

Teacher Leaders and Student Achievement: can the dots be connected?

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Abstract

This study was designed to determine the effects of teacher leadership on student achievement in middle school math and science. Participants were 173 eighth grade students, and eight teachers — four of whom were identified as teacher leaders. The experimental groups were comprised of students who were instructed by teachers identified as teacher leaders; and the control groups were comprised of students instructed by teachers not identified as teacher leaders. Each experimental and control group was compared using the Explorer test results to determine equivalence between groups. An ANOVA performed on End of Quarter Test data in advanced and non-advanced math and science revealed a significant difference in both the advanced science and math groups; teacher leaders are positively correlated with higher scores of the advanced math and science groups. No significant difference was found between the experimental groups and control groups in either non-advanced math or science classes; teacher leaders did not significantly impact the scores of the non-advanced math and science groups.

Keywords: Teacher leadership, Middle school, Math, Student achievement.

Introduction

Danielson (2007) states that teacher leaders are an important part of school success and student achievement. Teacher leadership is defined as the process by which teachers influence their colleagues and other members of the school community to improve teaching and learning practices (YORK-BARR; DUKE, 2004). Teacher leaders are experts in teaching and learning; they encourage success from their colleagues; and they facilitate communities of learning (DANIELSON, 2006). Teachers that take on leadership roles in their schools are successful representatives in promoting cultural change within their schools (WATERS; MARZANO; McNULTY, 2003). The work of

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these teachers inside and outside of the classroom moves the school culture to a more collaborative and effective one (BEACHUM; DENTITH, 2004).

Since administrators cannot be expected to complete all duties of an administrator alone, active involvement of teacher leaders is vital to school improvement (DANIELSON, 2007). Teacher leaders have the same attributes as those of good teachers: open-mindedness, flexibility, confidence, and experience in their fields (WATERS; MARZANO; McNULTY, 2003). Along with these attributes, they also possess the ability to actively listen, facilitate meetings, decide on a course of action, and monitor progress (DANIELSON, 2007).

Effective school administrators and teacher leaders are known for their use of transformational leadership. According to Bass and Riggio (2006), transformational leaders are those who “stimulate and inspire followers to achieve extraordinary outcomes and, in the process, develop their own leadership capacity” (p. 3). Transformational leaders can help their followers grow and develop into leaders. Danielson (2007) states, “teacher leaders call others to action and energize them with the aim of improving teaching and learning” (p. 16). It is important for school success to be linked the role of teachers to understand both the importance that teacher leaders play in a school and the use of transformational leadership by these teacher leaders. Danielson (2006) says that teacher leaders are experts in their field and oftentimes present information from their own teaching to colleagues and encourage them to do the same.

Teacher leaders have the same attributes of good teachers: open-mindedness, flexibility, confidence, and experience in their fields. They also possess several other qualities, which are listed below:

- Actively listen
- Facilitate meetings
- Decide on a course of action
- Monitor progress
- Have expertise in their field
- Encourage success from their colleagues
- Have expertise in teaching and learning
- Facilitate communities of learning through organization-wide processes
- Confront barriers in the school’s culture and structures
- Translate ideas into sustainable systems of action
- Strive for authenticity in their teaching, learning, and assessment practices

Beachum and Dentith (2004) suspect that by encouraging teacher leaders to be assertive, take risks, and assume greater responsibility, student perceptions and performance could be positively impacted. Research from Bass and Riggio (2006) on effective leadership supports that teacher leaders who use a transformational leadership style yields higher student achievement. Therefore, this research was designed to explore the following question:

- Are teacher leaders more effective classroom teachers, as measured by student academic achievement in science and math, than teachers who are not considered teacher leaders?

By examining the academic achievement of middle school students taught by teacher leaders and students taught by teachers not identified as teacher leaders,

one should be able to see what effect, if any, teacher leaders have on student achievement in the specified academic areas.

The Need for Teacher Leaders

The demands placed on today's principals are very difficult to meet (DANIELSON, 2007). "Principals today are expected to be visionaries (instilling a sense of purpose in their staff) and competent managers (maintaining the physical plant, submitting budgets on time), as well as instructional leaders (coaching teachers in the nuances of classroom practice)" (DANIELSON, 2007, p 15). Often, principals have one specific area of instructional expertise. Unfortunately, principals are expected to be experts in all areas, including that of curriculum and instruction. One solution to this problem may be the development of "teacher leaders" who are experts in teaching and learning and serve to help their colleagues develop more effective classroom practices that are translated into student academic gains.

Who Are Teacher Leaders?

Andrews and Crowther (2002) describe teacher leaders as those who have convictions about a "better world"; strive for authenticity in their teaching, learning, and assessment practices; facilitate communities of learning through organization-wide processes; confront barriers in the school's culture and structures; translate ideas into sustainable systems of action; and nurture a culture of success. York-Barr and Duke (2004) define teacher leadership in terms of impact on colleagues and other school stakeholders, ultimately improving the teaching and learning practices with the goal of improving student achievement. Danielson (2007) suggests that the knowledge for school improvement could be offered by a group of teachers. "Teaching and learning is arguably the centerpiece of any school; student learning is, after all, the *raison d'être* of education" (DANIELSON, 2006 p. 84). Danielson (2006) claims that a school is only as good as the instructional practices it offers and the resulting student achievement. She also states that a successful school must offer an outstanding instructional program to its students and the heart of such a program is teaching and learning.

Building upon the idea of teacher leaders who could provide leadership in all the areas of teaching and learning, freeing principals to focus on other areas of school administration, Danielson (2006) argues that:

Teacher leaders are in a strong position to influence the school's instructional program. Teachers are the school's experts in the subjects they teach and in the patterns of learning of their students. Teacher leaders, by mobilizing the energy of their colleagues, have a significant influence on the quality of that program (p. 84).

Why Teacher Leaders?

There are benefits to schools in developing teacher leaders among their faculties. Curtis (2013) lists several reasons that school districts may pursue teacher leadership: further developing top teacher talent, helping other teachers improve, more effectively implementing key priorities, building a pipeline to the principalship, distributing leadership in schools, increasing highly effective teachers' impact on

student learning, and making principals' span of supervision manageable. "Through new forms of teacher leadership, we may be able to transform students' learning experiences and teachers' work experiences" (CURTIS, 2013, p. 1). Thus, teacher leaders have the potential to improve student achievement, build camaraderie among school faculty, distribute leadership activities among the faculty, and ease the responsibilities on the school and district administrators.

How Teacher Leaders Emerge

Danielson (2007) claimed that teacher leaders serve in two types of roles: formal and informal. Formal teacher leader roles are typically applied for or are determined through a selection process. Formal teacher leaders organize curriculum projects, facilitate teacher study groups, and host workshops. In public schools, instructional coaches and department chairs are both types of formal teacher leader roles.

Informal teacher leader roles occur naturally and are not formally selected. Teachers in these informal roles see a problem and take initiative to solve problems when they see them (DANIELSON, 2007). Informal teacher leaders generally earn respect from their colleagues through expertise and practice. Research by Snell and Swanson (2000) found that the teachers who emerged as leaders had instructional expertise, skills in collaboration and reflection, and a sense of empowerment. Snell and Swanson (2000) hypothesized that those qualities were the essential building blocks of teacher leadership. Thus, through experience, expertise, and success in the classroom, teachers gain respect and trust from administration and coworkers, and emerge as teacher leaders (YORK-BARR; DUKE, 2004).

Some researchers express that the opportunity for teacher leadership should be extended to all teachers (YORK-BARR; DUKE, 2004). Danielson (2007) highlights several factors that can encourage teacher leaders to emerge within a school. One factor is feeling confident that the administration and other teachers support expressing new ideas. Another relevant factor is the administration supporting emerging teacher leaders in acquiring the skills and professional development needed in a leadership role. For example, training in curriculum planning, and instructional improvement, which is not part of a typical undergraduate teacher education program, will enable the teacher to emerge and contribute as a teacher leader. Throughout the factors that Danielson (2007) highlights, the administrator plays a crucial role in the emergence of teacher leaders. Andrews and Crowther (2002) also emphasized the importance of the leadership foundation to be built on a parallel relationship between the teacher leaders and principals.

Teacher Leaders and Student Achievement

Very few empirical studies have been conducted on the effects of teacher leadership on student achievement. Though there is descriptive literature pertaining to teacher leadership styles, surprisingly, little is known about the impact of teacher leadership on student achievement. However, the research that has been done in this area has not revealed positive results of the impact of teacher leaders on student achievement. For example, Leithwood and Jantzi (1999) found in their study that teacher leadership had no effect on student engagement. York-Barr and Duke (2004) also found little evidence that teacher leadership increased student achievement. They did, however, state that teacher leaders were effective because they lead

by preserving an emphasis on teaching and learning while establishing trusting relationships. Teacher leaders influence individual development and collaborative teams to improve teaching and learning within their schools (YORK-BARR; DUKE, 2004). York-Barr and Duke proposed a model of how teacher leadership could influence student achievement:

Improvements in teaching and learning practices such as creating positive learning relationships between teachers and students and among students, establishing classroom routines and expectations that effectively direct student energy, engaging students in the learning process, and improving curricular, instructional, and assessment practices, ultimately result in high levels of student learning and achievement (p 290).

Although there is little empirical evidence to support the idea that teacher leaders have any impact on student achievement, teacher leaders have been found to improve instructional techniques in their coworkers. Gigante and Firestone (2008) found that teacher leaders who engaged in developmental tasks improved math and science teaching in their colleagues. Coburn and Russell (2008) propose that a key strategy of making an impact on teacher social networks which promote improvements in curricular practices is to foster expertise in teacher leaders.

Literature on high quality professional development emphasizes the importance of professional development being focused on specialized content knowledge (ELLIOTT, et al., 2009; GARET; PORTER; DESIMONE; BIRMAN; YOON, 2001). Wahlstrom and York-Barr (2011) proposed, “the work of leadership is to create the conditions that support continuous professional learning that result in improved classroom practice such that students engage and learn at high levels” (p 25). Beachum and Dentith (2004) analyzed several interview responses that led them to suggest that teacher leadership could positively affect student perceptions and performance. “Educational outcomes depend more on the quality of the teacher a student is assigned to than on any other factor outside of the home” (JACOBS, 2012, p. 11). Bruggencate, Luyten, Scheerens, and Slegers (2012) found evidence in their research that suggested “the learning environment teachers create in their classroom can affect the degree students like to be at school and are engaged with school and their performance” (p. 721). Whitaker (1995) concluded from his study of college students that school growth and change such as successful student academic achievement cannot take place without the leadership of teacher leaders.

Teacher leaders serving in the role formally or informally, are generally identified as being experts in their content as well as in the pedagogy of teaching their content. Harrison and Killion (2007) stated that serving as an instructional specialist or a curriculum specialist are two of the ways that teachers can provide leadership in their schools. Since teacher leaders are experts in their content area, the researchers hypothesized that there is a positive relationship between student achievement and teacher leadership.

Methodology

The researchers sought to determine if there was a link between the academic achievement of middle school students who were taught by teachers who were identified as teacher leaders and those teachers who were not identified as teacher leaders.

Participants

Participants were in a large school district in southwest Alabama, in one of the largest middle schools. Student participants were in eighth grade and selected from one middle school. There were 173 student participants, 94 male and 79 female with ages ranging from 11-14 years of age. (It should be noted that fifteen students were eliminated from the study due to absences from either the Explorer Test or any of the math or science end of quarter tests.)

African Americans made up 19.19 % of the student participant population and white students made up the remaining 80.81 %. Eight teacher participants were also included in this study. From eight teacher participants, the school's principal identified four of the eight as teacher leaders based on the criteria found in Appendix A. The criteria are based on the literature of Danielson (2006, 2007), Andrews and Crowther (2002), and York-Barr and Duke (2004).

Research (Bill and Melinda Gates Foundation, 2010) revealed that teachers have a larger effect on the academic achievement of students in STEM disciplines, therefore participants in this study taught science and math. The experimental group consisted of the students in two grade 8 math classes taught by teacher leaders, and students in two grade 8 science classes taught by teacher leaders. The control group included the students in two grade 8 math classes taught by teachers who were not identified as teacher leaders, and the students in two grade 8 science classes taught by teachers who were not identified as teacher leaders. In order to decrease bias, neither student participants nor teacher participants were made aware of the study.

Data Collection

ACT Explorer. In this study, data were obtained from 2012-2013 academic year. The American College Test (ACT) Explorer (ACT, 2013) test data was used to determine equality in the experimental and control groups in terms of science and math ability. The Explorer test is a multiple choice nationally normed assessment developed by the ACT test developers to provide information about educational and career plans, high school curriculum plans and support needed to be successful in academics. Specifically, the Explorer test measured student achievement in math, science, language arts, and history and is administered during the first quarter of the academic year. The scores for math and science range from 1-25 with a score of 25 being the highest.

End of Quarter Test. End of Quarter Test (EQT) scores were used to measure student academic achievement in math and science. School district curriculum teams, under the direction of district content area supervisors, created these tests. The EQTs offered multiple choice items and were designed to measure what students learned each quarter. They represented 20% of the students' quarterly average. EQT questions reflected the curriculum that was designated for each quarter. Four EQTs were administered to eighth grade students each quarter: science, math, language arts, and history. EQT scores for each test ranges from 0-100. The EQT scores for four consecutive quarters within a school year in science and three consecutive quarters in math were analyzed using the statistical package SPSS. Due to test discrepancies, the school district made the decision not to count the fourth quarter math EQT as part of the quarterly grade, therefore it was removed from the data.

Procedures

The principal was given the criteria of a teacher leader and asked to make the selection of the eight teachers who would participate in this study. To ensure the principal had a deep understanding of the criteria, one of the researchers met with her to discuss the questions in depth. Once the four teachers were selected, the experimental group contained those students that the teacher leader instructed. The principal identified four additional teachers that were non-teacher leaders, therefore the control group of students were those students being taught by a non-teacher leader. There were approximately 86 student participants in the control group and 87 student participants in the experimental group. Student achievement was determined by comparing student EQT scores from two grade 8 advanced science and two grade 8 advanced math; and from two grade 8 non-advanced math and two grade 8 non-advanced science classes. This included a total of eight grade 8 teachers. The four teachers who were considered teacher leaders instructed the experimental groups and the four teachers who were not considered teacher leaders instructed the control groups.

The statistical test, ANOVA, was conducted on the Explorer math and science results to determine if the experimental groups and control groups were equivalent in academic achievement in these areas at the beginning of the year. A one-way ANOVA was also performed using the EQT data from all four quarters in science and three quarters in math. The experimental group's math scores were compared to the control group's math scores, with the knowledge of both advanced and non-advanced courses. The experimental group's science scores were compared to the control group's science scores, again with considering advanced and non-advanced courses. Descriptive statistics of the ANOVA were analyzed to determine if teacher leaders had an impact on student achievement.

Results

The results of the ANOVA for the Explorer test showed the advanced math control group and the advanced math experimental group were equivalent in academic ability in math, $(1,50)=3.872$, $p=.055$. The ANOVA for the Explorer test also showed the non-advanced math experimental and control groups were equivalent, $(1,37)=1.362$, $p=.251$. The non-advanced science control group and the non-advanced science experimental group were also equivalent, $(1,45)=3.950$, $p=.053$, but the advanced science control group and the advanced science experimental group were not equivalent, $(1,46)=9.272$, $p=.004$. This could possibly be due to the small sample size, or since this test is administered during the first quarter, it could also be due to previous academic courses/tracks (advanced versus regular) the students were enrolled in during prior years.

Advanced science. A repeated measures ANOVA was used to compare EQT data for four quarters in science; the experimental group being the advanced science class taught by a teacher leader, and the control group being the advanced science class not taught by a teacher leader. The following table shows the descriptive statistics of the ANOVA for advanced science EQT comparison.

Table 1 ANOVA for EQT Result Comparison of Advanced Science Classes

	Experimental (Teacher Leader Group)		Control (Non-teacher Leader Group)		<i>F</i>	<i>df</i>	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
1 st Quarter	84.42	4.90	69.29	9.13	52.80	(1,45)	.000
2 nd Quarter	81.46	6.12	82.29	11.15	.10	(1,45)	.749
3 rd Quarter	82.88	8.09	73.14	10.83	12.47	(1,45)	.001
4 th Quarter	87.19	7.53	73.43	11.70	23.81	(1,45)	.000

M = mean, *SD* = standard deviation

Teacher leaders are positively correlated with higher scores of the advanced science groups in three of the four quarters. The ANOVA showed a significant difference in the control and experimental groups for advanced science: first quarter - (1,45)=52.801, $p = .000$; third quarter - (1,45)=12.468, $p = .001$; and fourth quarter - (1,45)=23.811, $p = .000$. The analysis revealed that the experimental students scored higher ($m = 84.42$, $sd = 4.90$), ($m = 82.88$, $sd = 8.09$), ($m = 87.19$, $sd = 7.54$) than the students in the control group ($m = 69.29$, $sd = 9.13$), ($m = 73.14$, $sd = 10.82$), ($m = 73.42$, $sd = 11.70$) for first, third, and fourth quarters. However, second quarter data revealed that the teacher leaders did not significantly impact the scores of the advanced science groups; there was no significant difference in the control group and the experimental group, (1,45)=.104, $p = .749$). But the effect size and positive impact of teacher leaders for first, third, and fourth quarter were found to be large, ($r = 0.72$, $r = 0.45$, $r = 0.57$).

Teacher leaders did not significantly impact the scores of the regular science groups any of the four quarters. The regular science experimental group and the regular science control group were found to have no statistical differences $p > .05$.

Advanced Math. Since only the first three quarters of EQT results could be collected due to fourth quarter math EQT scores not being counted and recorded, the math data contains only the first three quarters of EQT scores. Teacher leaders are positively correlated with higher scores of the advanced math groups. The advanced math experimental group and the advanced math control group were found to be statistically different in all three quarters: (1,44)=10.333, $p = .002$, (1,44)=41.505, $p = .000$, (1,44)=14.545, $p = .000$. The advanced math experimental group scored higher ($m = 86.74$, $sd = 9.69$), ($m = 84.22$, $sd = 8.75$), ($m = 81.70$, $sd = 9.22$) than the advanced math control group ($m = 76.52$, $sd = 11.77$), ($m = 55.13$, $sd = 19.81$), ($m = 67.17$, $sd = 15.76$) for all three quarters. The effect sizes were found to be large for all three quarters ($r = 0.43$, $r = 0.69$, $r = 0.49$). The descriptive statistics for advanced math are shown in the Table 2.

Table 2 ANOVA for EQT Result Comparison of Advanced Math Classes

	Experimental (Teacher Leader Group)		Control (Non-teacher Leader Group)		<i>F</i>	<i>df</i>	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
1 st Quarter	86.74	9.69	76.52	11.77	10.33	(1,44)	.002
2 nd Quarter	84.21	8.75	55.13	19.81	41.50	(1,44)	.000
3 rd Quarter	81.70	9.22	67.17	15.76	14.54	(1,44)	.000

M = mean, *SD* = standard deviation

Teacher leaders did not significantly impact the scores of the regular math groups any of the quarters. There was no statistical difference found between the regular math experimental group and the regular math control group $p > .05$.

Discussion

The purpose of this study was to compare science and math EQT scores of grade 8 students that received instruction from teachers who were identified as teacher leaders and who received instruction from teachers who were not identified as teacher leaders. Specifically, this study sought to answer the question of whether teacher leaders had any positive effect on student academic achievement. The results indicated that students taught by teacher leaders performed better in advanced science and advanced math than those students taught by non-teacher leaders. Much of the previous research using quantitative data that examined the relationship between student achievement and leadership has been, at best, indirect (ROBINSON; LLOYD; ROWE, 2008). Therefore, it is interesting to note that in this study both advanced math and advanced science had large effect sizes, which further supports the idea that teacher leaders do have a great impact on student achievement in advanced math and advanced science.

According to this study, teacher leaders were not shown to have a significant effect on student scores in regular math and science classes. Though the school principal used the criteria based on the literature of Danielson (2006, 2007), Andrews and Crowther (2002), and York-Barr and Duke (2004) to identify the teacher leader and non-teacher leader participants, it is likely that there were variations among the strengths of the teacher leaders; in that there is no one size fits all teacher leader or non-teacher leader. It is also possible that the teachers originally selected to teach the advanced courses had a deeper level of content knowledge, as they are required to teach science and mathematics at advanced levels. This could potentially give the teachers identified as teacher leaders that taught the advanced classes an advantage in that they likely possess more teacher leader characteristics than those identified teacher leaders that taught the non-advanced courses. In addition, due to the typical characteristics of many high achieving students, it is possible that the students in the advanced courses were more intrinsically motivated than the students taking the regular sections of the courses.

Implications

Little research exists that supports the idea that teacher leaders have a positive effect on student academic achievement as found in this research. However, since a foundational characteristic of teacher leaders is that great teacher leaders begin in their own classrooms with a deep content knowledge and pedagogical skills (ROBINSON; LLOYD; ROWE, 2008), it stands to reason that the teachers would have a positive effect on student academic achievement. Thus, school administrators should consider leadership development for teachers that exhibit the characteristics of leaders, as their impact on academic achievement may be substantial. In addition, institutions of higher education should consider developing graduate teacher leadership programs for teachers that exhibit leadership characteristic and have a desire to be mentored in the area of knowledge and skills in teacher leadership.

Finally, it is recognized that not all teachers identified as leaders have strengths in the same areas. It is also noted that teacher leaders face various challenges depending on their teaching assignment, school situation, and administrative leader. The impact of teaching on student achievement should likely be considered foundational in some respects for leading other teachers. Therefore, school administrators should take into account student achievement data prior to assigning leadership roles.

Limitations

Results of this study should be considered along with a few limitations, which also lead to suggestions for future research. One limitation in this study was that the study took place in one school and the selection of math and science teachers was limited to only eight teachers. Out of the four grade 8 math teachers available, two of those were identified by the principal as teacher leaders and the other two teachers were identified as non-teacher leaders. The same limitation occurred while selecting the teacher leaders in science. Future research could include a larger selection of math and science teachers. It is also seen as a limitation that the principal of the school was the only person involved in identifying the teacher leaders. Involving more administrators or peer teachers in the process of identification would strengthen the study. It may also be helpful for future research to include several schools instead of just a single school.

A second limitation was the number of students involved in the study. Several students from each experimental and control group had to be removed from the study due to an absence during at least one of the EQT tests or Explorer test. Though the number of participants was appropriate to determine significance with a solid effect size, future research could include a larger number of students in each group to ensure validity.

A third limitation is that only math and science classes were used in this research study. Math and science are two subjects that are closely connected and sometimes students tend to perform well in both math and science classes. It would be interesting to see if teacher leaders have any effect on student achievement in other subject areas such as language arts and social studies.

A final identified limitation was the lack of qualitative data in this study. Qualitative data would help to triangulate the data, enrich the findings, and possibly help explain the reasons why significance was found in the advanced classes but not in the non-advanced classes.

Future Research

Based on the findings in this research, teacher leaders had a positive effect on students in advanced science and advanced math classes. They were, however, found not to have a significant effect on students in regular math and science classes. It is recommended that future research perform similar studies to determine if teacher leaders could have a positive effect on students in regular education classes. This should include additional quantitative and qualitative measures. It is also suggested that future research include other subject areas in addition to math and science classes, with varying ranges of ability.

Contrary to the finding of Leithwood and Jantzi (1999) and York-Barr and Duke (2004), the results of this study suggest that teacher leaders are more effective in increasing student academic achievement in advanced students than with non-advanced students. A possible explanation for this could be the affective nature of the classroom environment. This aspect of teacher leadership was not explored in this study; however, it is possible that the nature of the teacher leaders may be an important link to academic achievement, and should be considered as teachers are given their teaching assignments. Finally, future research should include studies that contain a larger sample size to help ensure a smaller margin of error.

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Appendix A

Characteristics of Teacher Leaders

Teacher leaders have the same attributes of good teachers: open-mindedness, flexibility, confidence, and experience in their fields. They also possess several other qualities, which are listed below:

- Actively listen
- Facilitate meetings
- Decide on a course of action
- Monitor progress
- Experts in their field
- Encourages success from their colleagues
- Experts in teaching and learning
- Facilitate communities of learning through organization-wide processes
- Confront barriers in the school's culture and structures
- Translates ideas into sustainable systems of action
- Strive for authenticity in their teaching, learning, and assessment practices

Definition of Teacher Leadership: the process by which teachers, individually or collectively, influence their colleagues, principals, and other members of school communities to improve teaching and learning practices with the aim of increased student learning and achievement.

Note: Characteristics based on the literature of Danielson (2006, 2007), Andrews & Crowther (2002), and York-Barr & Duke (2004).

Submitted on: 13/November/2017

Approved in: 20/December/2017