications for motivation and self-regulated learning. A number of studies have demonstrated positive relationships between a task goal orientation and such motivational variables as self-efficacy (Anderman & Young, 1994), effort attributions and intrinsic value (Ames, 1992), efficacy and persistence in the face of difficulty (Dweck & Leggett, 1988), and task value (Wolters, Yu, & Pintrich, 1996; as cited in Pintrich, 2000a). Pintrich (2000a) suggests however,

that more research is needed into the causal ordering of these variables, as it is presently unclear whether personal motivational variables lead to achievement goal orientation, or whether achievement goal orientation leads to personal motivation.

The effects of achievement goal orientation on self-regulated learning.

In addition to the relationships between achievement goal orientation and motivation, numerous studies have also demonstrated relationships between achievement goal orientation and cognitive and self-regulated learning strategy use. Meece, Blumenfeld, and Hoyle (1988) found that a task goal orientation was strongly correlated with fifth and sixth grade students' active cognitive engagement. Anderman and Young (1994) demonstrated that task goals were highly correlated with eighth grade students' use of deep level cognitive strategies. Middleton and Midgley (1997) found that sixth grade students' self-reported self-regulated learning was positively correlated with a task goal orientation. Ablard and Lipshultz (1998) administered the Self-regulated Learning Interview Schedule (SRLIS; Zimmerman and Martinez-Pons, 1986) along with the Patterns of Adaptive Learning Survey (PALS; Midgley, Maehr, Hicks, Roeser, Urdan, Anderman, Kaplan, Arunkumar, & Middleton, 1997) to a group of seventh grade high-achieving students. Their results indicated that mastery goal orientation accounted for most of the variance in self-regulated learning.

Wolters et. al., (1996) investigated the achievement goal orientations of seventh and eighth grade students. These students completed an adapted version of the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich, Smith, Garcia, & McKeachie, 1991), which incorporated the subscales of task value, self-efficacy, test anxiety, cognitive strategy use, and self-regulated strategy use. Results of their study showed that a learning goal orientation was positively related to adaptive motivational beliefs and self-regulated learning. In contrast, an

extrinsic goal orientation was negatively related to self-efficacy, task value, self-regulated learning and performance. Achievement goal orientation was the strongest predictor of students' cognitive and self-regulated learning strategies.

Pintrich (2000b) investigated the effects of achievement goal orientation on the motivational, affective, cognitive and performance outcomes of eighth and ninth grade students. To measure these performance outcomes, Pintrich used the Mastery and Performance subscales of the Patterns of Adaptive Learning Survey (PALS; Midgley, Maehr, Hicks, Roeser, Urdan, Anderman, Kaplan, Arunkumar, & Middleton, 1997), along with the following subscales from an adapted version of the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich, Smith, Garcia, & McKeachie, 1991): self-efficacy, task value, test anxiety, cognitive strategies.

Results of his study indicated that the group with the highest self-efficacy was the high mastery/high performance group. This was somewhat contrary to what might be predicted by the normative goal theory, which would have predicted that the high mastery/low performance group would have the highest self-efficacy. As predicted by normative goal theory, students high in mastery goal orientation reported more use of cognitive strategies in all three waves. Students who were high in mastery goal orientation also reported more self-regulation of their cognition in comparison to students who were low in mastery goal orientation. The findings of this study lend support to both normative goal theory as well as a revised perspective on goal orientation, as there was not a significant difference between the high mastery/low performance group and the high mastery/high performance group on the outcome variables of self-efficacy, cognitive strategy use, and metacognitive strategy use.

The effects of perceived classroom goal structure on students' achievement goal orientation.

An individual learner's achievement goal orientation may be further influenced by the goal orientation of the classroom context (e.g., Ames & Archer, 1988; Maehr & Midgley, 1996; Midgley & Urdan, 2001). Teachers who emphasize a learning or mastery goal orientation in their classroom tend to use such practices as collaborative or other forms of group learning, more learner-centered approaches to instruction, an emphasis on effort and improvement, and more authentic, individualized assignments and assessments, such as the use of portfolios. In contrast, teachers who emphasize a performance goal orientation tend to emphasize competition, grades, comparison and performance (see Anderman & Maehr, 1994).

Anderman and Young (1994) found that the use of performance-oriented instructional strategies was related to lower levels of mastery goal orientation in science classrooms. Anderman and Anderman (1999) administered the Patterns of Adaptive Learning Survey (PALS; Midgley, Maehr, Hicks, Roeser, Urdan, Anderman, Kaplan, Arunkumar, & Middleton, 1997) including the perceptions of classroom goal structure subscale. This study supported the findings of the Anderman and Young (1994) study, and demonstrated that students' perceptions of the goal structure in the classroom predicted their personal goal orientations. Roeser, Midgley, and Urdan (1996) showed that eighth grade students' perceptions of a task goal structure in the classroom was positively related to self-efficacy which was mediated through personal task goals. In contrast, perceiving a relative-ability classroom goal structure was negatively related to self-efficacy as mediated through personal task goals. Salisbury-Glennon and Gorrell (1999) found that sixth and seventh grade students in a classroom context that was observed to have a mastery oriented task goal structure demonstrated a significantly greater use of the self-regulated learning strategies of goal-setting and planning, self-evaluation, and seeking social assistance

from adults than sixth and seventh grade students at the same school, but who were in a classroom that was observed to have a performance oriented task goal structure.

The Need to Examine Cultural Differences

The research reviewed thus far has demonstrated that motivation and self-regulated learning strategies are essential for academic success. In addition, achievement goal orientation is related to motivation and the use of self-regulated learning strategies. Further, the perceived classroom goal structure has been shown to be related to the individual learners' achievement goal orientation. The majority of the research into motivation, self-regulated learning and achievement goal orientation has been conducted using predominantly White subject populations. There remains a paucity of research into motivational variables, self-regulated learning and achievement goal orientation among ethnically diverse subject populations, particularly at the elementary level. Thus, the purpose of the present study was to explore the relationships among the constructs of classroom goal structure, achievement goal orientation, motivation, and self-regulated learning among an ethnically diverse sample of fourth and fifth grade learners.

Perry and Weinstein (1998) cite research evidencing a mismatch between the culture of the family and the school at the elementary level. They suggest that this mismatch may explain school and adjustment problems among some children especially racial and ethnic minority students and those who speak limited English (see Skinner, Bryant, Coffman, & Campbell, 1998; as cited in Perry & Weinstein, 1998). For example, the Latino culture has been shown to promote a cooperative learning style that can be discrepant from the often individualistic and competitive nature of many classrooms, particularly those espousing a performance goal orientation. Covington (1992; as cited in Midgley & Urdan, 1995) cites Suarez-Orozco (1989) and Fordham

and Ogbu (1986) who suggest that African American and Hispanic children do not share the same achievement goals as those demonstrated by White middle class children. With regards to self-efficacy, Graham (1994) as well as others has noted that while self-efficacy is critical to academic achievement, it has been inadequately studied among minority students. In her review of the literature on the motivational differences between African American and European American students on such motivational constructs as need for achievement, locus of control, and ability beliefs, she concluded that overall, the differences are not very large. Thus, with regards to motivation there remains a need for further research into the motivation of ethnically diverse populations.

With regards to self-regulated learning, the research into gender and ethnicity differences has also been limited (Pintrich & Zusho, 2002). Pintrich et. al., assert that they "don't know of any study that has methodically investigated differences in ethnic minority student self-regulatory processes." Finally, there is a scarcity of research into the achievement goal orientations of ethnically diverse subject populations. Pintrich and Schunk (2002) assert that "given the importance of goal orientation to a variety of other motivational and cognitive outcomes, we need research that examines goal orientation beliefs and their relations to these outcomes for diverse populations." They further assert that future research using diverse cultures will contribute greatly to the motivation literature as it will help us to develop a broader understanding regarding motivation across cultures and contexts. Thus, the purpose of the present study was to explore strategies used by ethnically diverse students and the relationships among the constructs of classroom goal structure, achievement goal orientation, motivation and self-regulated learning among an ethnically diverse sample of fourth and fifth grade learners.

Methods

Setting. This study was conducted as part of the South Florida Annenberg Challenge, funded as part of the National Annenberg Challenge (Annenberg Challenge, 2006). This Challenge focused on school reform in our nation's schools, predominantly within nine large urban school systems or partnerships. The South Florida Annenberg Challenge included schools from Miami-Dade, Broward, and Palm Beach counties and was funded for $100 million.

Participants. The subjects in this study consisted of 396 fourth and fifth graders from Miami-Dade County. Of these students, 54.7% were female. Forty-one (41.4) percent of these subjects identified themselves as Hispanic American and an additional 28.6% of these subjects identified themselves as African-American. In addition, 9.7% described themselves as White-Non-Hispanic and 9.7% indicated that they were Biracial/Multiethnic. The majority of the participants (64.3%) received a free or reduced lunch. Fifteen percent (15.7%) were born outside of the United States and 64.1% had at least one parent born outside the United States. In over one-third (35.6%) of their homes, English was NOT the primary spoken language.

Procedures. One fourth or fifth grade classroom was randomly selected from each of the 24 participating elementary schools in Miami-Dade County. Surveys were completed during a class period. Six-hundred surveys were distributed to these participating elementary schools and 396 were returned, resulting in a response rate of 66%.

Each elementary student completed a survey instrument that included sections pertaining to their academic and social experiences in school, school climate, family background, and information regarding his/her language arts or math class. The majority of the survey instrument was constructed to gather information about students and their experiences in schools in South Florida so that it could be compared with information gathered at other sites (e.g., Bay Area, Chicago, New York, Los Angeles) participating in the National Annenberg Challenge. Students

were asked to describe their academic experiences in reference to a target class (i.e., language arts or math). This target class was determined randomly so that children with birthdays between January and June were asked to respond in reference to their reading or language arts class while those born between July and December responded in reference to their math class.

Instrumentation. The majority of the survey instrument was constructed to gather information about students and their experiences in schools in South Florida. In addition, the Patterns of Adaptive Learning Survey (PALS; Midgley, Maehr, Hicks, Roeser, Urdan, Anderman, Kaplan, Arunkumar, & Middleton, 1997), and a version of the Motivated Strategies for Learning Questionnaire (MSLQ) used previously with seventh graders (see Pintrich & De Groot, 1990) was included in the section pertaining to students' academic experiences. The final section of the survey instrument was an adaptation of the Self-regulated Learning Interview Schedule (SRLIS; Zimmerman, & Martinez-Pons, 1986).

Four constructs were derived from variables or items on the survey and explored in this study. These constructs included: 1) classroom goal structure, 2) achievement goal orientation, 3) motivation, and 4) self-regulated learning. Goal structure was defined using two subscales, task goal structure (TGS) and performance goal structure (PGS) from the Patterns of Adaptive Learning Survey (PALS). Achievement goal orientation was also defined using subscales from the PALS. These subscales included task goal orientation (TGO), performance-approach goal orientation (PAppGO), and performance-avoid goal orientation (PAvdGO). The construct of Motivation was derived from the subscales of intrinsic motivation (IntMot) and self-efficacy (SelfEff) from the version of the Motivated Strategies for Learning Questionnaire (MSLQ) while the construct of self-regulated learning was drawn from the subscales of cognitive strategies (CogStag) and self-regulation (SelfReg) also from the MSLQ. Additional items were included on

the survey instrument as indicators of students' academic standing and aspirations. Specifically, students were asked whether they had previously received a failing grade in the class, what grade they expected in the current marking period, and what level of education they planned to pursue.

Analysis of Data. The analysis consisted of three primary components. First, responses to each of the eight learning contexts were coded using the self-regulated learning category structure established by Zimmerman, & Martinez-Pons (1986). These responses were coded using 15 different self-regulated learning strategies. For each learning context, the frequency of the use of each strategy use was computed for African American, Hispanic, and White elementary students. Second, Pearson Product Moment Correlations were used to describe the bivariate relationships among the variables used to support the constructs of classroom goal structure, achievement goal orientation, motivation, and self-regulated learning.

Third, the multivariate procedures of structural equation modeling (SEM) and multivariate analysis of variance (MANOVA) were used. SEM was used to examine the relationships among the constructs of goal structure, goal orientation, motivation, and self-regulated learning based on the theories and findings from other research conducted primarily with older and less ethnically diverse subject populations. This model, which included positive relationships between classroom goal structure and achievement goal orientation as well as positive relationships between achievement goal orientation and the constructs of motivation and self-regulated learning, was applied to two groups of elementary students (African American students, and Hispanic students) to determine the comparability of fit across the two groups. The data were examined using AMOS version (4.0) maximum likelihood factor analysis (Arbuckle, 1999). The results were evaluated using several criteria. First, departure of the data from the specified model was tested for significance by using a chi-square test (Joreskog and Sorbom,

1989). Second, goodness-of-fit between the data and the specified model was estimated by employing the Comparative Fit Index (CFI) (Bentler, 1990; Byrne, 1999), the Tucker-Lewis Index (TLI) (Bentler & Bonett, 1980), and the Root Mean Square Error of Approximation (RMSEA) (Browne & Cudeck, 1993). A second multivariate procedure, MANOVA, was used to examine differences among Hispanic, black, and white elementary students on these constructs.

Results

Use of self-regulated strategies

Table 1 summarizes the use of strategies in different learning contexts. Those strategies employed most frequently across the different learning contexts were goal setting and planning, environmental structuring, seeking social assistance from adults, and other strategies (e.g., learning behavior that is initiated by others such as teachers or parents, and any unclear responses). The strategies used least frequently included self-evaluation, seeking information, self-consequences, seeking social assistance from teachers, and reviewing notes and old tests.

Further comparisons between African American and Hispanic students were conducted using the categorical responses outlined by Zimmerman and Martinez-Pons (1986). These comparisons included strategy use (SU), strategy frequency (SF), and strategy consistency (SC). The most basic of these, strategy use (SU), is simply a dichotomous variable of whether each strategy was used (or not used) during any of the learning contexts. The second comparison, strategy frequency (SF), indicates the number of times each strategy was used. Finally, strategy consistency (SC) is a weighted strategy use procedure. Specifically, each student was asked to indicate how consistently he/she used each strategy using a four-point scales (1=hardly ever, 2= sometimes, 3 = lots of times, 4 = most times). Because of the limited response regarding

consistency of strategy use, further analyses were conducted using SU and SF. Table 2 summarizes strategy use and strategy frequency for each strategy for African American and Hispanic students.

The strategy used most frequently by both groups of students was goal setting and planning, used by 76% of the African American sample and 67% of Hispanic students. The second and third most frequently used strategies were environmental structuring (48% of each group) and seeking assistance from adults (36% for African Americans and 48% for Hispanics). After these three strategies, some differences between the groups emerged. Specifically, African American students were more likely to report the use of self-consequences and seeking information while Hispanic students more frequently reported the use of rehearsing and memorizing, reviewing tests, reviewing text, and organizing and transforming. Both groups reported little use of self-evaluation, reviewing notes, and seeking assistance from the teacher.

Relationships Between Goal Structure, Goal Orientation, Motivation, and Self-Regulated Learning

Table 3 summarizes the reliability estimates for each of the measured constructs in this study as well as the relationships among these constructs. The reliability estimates, reported in the diagonal of the correlational matrix, are supportive ranging from .544 to .883, with a median of .810. More specifically, the reliability estimates for the five PALS scales ranged from .544 for the Performance Goal Structure scale to .867 for the Task Goal Structure scale with a median of .805 for the five PALS scales used in this study. Furthermore, estimates for the four MSLQ scales used in this study ranged from .770 (Self-Regulation) to .883 (Cognitive Strategies) with a

median of .869. These reliabilities are consistent with those cited by the original developers of these instruments (Midgley et al., 1997; Pintrich & De Groot, 1990).

Overall, there were moderate positive relationships among the measures of classroom goal structure, achievement goal orientation, motivation, and self-regulated learning. Specifically, those students perceiving a task goal structure in their classroom were more likely to report a higher individual task goal orientation. On the other hand, those students perceiving a higher performance goal structure were more likely to report a performance avoidance goal orientation. Furthermore, students indicating higher perceived task goal structures and task goal orientation scores also reported higher levels of intrinsic motivation, self-efficacy, cognitive strategies, and self-regulatory behavior.

Relationships among these constructs and previous academic failure, expected grade, and plans to attend college were also found. Specifically, measures of self-regulation and motivation correlated negatively with previous academic failure and positively with expected grade. In addition, those students having a greater tendency to have a task goal orientation are less likely to have failed and expected a higher grade in their current language arts or math class. The restricted nature of relationships with academic failure may, at least in part, be influenced by the limited variability of failure in this sample as only 102 students (25.8%) reported failing at least one subject or course during the year in which the study was conducted.

Overall, expected current performance was very positive as nearly half (49.7%) of the sample expected an A while an additional 34% expected a B. Finally, slightly over half of the subjects (56.4%) indicated that they planned to attend college. Only one statistically significant correlation was found with plans to attend college; those students with higher levels of self-efficacy were more likely to indicate plans to attend college.

Structural Model

To further investigate the relationships among the constructs of classroom goal structure, achievement goal orientation, motivation, and self-regulated learning, a structural equation modeling approach was used (see Figure 1). Specifically, a series of two-group confirmatory factor analyses (CFA's) was performed to examine the similarity of the factor structure across the two ethnic groups. An initial model was tested allowing all paths to vary while a second model constrained each path to be equal for the two groups (i.e., black and Hispanic elementary students). When the path coefficients were constrained to be equal, a CFI of .979, TLI of .969, RMSEA of .097 resulted. The constrained model did not statistically differ from the initial unconstrained model ($\chi^2_{\text{difference}} = 14.72$ $p = .07$, indicating that the measured variables correlated with their respective constructs and the correlation among the constructs were consistent for the two groups of students

All path coefficients were statistically significant ($p < .05$). Furthermore, all indicator path coefficients were statistically significant ($p < .01$). These results support several theorized relationships. Specifically, strong significant positive relationships between perceived classroom goal structure and achievement goal orientation, achievement goal orientation and motivation, and achievement goal orientation and self-regulated learning were found. Correlations among these constructs were strong for each group of elementary students with all standardized path coefficients exceeding .75 and in excess of 50% of each construct explained through these multiple correlations.

Multivariate Differences Among Ethnically Diverse Elementary Students

The results from multivariate comparisons are summarized in Table 4. The overall multivariate test of significance resulted in a Wilks' Lambda of .766, $p < .001$. Follow-up

univariate F tests identified group differences on four of the twelve examined scales. Three of these scales were from the PALS (task goal structure, performance goal structure, task goal orientation) while one was drawn from the MSLQ (test anxiety). Post-hoc comparisons among the three groups of students revealed that Hispanic students responded with higher levels of task goal structure and task goal orientation than African American students. Hispanic students also responded with higher levels of performance goal structure than White students. Finally, Hispanic students exhibited a greater degree of test anxiety than White students.

Discussion

While recent educational reform has been enacted to help every child to succeed, many elementary children are simply not succeeding. Further, research has suggested that there may be an achievement gap between White elementary students and their African American and Hispanic counterparts. This gap may be further compounded by the fact that many teachers do not feel adequately prepared to work with ethnically diverse learners.

The present study sought to investigate the relationships among factors that relate to the perceived academic achievement of an ethnically diverse population of fourth and fifth grade learners. The results of our exploratory analyses supported our hypothesized relationships among the constructs of classroom goal structure, achievement goal orientation, motivation and self-regulated learning. Specifically, structural equation modeling supported our theoretical predictions asserting a positive relationship between classroom goal structure and the learners' achievement goal orientation. This result suggests that elementary students who perceived their classroom to have a task goal structure were more likely to adopt an individual task goal orientation. In contrast, fourth and fifth grade students who perceived their classroom to have a performance goal structure were more likely to adopt a performance goal orientation.

The structural model also supported our theoretical prediction asserting a positive relationship between the individual learners' achievement goal orientation and motivation and self-regulated learning strategies. Ethnically diverse fourth and fifth grade learners who perceived their classrooms to have a task goal structure were more likely to adopt a task goal orientation. Further, these students reported higher levels of intrinsic motivation and self-efficacy as well as a greater use of cognitive and self-regulated learning strategies. The results of the present study corroborate the findings of previous research conducted with primarily White middle school learners (e.g., Ablard & Lipschultz, 1999; Anderman & Young, 1994; Wolters et al., 1996), and fifth and sixth grade learners (e.g., Turner, Thorpe, & Meyer, 1998) and extend these findings to an ethnically diverse sample of fourth and fifth grade learners. In the present study, students were primarily Hispanic American, African American or Biracial/Multiethnic.

Practical Implications

The results of the present study suggest implications for teachers to help ethnically diverse elementary school-aged learners to succeed academically. A perceived task goal structure was positively associated with a personal task goal orientation and a personal task goal orientation was further positively related to motivation and self-regulated learning strategies. These results suggest that elementary teachers should strive to foster a task or mastery classroom goal structure in their classrooms. Since less than 20% of teachers feel prepared to meet the needs of today's ethnically diverse learners (United States Department of Education, as cited in http://www.whitehouse.gov/infocus/education; 2006), fostering a task or mastery classroom goal structure may serve as one vehicle to helping these students to achieve academically.

Researchers have articulated a model of teacher practices that can help to promote a task goal structure in their classrooms. This model has been commonly referred to as the TARGET

model (see Ames, 1992; Ames & Archer, 1988; Maehr & Anderman, 1993; Maehr & Midgley, 1991; Midgley & Urdan, 1992). This model suggests seven dimensions of the classroom context that instructors can develop to foster a task goal structure in their classrooms. These dimensions include: tasks, autonomy, recognition, grouping, evaluation, and time (Ames, 1992; Ames & Archer, 1988; Maehr & Midgley, 1996; Midgley & Urdan, 1992). Based on the TARGET model and the results of the aforementioned research, it is suggested here that elementary school teachers can foster a task goal structure in their classrooms by: providing a variety of challenging, meaningful, and intrinsically motivating tasks; by providing opportunities for students to develop autonomy and responsibility by choosing and planning their own work; by providing opportunities for grouping and collaboration; by using forms of evaluation which focus on individual effort and improvement such as portfolio assessment; and by providing some flexibility with regards to time constraints.

Limitations of the Study

First, many prior studies have used student learning outcomes or student achievement as the dependent variable. Since we were unable to obtain student achievement information from student records, we were unable to link motivation and self-regulated learning to actual school achievement. In the present study, perceived academic performance was assessed through three survey questions which asked students to indicate: a) whether they had failed a course in the past year, b) what grade they expected to earn in their present class, and c) whether they planned to attend college. It is possible that all fourth and fifth grade learners do not have the metacognitive ability to accurately predict the grade they expected to earn in their present class. Therefore, these predictions regarding future plans should be cautiously reviewed. To further explore and validate the relationship between self-regulated learning and academic performance, additional

research is needed using actual academic performance indicators such as standardized test scores and classroom performance. However, due to the restricted access to such academic performance data, researchers also need to continue to explore and refine the measurement of this construct through proxy variables such as, but not limited to, those used in this study.

Second, our subject population was an ethnically diverse sample of fourth and fifth grade students from a large urban school system. Previous research examining the relationships among the constructs of goal structure, goal orientation, motivation, and self-regulation has been largely restricted to older, less diverse populations. Therefore, the results of the present study may not be generalizable to those populations typically examined in the field. However, this also demonstrates the need to broaden the population base in future research efforts to reflect the increasing diversity of the student populations in our schools.

Finally, this study explored relationships among the constructs of goal structure, goal orientation, motivation, and self-regulated learning using student-reported data regarding these constructs. There remains a need for additional experimental, mixed methodological studies to further investigate the relationships among these constructs. Such efforts should incorporate data from not just students, but from teachers and observers of diverse classrooms in an effort to more thoroughly examine the relationships among classroom goal structure, achievement goal orientation, motivation and self-regulated learning and their impact on academic achievement.

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Table 1
Strategies used in Eight Different Learning Contexts

	Learning Contexts							
Strategy Used	A1 (n=102)	A2 (n=76)	A3 (n=73)	A4 (n=72)	B1 (n=152)	B2 (n=128)	B3 (n=116)	B4 (n=90)
Self-evaluation	5	3	3	0	3	1	0	1
Organizing and transforming	4	0	0	2	4	5	9	**26**
Goal-setting and planning	13	**20**	12	2	14	4	**61**	**26**
Seeking information	9	0	2	2	8	3	1	8
Keeping records and monitoring	3	1	1	**31**	1	0	2	5
Environmental structuring	6	5	**23**	2	**71**	0	3	1
Self-consequences	0	0	4	1	0	0	1	1
Rehearsing and memorizing	**20**	12	2	12	0	3	1	1
Seeking assistance – peers	2	0	6	2	4	18	2	0
Seeking assistance – teachers	0	0	0	1	0	11	1	1
Seeking assistance – adults	3	1	5	0	8	**50**	4	1
Reviewing records – tests	4	7	0	0	1	1	0	0
Reviewing records – notes	9	4	0	3	1	0	0	1
Reviewing records – textbooks	9	7	0	2	5	1	1	0
Other	**15**	**16**	**15**	12	32	31	30	18

Learning Contexts: A1 – Preparing for a test A2 – Taking a test A3 – Motivating yourself to study at home A4 – Remember information from class B1 – Completing homework assignments B2 – Need help on an assignment B3 – Deciding what homework to do first B4 – Planning and writing a 3-5 page paper								

Table 2
Summary of Strategy Use, Strategy Frequency, and Strategy Consistency

	African Americans (n=25)		Hispanic (n=64)	
	SU	SF	SU	SF
Strategy				
1. Self-evaluation	.04	.04	.08	.09
2. Organizing and transforming	.16	.20	.28	.28
3. Goal-seeking and planning	.76	1.08	.67	.91
4. Seeking information	.28	.44	.14	.16
5. Keeping records and monitoring	.24	.24	.23	.27
6. Environmental structuring	.48	.48	.48	.48
7. Self-consequences*	.12	.12	.02	.02
8. Rehearsing and memorizing**	.04	.04	.19	.20
9. Seeking assistance – peers	.16	.16	.13	.13
10. Seeking assistance – teacher	.08	.08	.03	.05
11. Seeking assistance – adults	.36	.40	.48	.50
12. Reviewing tests**	.00	.00	.09	.11
13. Reviewing notes	.08	.12	.08	.08
14. Reviewing text	.04	.04	.13	.14
Total *2.9* *3.64*		*3.03* *3.42*		
15. Other	.36	.56	.36	.67

* indicates a significantly higher use by African American students
** indicates a significantly higher use by Hispanic students

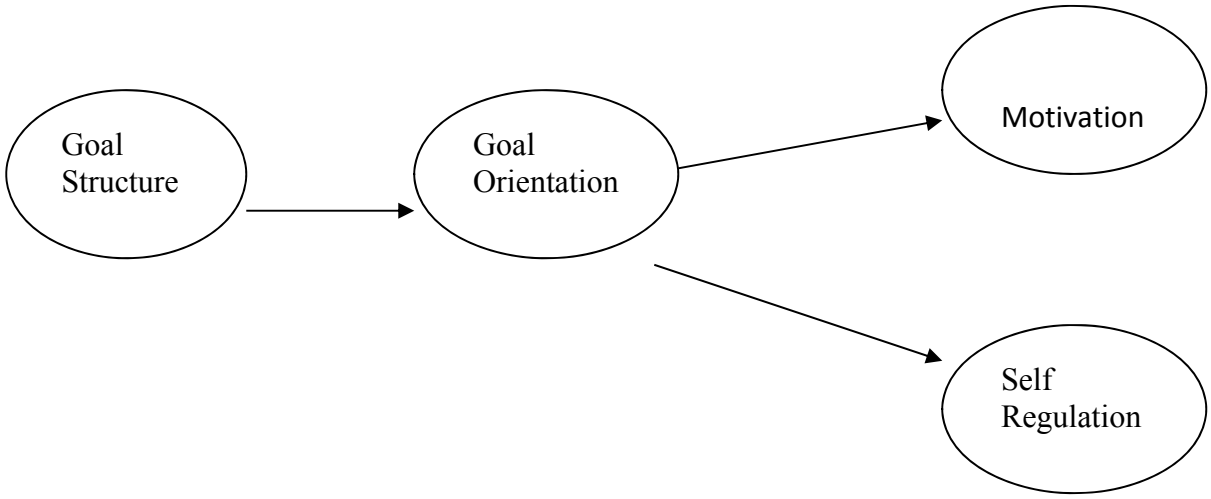
Table 3 – Summary of Correlations and Reliabilities												
	TGS	PGS	TGO	PAppGO	PAvdGO	IntMot	SelfEff	CogStrag	SelfReg	Fail	ExpGrd	College
Goal Structure												
Task (**TGS**)	**.867**	.355***	.582***	.331***	.132*	.568***	.511***	.613***	.564***	-.163*	.143*	.006
Performance (**PGS**)		**.544**	.289***	.413***	.398***	.298***	.302***	.442***	.435***	-.063	.048	.095
Goal Orientation												
Task (**TGO**)			**.810**	.430***	.284***	.706***	.585***	.663***	.592***	-.134*	.140*	.062
Performance Approach (**PAppGO**)				**.805**	.603***	.424***	.430***	.462***	.424***	.008	.091	.002
Performance Avoid (**PAvdGO**)					**.767**	.268***	.195*	.323***	.401***	.047	-.077	-.128
Motivation												
Intrinsic (**IntMot**)						**.860**	.809***	.642***	.574***	-.150**	.233**	.091
Self-Efficacy (**SelfEff**)							**.878**	.601***	.539***	-.231***	.404***	.143*
Self-Regulation												
Cognitive Strategies (**CogStrag**)								**.883**	.852***	-.193**	.233**	.045
Self-Regulation (**SelfReg**)									**.770**	-.177**	.169*	.007
Academic Indicators												
Previous Failure (Fail)										X	-.290**	.093
Expected Grade											X	.290**
College Plans												X

Table 4

Summary of Multivariate Comparisons Among Black, Hispanic, and White Elementary Students

	Black	Hispanic	White	
	Mean (SD)	Mean (SD)	Mean (SD)	F
Post-hoc results				
PALS Scales				
Task Goal Structure	3.29 (1.12)	4.01 (.95)	3.96 (.90)	
11.66*** Hispanic and White > Black				
Performance Goal Structure	2.99 (.99)	3.02 (1.26)	2.37 (.92)	3.35*
Hispanic > White				
Task Goal Orientation	3.40 (1.05)	3.78 (1.01)	3.78 (1.05)	3.15*
Hispanic > Black				
Performance Approach Goal Orientation	3.49 (1.02)	3.51 (1.06)	3.49 (1.07)	.01
Performance Avoid Goal Orientation	3.16 (1.08)	3.08 (1.14)	2.59 (.89)	2.40
Academic Efficacy	3.61 (.90)	3.89 (.84)	3.86 (.59)	2.59
Cultural Dissonance	2.69 (1.13)	2.39 (.98)	2.39 (1.07)	1.93
MSLQ Scales				
Self-Efficacy	3.75 (1.10)	3.95 (.83)	3.94 (.64)	1.21
Intrinsic Motivation	3.81 (1.05)	4.09 (.80)	3.95 (.72)	2.31
Test Anxiety	2.29 (.89)	2.53 (.99)	1.93 (.84)	4.30*
Hispanic > White				
Cognitive Strategies	3.19 (.87)	3.43 (.78)	3.33 (.72)	1.98
Self-Regulation	3.23 (.62)	3.41 (.66)	3.44 (.66)	1.87

NOTE: Wilks' Lambda of .766, $p < .001$.



Comparison of Models

	Default Model	Constrained Model
Chi-Square (df)	169.42 (48)	184.14 (56)
CFI	.980	.979
RMSEA	.107	.097

Path coefficients reported below are from constrained model

	Black	Hispanic
Goal Structure → Goal Orientation	.79***	.75***
Goal Orientation → Self-Regulation	.86***	.79***
Goal Orientation → Motivation	.88***	.86***

* p < .05 ** p < .01 *** p < .001

Figure 1 –
Structural Model of relationships among goal structure, goal orientation, motivation and self-regulation

Correspondence concerning this article should be addressed to:
David M. Shannon, 4036 Haley Center, Auburn University, AL 36849
shanndm@auburn.edu, 334-844-3071

The complexities of teaching prime decomposition and multiplicative structure with tools to preservice elementary teachers

Terri L. Kurz
Arizona State University, Polytechnic

Jorge Garcia
California State University, Channel Islands

Abstract:

Preservice elementary teachers often struggle with prime decomposition and other mathematical topics that correlate with number theory. This paper provides a framework for integrating prime factor tiles into their curriculum with a particular emphasis on prime decomposition. Using this framework, preservice teachers explored and evaluated numbers using prime factor tiles. The results of the exploratory inquiry showed that preservice teachers made some progress in their understanding of prime decomposition after exploring with the tools. However, they struggled with problems requiring the application of prime decomposition. More time to delve into this topic is probably needed in order to observe further gains.

Introduction

Prime decomposition is an important skill for preservice teachers to have as it connects to many different areas of mathematics including Fundamental Theorem of Arithmetic, Modular Arithmetic, Group Theory, Galois Theory and Number Theory among others. Unfortunately, prime decomposition and number theory are often ignored in relation to research (Zazkis, 2000; Zazkis & Campbell, 1996; Zazkis & Liljedahl, 2004).

Prime decomposition can be described as the multiplicative decomposition of numbers into their prime number components. Oftentimes, prime decomposition is presumed as difficult (Lenstra, 2000). Although presumed difficult, it is an important concept starting with third through fifth grade *Standards*. Students in these grades should “recognize equivalent

representations for the same number and generate them by decomposing and composing numbers" (NCTM, 2000, p. 148). At the sixth through eighth grade *Standards*, students should "use factors, multiples, prime factorization, and relatively prime numbers to solve problems" (NCTM, 2000, p. 214). Because of this emphasis, it is imperative that preservice teachers have a robust awareness of prime decomposition and can work interchangeably between factors and the numbers they produce. It is important to help preservice teachers become exposed to some of the richness of prime decomposition and divisibility notions (Brown, 1968).

A common method for teaching prime decomposition involves the formation of factor trees (Griffiths, 2010) (see Figure 1). Factor trees help students visualize the multiplicative breakdown of a number but do little else in relation to the development of the concept. Preservice teachers can usually perform the procedure of creating a factor tree. When they have to apply the yielded factor tree in a context or work backward from the factors, difficulties often result (Zazkis, 1999; Zazkis & Liljedahl, 2004).

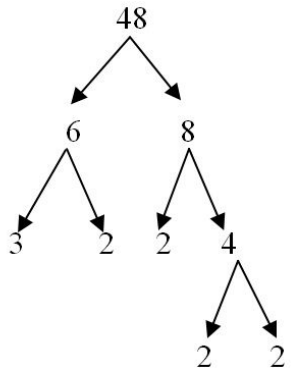


Figure 1. A demonstration of the typical prime factor tree format.

To address this, an alternative method to teach prime decomposition was developed (Kurz & Garcia, 2010; 2012). Using tiles, students decompose numbers to their prime factors. These prime numbers can then be used in a number of ways such as discovering the uniqueness of prime decomposition, simplifying fractions, finding the greatest common factor (GCF),

finding the least common multiple (LCM), finding all factors and identifying roots. The purpose of this paper is to describe methods for teaching prime decomposition using tools and then present the findings of an inquiry that investigated preservice teachers' knowledge after exposure to the prime factor tiles. First, an explanation of prime decomposition along with preservice teachers' difficulties with the topic is described. Then, an alternative method for teaching prime decomposition using tools is explained with supportive lesson ideas. Preservice teachers explored these lessons using the tools. The following question was investigated: How did exposure to prime factor tiles influence preservice teachers' understanding of prime decomposition? Recommendations for teaching prime decomposition based on the results are provided.

Prime Decomposition

For preservice teachers, there seems to be real difficulty with understanding and applying prime decomposition in relation to factors (Zazkis, 1999). Several studies have outlined preservice teachers' difficulties. Zazkis and Liljedahl (2004) found that preservice teachers were able to define (or explain) what makes a number prime. Greater difficulty resulted when preservice teachers were asked to implement their knowledge of prime. Once they had to apply reasoning, the preservice teachers were unsuccessful (for the most part). Their understanding of primes was incomplete or inconsistent and focused primarily on the algorithm.

In another study, Zazkis and Campbell (1996) conducted research after the preservice teachers concluded their lessons on number theory. They found that preservice teachers demonstrated misunderstandings and misconceptions about divisibility and factors. They relied on procedural algorithms rather than applying logic and reasoning to determine divisibility. They

concluded, “insufficient pedagogical emphasis has been placed on developing an understanding of the most basic and elementary concepts of arithmetic” (p. 562).

Bolte (1999) used concept maps to help preservice teachers voice their understanding of 20 terms related to number theory such as factor, prime, composite, prime factorization, multiple, divisible and other terms. In her analysis of two specific cases, one preservice teacher was able to use the concept map to show depth in relation to number theory. The participant was fluent in her connections and properly demonstrated the interconnectedness of the terms. Another participant created a weak map that showed superficial understanding of the interconnectedness of the 20 number theory terms. While Bolte specifically focused on concept maps, the showcased maps and supportive essays provide insight into preservice teachers’ connections and misconceptions regarding number theory.

With the documented difficulties preservice teachers have in relation to prime decomposition, it is important that they are provided with opportunities to explore number theory concepts. Alternative methods to teach prime decomposition using tools with an emphasis on discovering the meaning of number theory terms are illustrated. The goal was to implement tools to support preservice teachers’ conceptual understanding of prime decomposition so that they could better understand the multiplicative structure of numbers.

Investigative Ideas

Prime factor tiles were developed as an alternative method to teach prime decomposition with the goal of implementing the tools. These lessons go beyond the drill aspect of mathematics and instead focus on sense making and reasoning as is recommending in a reform-based curriculum (Cooney, 1999). Prime factor tiles are tiles with a specific prime number written on each tile. In order to build all primes and composites equal or less than 102, the tiles should

contain the following numbers: 2^6, 3^6, 5^4, 7^3, 11^2, 13^2, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97 and 101. Other composites beyond 102 are possible. The tiles can be easily made in two ways. The tiles can be printed on cardstock, see Kurz and Garcia (2010) for the template. Using inch-flats, a permanent maker and blank stickers, a more permanent set of factor tiles can be made.

Exploring the Fundamental Theorem of Arithmetic

The Fundamental Theorem of Arithmetic assures that the prime decomposition of a given number is unique. The instructor gives a number to the class and asks the students to find the prime decomposition using the prime factor tiles. Call on a student and ask what did you get? Call on another student and ask what did you get? Repeat this process for a few more students. All students should have the same result. Repeat this process whole class with several more numbers. Ask, can two students have different prime factor tiles that equal the same number? Can they have tiles that are a little different? Why not? How can we explain what we discovered? What does this mean?

Simplifying fractions

Prime factor tiles can be used to simplify fractions. A fraction is given to the students, perhaps 24/42. A large fraction bar is drawn. The student decomposes the numerator and denominator into a product of primes using the tiles. Then, the student places the corresponding tiles above and below the fraction bar (see Figure 2). The student continues removing any shared tiles until there are no further common tiles to remove. By multiplying the numbers in the numerator and denominator, the student finds the simplified fraction. What happens when a common tile is removed from both the numerator and the denominator? What does that process do to the fraction? Is the value of the fraction the same once the common tile has been removed?

Explain. Can you create a fraction with no common tiles? Can you create a fraction with at least three prime factor tiles for both the numerator and denominator with no common tiles? Can you create a fraction with at least three prime factor tiles located in the numerator and four prime tiles located in the denominator that simplifies yielding a 1 in the numerator? Explain your process.

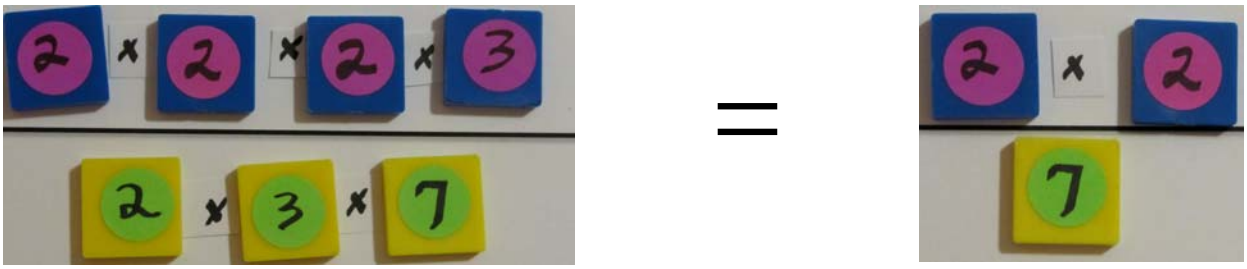


Figure 2. Prime factor tiles demonstrating fraction simplification.

Finding the GCF and the LCM

Two numbers are given, possibly 48 and 72. The student finds the prime decomposition of the given numbers using the prime factor tiles. A Venn diagram consisting of two circles that overlap is made. Prime factor tiles that correspond to the first number (48) are placed in one circle. The prime factor tiles that correspond to the second number (72) are placed in the other circle. If a prime factor tile is common to both numbers, the student picks up the tile from both circles and places one of the tiles in the overlapping section of the Venn diagram. The second duplicate tile is discarded. The overlapping circles demonstrate that both numbers share that prime tile in their prime decomposition (see Figure 3). The student continues to identify more common prime factor tiles and repeats the procedure if applicable. If a prime factor tile is not common, it remains in the circle of the Venn diagram corresponding to that number. Tell the student that the GCF is 24. How can the Venn diagram be used to find the GCF? How would you define GCF? The student can discover that when multiplying all of the numbers in the overlapping portion of the Venn, the GCF will result. What happens when all of the numbers in

both circles are multiplied? What does that number represent? The student can find the LCM by multiplying all the prime factor tiles available in all the circles including the overlap. What would a Venn have to look like to yield a smaller LCM? What would a Venn have to look like to yield a large LCM? How do the numbers in the circles impact the size of the GCF and LCM? Can you build a Venn that has all of the prime factor tiles of one number in the overlapping portion of the Venn? What two numbers below 100 have the most factors in common? Build the Venn to show the breakdown of these two numbers.

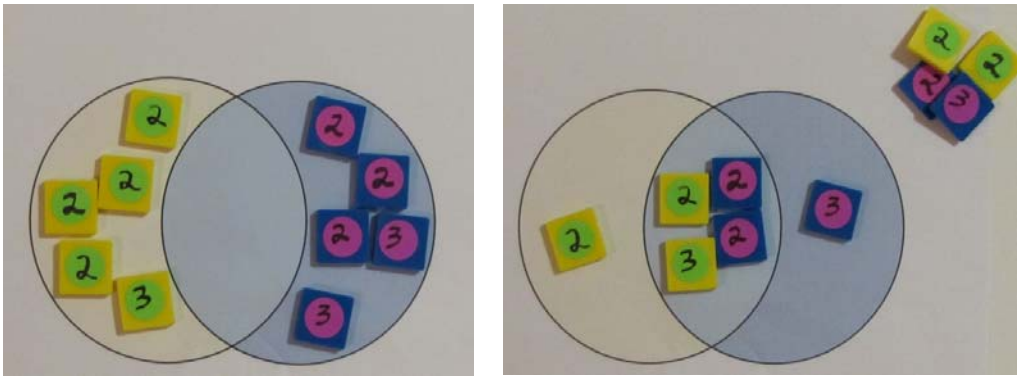


Figure 3. Venn diagrams demonstrating 48 and 72. Students may need to build the first diagram to yield the proper second diagram.

The previous activity can be generalized to three numbers. First, a Venn diagram with three circles is created. In the triple overlapping section, place a prime factor tiles that are common to the three given numbers (the two other tiles are discarded). This will yield the GCF for all three numbers. If a prime factor tile is only common to two numbers, we place that tile in the overlapping section of those two numbers. All of the prime factor tiles are then multiplied to find the LCM. Students can then investigate what the Venn represents where two circles overlap.

Finding all the factors

The student is given a number to decompose, 30 for example. The prime factor tiles that yield 30 are 2, 3, and 5. Using the prime factors, all the factors of a given number can be found.

Ask the student to place the numbers into two distinct groups (one of the groups might even be empty). The student then multiplies all the numbers in each group and records the results. The student continues this process until all distinct groups are found. The recorded results yield the factors of the given number (see figure 4). How many different groups of numbers can the student make? What do these numbers represent? Can you make a number with 10 factors? How about 9 factors? What kinds of numbers yield the least amount of factors? 20 is decomposed into 2x2x5 and 30 is decomposed into 2x3x5. Both numbers have 3 prime factors. Do 20 and 30 have the same number of factors? Why is that? What influences the number of factors a number has?

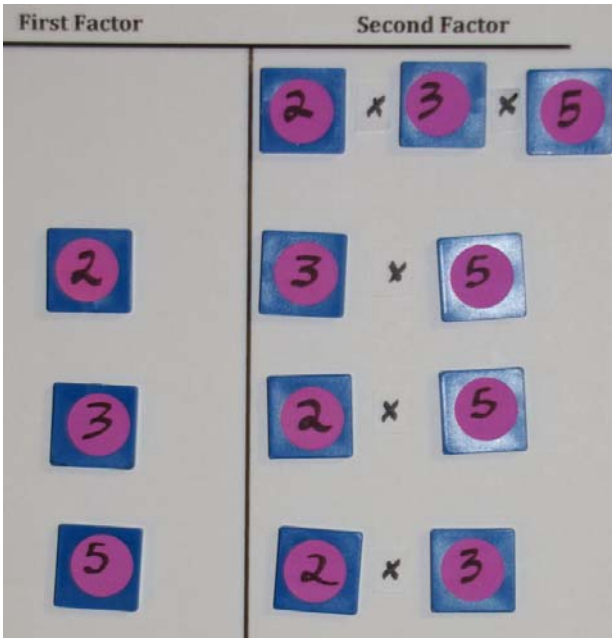


Figure 4. The factor groups that yield all the factors of 30 are shown.

Recognizing squares, cubes and roots

The student is given a perfect square (1,764) but not told the number is a perfect square (see Figure 5). The student finds the prime decomposition using the prime factor tiles. The student is asked to arrange all the prime factor tiles into two identical groups. Is this possible? What does this mean? If the student multiplies the tiles of the first group and records this

number, the student will then discover that the number is a perfect square. What is the relationship between the recorded number and the original given number?

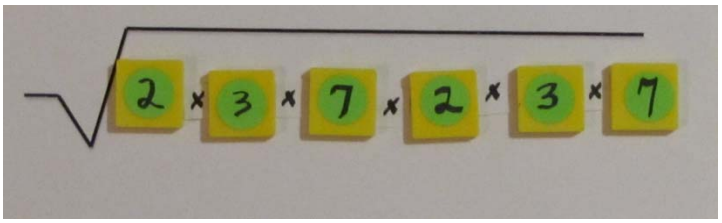


Figure 5. The square root representation of 1,764 is shown.

The instructor gives provides another number (not a perfect square) and asks the student to repeat the activity. Why couldn't the student separate the tiles into two identical groups? Based on your findings, when is a number a perfect square? When the number is a perfect square, how can the square root be determined using the prime factor tiles? This activity can be generalized for perfect cubes. How can a perfect cube be identified from the prime decomposition? How do we find the cubic root?

The same idea can carry over to finding simplified roots of numbers that are not perfect squares or cubes. For example the $\sqrt{180}$ can be investigated using prime factor tiles. Students can build the prime decomposition of 180 (2x2x3x3x5). How can $\sqrt{180}$ be simplified? What would the rewritten root look like? It can be rewritten as $6\sqrt{5}$.

Methodology

Participants

The prime factor tiles were used with preservice teachers in a *Mathematics for Elementary School Teachers* course. The preservice teachers had not yet entered the pedagogical portion of their program; they had not been exposed to educational theory. Data were gathered from ten preservice teachers; nine were female.

Procedure

Preservice teachers engaged in several activities over two class meetings (1 hour 15 minutes each) to help guide their understanding of prime decomposition supported by the use of prime factor tiles. Four distinct topics were examined: defining prime and composite numbers, explorations involving factors, using Venn diagrams to find the GCF and LCM, and application questions (discussed whole class). Observational notes were taken during and after all classroom interactions. In addition, data were collected from the written responses of the participants. During the third meeting, they completed an individual assessment encompassing prime decomposition concepts.

Defining prime and composite numbers

They were asked to develop the meaning of the terms prime and composite after prime decomposing fifteen different numbers using prime factor tiles. They put the numbers that were decomposed into two distinct categories and provided a description. They were then asked to describe where the number 1 fit in terms of their generated definitions. (See Kurz and Garcia (2010) for the specific activity.)

Investigative Explorations

Next, they investigated various explorations using prime factor tiles. For example, find (Kurz & Garcia, 2010, p. 259):

- Two numbers that share the factors 2, 3, 4 and 5. Find the smallest number that has all four factors
- A number that is even and has factors of 17 and 41

- The smallest number that has 3 and 11 as factors; to find it, multiply the two numbers. To find the smallest number that has 3 and 12 as factors, you cannot multiply the two numbers (it would not result in the smallest number possible). Why not?

Using Venn diagrams for finding the GCF and LCM

Preservice teachers used Venn diagrams to develop a method of finding the GCF and LCM of two numbers. Using the prime factor tiles, they built the prime decomposition of 48 and 72. Then, they were supplied with overlapping circles and asked how the tiles would be properly placed in the circles. After the tiles were placed, they were asked to find a method using Venn diagrams that would lead to the GCF and LCM. They worked through several examples to test their conjectures.

Application questions

The next set of questions was designed specifically to observe whether the preservice teachers could apply some of the knowledge they gained in the investigations/lessons. These problems generally give preservice teachers difficulty (Zazkis & Campbell 1996). They examined the following questions (Zazkis & Campbell, 1996, p. 542):

- Consider the number $M=3^3 \times 5 \times 7$
- Is M divisible by 7? Explain
- Is M divisible by 5, 2, 9, 63, 11, 15? Explain.

The questions were analyzed whole class. Algorithmic methods were discussed (dividing) along with reasoning techniques.

Individual assessments

During the next course meeting, the preservice teachers completed an individual assessment. Using a calculator and/or tools, these questions were designed to provide an

opportunity to apply prime decompositions techniques to new and previously explored examples. They answered the following questions:

1. Tell whether 97 is prime, composite or neither.
2. Tell whether 1 is prime, composite or neither.
3. Find the prime factorization of 1002 and 1002^2.
4. True or False. "If a number is divisible by 6, then it is divisible by 2 and 3." (Billstein, Libeskind & Lott, 2010, p. 297)
5. True or False. "If a number is divisible by 2 and 4 then it is divisible by 8." (Billstein, Libeskind & Lott, 2010, p. 297)
6. "Find the least divisible number by each natural number less than or equal to 12." (Billstein, Libeskind & Lott, 2010, p. 312)
7. Find the GCF and LCM of 400 and 75.
8. Find the GCF and LCM of *abc* and *bcd*.
9. True or False. 5 is a multiple of 25.

Because these questions were not specifically discussed in class (other than problem 2), the researchers wanted to determine whether or not the preservice teachers could apply the reasoning techniques explored in class to different questions addressing very similar mathematical ideas.

Results and Discussion

Initial Classroom Interactions

When first using the tiles, they preservice teachers were perplexed and could not immediately understand how to use them. They could not grasp how the tiles connected to prime decomposition. A few of the preservice teachers were very resistant to the tiles stating, "These are hard to use, I just want to build factor trees" and "I don't like these tiles." While the

preservice teachers were permitted to use alternative techniques, all but one used the tiles. When they did use the tiles, some first built factor trees (either on paper or in their heads) and aligned the tiles with the factor tree. It took the preservice teachers some time to connect the tools to their algorithmically based procedures. In the beginning, some preservice teachers were not able to distinguish the tools as mathematically helpful. As time progressed however, they relied less on factor trees and more on the tiles.

Table 1 displays the overall accuracy of the individual assessment questions asked at the completion of the unit. These findings will be used to support the analysis of preservice teachers' development in the four prime decomposition activities explored.

Table 1. Accuracy of Individual Assessment

Question	Answer	Accuracy
1. Tell whether 97 is prime, composite or neither.	Prime	100%
2. Tell whether 1 is prime, composite or neither.	Neither	90%
3. Find the prime factorization of (a) 1002 and (b) 1002^2.	(a) $2 \cdot 3 \cdot 167$ (b) $2^2 \cdot 3^2 \cdot 167^2$	(a) 80% (b) 60%
4. True or False. "If a number is divisible by 6, then it is divisible by 2 and 3." (Billstein, Libeskind & Lott, 2010, p. 297)	True	100%
5. True or False. "If a number is divisible by 2 and 4 then it is divisible by 8." (Billstein, Libeskind & Lott, 2010, p. 297)	False	50%
6. "Find the least divisible number by each natural number less than or equal to 12." (Billstein, Libeskind & Lott, 2010, p. 312)	27,720	10%
7. Find the (a) GCF and (b) LCM of 400 and 75.	(a) 25 (b) 1,200	(a) 60% (b) 70%
8. Find the (a) GCF and (b) LCM of *abc* and *bcd*.	(a) *bc* (b) *abcd*	(a) 80% (b) 70%
9. True or False. 5 is a multiple of 25.	False	60%

Defining prime and composite numbers

Classroom Interaction Results

During the class activity, 90% preservice teachers stated that 1 was a prime number. When questioned about their generated definitions, most of the preservice teachers provided a memorized definition "a prime is divisible by 1 and itself." The professor asked how does the number 1 fit into that definition. Responses included "One can only go into itself and by 1." When further questioned, the preservice teaches continued to insist 1 was prime number because it is divisible by 1 and itself. One preservice teacher objected, "No, because a prime number is divisible by 1 and itself but 1 is only divisible by itself [which is also 1]." After a brief whole class analysis of her statement, the group still felt 1 was prime. The professor defined the number 1 as neither prime nor composite. Some of the preservice teachers continued to insist 1 was a prime number in their other mathematics classes. The case that 1 was neither prime nor composite was reiterated. They asked, "Are you sure?" The professor assured them that once

they walked out of the classroom, 1 would continue to be neither prime nor composite forever; they laughed.

Other than one participant, the preservice teachers were not able to understand that 1 was neither prime nor composite. They just took the professor's word on its categorization. While this discourse shows the professor's failure at helping preservice teachers understand why 1 is neither prime nor composite, it is important to recognize that this was a very difficult concept for these preservice teachers to conceptually understand. Perhaps the difficulty stems from being taught incorrectly in the past, as nearly all of the preservice teachers stated that they were told that 1 was a prime number. Because the trajectory of learning and quality of instruction cannot be mapped at this point, there is no way to know. This finding shows the difficulty of this content and the need to address these misconceptions through curriculum development.

Assessment Results

In terms of the individual assessment, all of the preservice teachers recognized 97 as prime. Nine out of the ten said 1 was neither prime nor composite. The preservice teacher who answered incorrectly stated 1 was a prime number. Zazkis and Liljedahl (2004) found similar misconceptions. Preservice teaches were able to define what prime meant and could recognize prime numbers. However, the application of this knowledge was much more difficult.

Investigative explorations

Classroom Interaction Results

The explorations were the most difficult component of the prime decomposition lessons. The preservice teachers struggled throughout the investigations. They commented, "These problems are hard." Some of the preservice teachers were struggling because they randomly selected a number and then tested the divisibility (guess and check unsupported by conjectures).

They were not working from the factors. The professor guided their investigations by encouraging the preservice teachers to work with the factors. Once the preservice teachers understood that it was easier to start from the factors rather than a randomly generated number, they became more successful. They were able to work through the rest of the explorations. Working with one another, they correctly solved most of the explorations. The final exploration gave the preservice teachers the most difficulty: Find "the smallest number that has 3 and 11 as factors; to find it, multiply the two numbers. To find the smallest number that has 3 and 12 as factors, you cannot multiply the two numbers (it would not result in the smallest number possible). Why not?" (Kurz & Garcia, 2010, p. 259). Some explanations were not mathematically clear: "Because 12 is not prime. 12 is smallest." "Because it is divisible by 3 and 11" "Because 12 is made up of several twos." Others had a clearer understanding: "With 3 and 11 both are only divisible by itself. 12 and 3 can be divisible by 4 and 3." "Because 12 has a factor of 3" "Because 12 has multiple factors but 3 and 11 are both prime."

Assessment Results

The difficulties with the explorations were also demonstrated in problem 6 of the individual assessment; "Find the least divisible number by each natural number less than or equal to 12" (Billstein, Libeskind & Lott, 2010, p. 312). Only one preservice teacher correctly answered this question. Even though this question somewhat aligned with the second problem "What is the smallest number that has [2, 3, 4 and 5 as] factors?" the preservice teachers were unable to find a solution. Perhaps the problem was in the decoding the question (for example "natural number" or "least divisible number"). However, it seems to go deeper than vocabulary. They were perplexed by the explorations; the factor tree model was taken out of its standard context and the preservice teachers had to think in a more complex manner. The algorithmic

procedure did not work; other methods had to be developed and evaluated. They had to work backward from the factors.

The difficulties the preservice teachers had with the explorations were not predicted; the questions were written for the upper elementary student and not perceived by the researchers as too complex. They started with a random number rather than using factors to determine the number. What these findings indicated was that preservice teachers need activities to analyze the factor tree procedure and work toward the application and decoding of prime decomposition. They could create factor trees and could decompose numbers using tiles. But when they had to apply reasoning beyond the procedure, difficulties resulted. Zazkis and Campbell (1996) found similar results in that "checking whether or not an object has a certain property appears to be easier than constructing an object that has such a property" (p. 550).

Using Venn diagrams for finding the GCF and LCM

Classroom Interaction Results

Using a Venn diagram, the preservice teachers were provided with an opportunity to develop a method for finding the GCF and LCM. After building the prime decomposition of 48 and 72, they placed tiles in the Venn diagram. The preservice teachers then conjectured that the center numbers multiplied together yielded the GCF while all of the numbers multiplied together yielded the LCM. Other numbers were then tested to investigate whether the preservice teachers discovered a method that always works.

This was the last activity that integrated prime factor tiles. The preservice teachers were more at ease using the tiles; there were no complaints. Perhaps their comfort with the tiles was a result of exposure. They had already explored using the tiles and became more aware of the tiles' features. When asked to describe the process, a preservice teacher responded:

To find the GCF between the two numbers, you multiply all the numbers that are in the intersecting section, which are the common factors between the numbers. Once you have multiplied them, you have found the GCF between the two numbers. To find the LCM is also very simple, you multiply all the numbers in both circles, including the intersecting section, and once you have done so, you have found the LCM.

Assessment Results

This process seemed to transfer to the individual assessment but there were some issues. The preservice teachers were more successful when finding the GCF using variables rather than numbers (problem 8). When finding the GCF of 400 and 75, the overlapping portion of the Venn diagram contained 5^2. The preservice teachers who missed this problem failed to place both fives in the center of the Venn diagram or they placed both fives but failed to multiple them. This was the case for 3 of the incorrect preservice teachers. Another preservice teacher wrote a 5 for the LCM. The preservice teachers were able to find the LCM (for the most part) but had difficulty recognizing that 5 is not a multiple of 25. They could find the LCM (70% for numbers and 80% for variables) but could not accurately identify a multiple for problem 9 (60%). When Zazkis (2000) researched preservice teachers' understanding of factors, divisors and multiples, she found that multiple was the most difficult concept. The majority of her participants did not have a thorough understanding of the meaning of multiple. Multiple implied multiplication according to Zazkis' participants; they perceived a multiple as either a product or a factor as these are the components of a multiplication problem.

Application questions

Classroom Interaction Results

The next questions were analyzed whole class. The first two parts were written on the whiteboard (Zazkis & Campbell, 1996, p. 542):

- Consider the number $M=3^3 \times 5 \times 7$

- Is M divisible by 7? Explain.

Some preservice teachers began to multiply M then divide. The professor queried, “Is there a quicker way to solve this?” A preservice teacher stated, “Because 7 is a factor then that means that 7 will go into the number with no leftovers.” The preservice teachers agreed that the logic was true. The next component was presented (Zazkis & Campbell, 1996, p. 542):

- Is M divisible by 5, 2, 9, 63, 11, 15? Explain.

The preservice teachers went through the numbers and stated M was (or was not) divisible by the listed numbers based on its factors. One preservice teacher said, “In the case of 9, we have 3 to the third power which nine is dividable by that number. On the other hand, we have 2 and 11 which are not divisible of the numbers in the equation.” Another preservice teacher commented that while she understands the logic, “I’d still have to check by multiplying it out and then dividing.” The professor asked why. She said, “Because then, I’d know for sure. I don’t know for sure using the shortcut.” She was asked, “Why don’t you know for sure?” She said that the calculator would tell her for sure because she could see whether or not the number divided into it without a remainder. This aligns with Zazkis and Liljedahl’s (2004) findings; preservice teachers divide to check a number’s divisibility to be on the safe side. There is a reliance on procedures to justify reasoning and feel certain (Zazkis & Campbell, 1996).

Assessment Results

Three questions from the individual assessment were designed to observe whether preservice teachers were able to apply these techniques. Find the prime factorization of 1002 and 1002^2 were asked with the hope that the preservice teachers would square the prime factorization of 1002. Eighty percent accurately factored 1002. Sixty percent accurately factored 1002^2. Out of those who accurately factored 1002^2 all but 1 worked from the factorization of 1002. Of the two

who accurately factored 1002 and then inaccurately factored 1002^2, the preservice teachers squared 1002 and then factored.

All the preservice teachers recognized that if a number is divisible by 6, then it is divisible by 2 and 3. But once the statement was altered, if a number is divisible by 2 and 4 then it is divisible by 8, they were generally unable to observe a difference in the rule. A number divisible by 8 would need 2^3 as a factor, not 2^2 as indicated. Only half recognized the statement as false.

Student Feedback

At the conclusion of the course investigations, preservice teachers were asked to comment on what they thought of the tools. Many preservice teachers felt that the tools should be used as a supplement to factor trees. They felt that the tools would only help certain kinds of learners and that the factor trees were better because they were a specific, prescribed method. When asked if students would understand conceptually the mathematics using factor trees, the preservice teachers felt that students would not develop conceptual understanding but did not seem concerned with their observation. One commented, “The factor trees are easier because there is a process; the tiles make you think and they are harder.” This response emulates what would be expected from preservice teachers who have yet to be exposed to educational theories or approaches to learning. They focused more on the procedures of mathematics rather than the sense making often encouraged (Cooney, 1999).

Conclusion

The brief exposure to prime factor tiles did not solve the issues that preservice teachers have in relation to factoring and prime factorization. However, that does not mean that the tools were not valuable. The preservice teachers did use the methods they discovered for finding the

GCF and LCM. They also became more comfortable using the tiles as time went on. Because they did not like the tools does not mean that they were ineffective. On the contrary, the prime factor tiles made them think harder, perhaps bringing about richer experiences. Lubinski and Otto (2004) discuss the importance of mathematics to go beyond memorizing procedures. Instead, mathematics should encompass sense making; this is more beneficial. The preservice teachers were also able to understand that the tools provided a different method for investigating prime factorization above and beyond what can be done with factor trees alone. But most importantly, the preservice teachers were able to multiplicatively decompose numbers in more than one way; they experienced an alternative method.

The real issue is the amount of exposure. If the course structure provided the time to focus on prime decomposition for more than several hours, perhaps the preservice teachers would have developed a deeper understanding. In Griffiths' (2010) framework, mathematical investigations focusing on the single theme of prime factorization lasted over many weeks; this depth was helpful in developing students' greater understanding of the theme. Szydlik, Szydlik and Benson (2003) provide investigations that delve deeper into the concepts of prime decomposition. This may be what is necessary for preservice teachers as well. However if this depth is provided, other curriculum topics must then be slashed and how does one decide what to slash? What makes a mathematical topic less important than another?

If more time is not an option, the explorations seem to be the most needed curriculum in relation to prime decomposition. Because preservice teachers had such trouble, it is imperative that these difficulties are addressed. It may be helpful to have preservice teachers solve the explorations and then create their own explorations. This provides the opportunity to move beyond the creation of factor trees while focusing more deeply on prime factorization.

Additionally, Szydlik et al. (2003) provide a rich question for investigating prime decomposition: find the number less than 1,000 with the most factors. Robbins and Adams (2007), Kurz and Garcia (2010) and Kurz and Garcia (2012) provide readymade handouts that can be used to delve deeper into prime decomposition. Deeper and more meaningful investigations with explorations may be more advantageous than the curriculum implemented in this inquiry. Our focus was on several topics scratched just below the surface. Perhaps fewer topics that go deeper may be more fruitful if time is an issue (Lubinski & Otto, 2004).

Our findings concur with Zazkis and Campbell (1996) that there needs to be an increased focus on basic arithmetic ideas. In addition, number theory should be an integral part of preservice teachers' program of study (Brown, 1968). Future studies should measure impact after additional time was provided for preservice teachers to mathematically explore and evolve. These results give further support for the need to go deeper (Lubinski & Otto, 2004) and more analytical when teaching prime decomposition. A richer environment that has a greater emphasis on the prime factor tiles should be investigated. While tiles were encouraged during the investigations, they were not required. Preservice teachers who were challenged by the tools tended to disregard them. It would be interesting to research whether a deeper emphasis on prime factor tiles with labs, class activities and creation of explorations would improve understanding of prime decomposition. In addition, concept maps can be used to guide growth and understanding of terms (Bolte, 1999). Because the findings presented were based on an exploratory inquiry, there needs to be a larger study with a control and experimental group. This kind of study will help shed light on exactly what mathematical concepts the tiles can support beyond a lecture-based, factor tree approach.

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Correspondence concerning this article should be addressed to:
Terri L. Kurz, Arizona State University, Polytechnic, 7001 E. Williams Field Rd.
Mesa, AZ 85212, (480) 727-5204, terri.kurz@asu.edu