

Does Collaborative Teacher Feedback Impact Student Attitude and Achievement in
Mathematics?

Mary Healy
Assistant Principal
Aurora Charter School

Betty-Lou Steinke
Teacher
Aurora Charter School

Angela Craig
Teacher
Aurora Charter School

Key Word: Feedback, Teacher Collaboration, Primary Mathematics, Mathematics Attitude,
Mathematics Achievement

COLLABORATIVE TEACHER FEEDBACK

Abstract

This mixed-method study was conducted in an academic school. The sample of 40 students were enrolled in grade two and grade three mathematics program that was delivered through direct instruction. The sample consisted of 20 lower tier students in the treatment group and 20 higher tier students in the control group. The treatment group received targeted feedback on six mathematic tests for eight weeks. During the treatment period, the four teachers in the study analyzed student mathematics tests in collaborative meetings and provided feedback to treatment group using Hattie's Model for feedback. Students completed pre and post Likert attitude surveys. At the end of the treatment period, students and teachers participated in a focus group interview. Results of the surveys indicated the gap between the treatment and control group attitude remained relatively the same. The treatment group showed no statistically significant difference in the mean test scores after the treatment. Teachers and the treatment group students reported a positive attitude toward the feedback process and felt that it helped the students. Teachers stated that the collaborative meetings were beneficial, created accountability and provided additional resources for instruction.

Context

Aurora Charter Elementary School was established in 1996 with a focus on traditional teacher-direct instruction. The publicly funded school emphasizes strong school-parent partnerships and is governed by an elected board of school parents.

The school program follows Alberta Government Program of Studies and also offers explicit instruction in phonograms with additional instructional minutes in Language Arts and Mathematics.

COLLABORATIVE TEACHER FEEDBACK

The students wear uniforms and are expected to complete daily assigned homework. Many students who attend the school are bussed in from several areas of the city and are from multi-ethnic backgrounds with average social economic status. The current enrollment is 408 students with a cap of 20 students from kindergarten to grade three and 22 students in grade four.

Introduction

The education system is continually striving to improve student learning. There is also more emphasis on increasing accountability of schools to provide quality learning for all students. It is through this reform that focus has targeted teacher development. Supovitz and Christman (2003) examined school reforms in Cincinnati, Pennsylvania, and Philadelphia and found that teacher communities of practice improved student learning, if the focus was on instructional improvement. In addition, they stated that teachers required structures, strategies and supports to further develop their teaching craft in these learning communities (Supovitz & Christman, 2003).

Teacher communities fuel the social network required to bring teaching out of isolation and provide a supportive environment for disciplined inquiry and investigation. Teachers identify and support the goal of improving student learning. This collaborative process enables teachers to align with common goals and learn from each other (Supovitz & Christman, 2003). Teachers who create common formative assessments in mathematics have a basis of comparison. By having a team dialogue about how students performed on various skills, teachers can access the ideas, talents and resources of their colleagues to address areas of concern (Dufour, 2004).

Collaboration among teachers can be defined as professional engagement with colleagues with a mandate to explore student learning by focusing on the student rather than the instruction. This

COLLABORATIVE TEACHER FEEDBACK

student focus and the incorporation of three essential questions guide the work of a professional community (Dufour, 2004).

What do we want each student to learn in our schools?

What evidence do we have that each student has learned it?

What will we do when a student experiences difficulty in learning?

Collaborative processes can provide opportunities for evaluating instructional strategies and examining their impact on student learning. According to Supovitz and Christman (2003), time for collaboration must be structured, so instructors have quality uninterrupted time in which to have the disciplined conversations about instruction and student work.

“Educators must stop working in isolation and hoarding their ideas, materials, and strategies and begin to work together to meet the needs of all students” (Dufour, 2004, p.8).

Research does support the effectiveness of collaboration within professional learning communities, however the success of the collaborative process hinges on member commitment and persistence (Dufour, 2004). How can collaboration improve student learning? A team of teachers at our school embarked on a process to address student learning with the idea that collaboration enables stakeholders to benefit from a pool of expertise and that through this process of collaborative work generate ideas for instructional strategies. The team focus for improvement through instructional strategies zeroed in on feedback to students. The teacher team, in the study, hypothesized that students who receive targeted feedback would also develop a more positive attitude toward mathematics and improve their performance. By identifying specific goals for

COLLABORATIVE TEACHER FEEDBACK

instructional strategies, through a collaborative discussion and analysis of student work, teachers could make decisions that would impact student performance in mathematics.

Literature Review

Schools are in the business of learning and are accountable to the public for the funds they spend to educate students. It is with this in mind, the study is focused on instructional strategies, such as feedback, to improve student learning and success in mathematics. By examining targeted feedback and their relationship to student attitudes and achievement in mathematics collaborative teacher teams can reduce the gap between lower tiered and higher tiered student achievement and performance in mathematics. By sharing ideas about student learning and instructional practice such as feedback, teacher collaboration can be a method to facilitate the implementation of evidenced based instructional practices.

It is also important to state that there has been very few studies that examine the effect of teacher collaboration on student achievement. However, one research study in an urban mid school district in the United States does indicate a statistically significant relationship between teacher collaboration and student achievement (Goddard, R. Goddard, Y. & Tschannen-Moran, 2007). The study by R. Goddard, et al. (2007) gathered data from 2, 536 students and 452 teachers from a sample of elementary schools. Data collected from the teacher surveys assessed teacher collaboration and the student data was collected from mandatory state assessments scores. The study controlled for variables such as socio-economic status and academic status in the students sampled. The findings from this study showed that fourth grade student achievement is higher on state assessments in mathematics and reading in schools characterized by teacher collaboration (Goddard et al., 2007).

COLLABORATIVE TEACHER FEEDBACK

A more recent study examined professional learning communities where high-school teachers in Texas collaborated to improve student achievement on assessments. The findings from this study indicated that collaboration amongst teachers failed to improve student achievement scores in district testing (Sims & Penney, 2015). Sims and Penney pointed out that the six teachers involved in the study reported that the meetings were too focused on test data and time was limited for discussions. Although there was no improvement in student scores, the teachers did report that the collaboration amongst teachers benefitted their instructional practices. Sims and Penney (2015) emphasized the importance of structures, the willingness of members to be open to improvement and building trust amongst members as key components for developing successful Professional Learning Communities. Building trust is important, but Hargreaves (2010) also adds that absence of betrayal in terms of competence, conflict, and communication is also necessary for building strong professional communities as indicated by his interview case study of 50 Canadian teachers in 15 elementary and secondary schools.

Burde (2016) also found no statistical significance between elements of a PLC and student achievement after examining a dataset of 12 middle schools consisting of 275 teachers and over 6000 students. He also stated that there was conflicting results regarding PLCs and student achievement and noted that the earlier studies showed more positive effects than more recent studies.

Data analysis plays an important role in learning and improving student achievement. The Literacy and Numeracy Secretariat (2007) states that professional learning communities can use data to focus on actions and activities to improve the learning environment. By evaluating the strengths and needs of students, professional learning communities can determine the focus of

COLLABORATIVE TEACHER FEEDBACK

inquiry and implement the best strategies to facilitate the desired outcomes. It is only with the inclusion of data that the actions and activities of a professional learning community can narrow their focus to work on learning and improved student achievement (Literacy and Numeracy Secretariat, 2007).

Feedback on performance has been used as an instructional strategy in the schools for a long time. The type of feedback varies and is not always helpful. Effective feedback needs to be descriptive, actionable, based on evidence and related to the learning goals (Wiggins, 2012). Successful feedback is designed to close the gap between current and future desired performance by using data to inform student and teacher behaviour (Australian Institute for Teaching and School Leadership, 2017; William, 2016). Hattie and Timperley (2007) emphasize that feedback is effective if both the teacher and student seek to learn from the feedback. In addition, students who trust and believe their teachers have their best interests at heart, will more likely use the feedback to improve their performance (William, 2016).

Assessments are most often used as a measure of recall but they also provide a measure of external accountability. It is important to note that the assessments themselves give minimal feedback information to support learning. Hattie and Timperley (2007) point out that the interpretation of assessments in conjunction with the feedback information are what matter, not the grades and this process adds the value to the learners.

Student attitudes have a relationship to achievement according to a study conducted by Michelli (2014). Her research looked at 266 fifth grade students in the same school in Mississippi and she found a positive correlation between student attitude and student math achievement on a word problem test.

COLLABORATIVE TEACHER FEEDBACK

Student attitude has been defined differently amongst scholars. Larsen (2013) states that the recent views have shifted to the notion that emotions, attitudes and beliefs are influenced by the learning environment and are not stable. She goes on to state in her article that this has implications for teachers in the classroom. Is it possible to shift student attitude toward a more positive view of mathematics in our schools by influences in the learning environment? Research about attitudes have important implications in mathematics, as studies have shown a correlation between attitude and achievement.

In a study of 230 students in 12 primary schools in North Cyprus, Tezer and Karasel (2010) administered a questionnaire using emotional faces as a scale and discovered that the grade two and three students expressed a very happy attitude toward their mathematics courses. It is important to create learning environments that support student learning, shift attitude toward mathematics in a positive direction and enable students to be successful.

Participants

The participants were students and teachers selected from two grade two and two grade three classrooms in a charter school with an academic focus. The teacher participants were four homeroom teachers that instructed the mathematics program, two of the teachers taught grade two mathematics and the other two teachers taught grade three mathematics.

Students participating in the study were grouped into tiers based on their achievement scores in mathematics in term one. Teachers selected five lower tier students from each class as part of the treatment group and they selected five higher tier students from each class for the comparison group. In total there were 40 students in the sample.

Methods and Rationale

COLLABORATIVE TEACHER FEEDBACK

The study wished to answer three questions about the relationship between collaborative teacher feedback and student attitude and achievement. How did collaboration amongst teachers change their instructional practice when providing feedback to students about mathematics tests? How did the feedback impact student attitude toward mathematics? How did the feedback impact student achievement on mathematics tests?

The study was conducted using a mixed method approach consisting of surveys, pretests, post-tests, and focus group interviews with the four participating teachers and the sample of 20 lower tier students. The sample also contained 20 high tier students who were the comparison group for the attitude survey. Both tiers of students were comprised of tgrade two and ten grade three students. The convenience sample of students were selected based on their term one Mathematic score.

At the beginning of the study, all students in the four classes were given an attitude survey which consisted of 20 statements. The students were asked to rate their responses to the statements using a five- point Likert Scale. The statements were equally divided into positive or negative statements with regard to mathematics. The survey instrument used was revised and modified to suit the ages of the participating students and was guided by the statements taken from the Aiken Attitude Survey. The five choices on the Likert scale ranged from strongly agree to strongly disagree and each measure on the scale had a representative emoticon above the wording (Appendix A). The attitude survey responses were evaluated by converting the Likert scale to values. These values ranged from one to five and the sum of the values returned a percentage score for each student.

COLLABORATIVE TEACHER FEEDBACK

The attitude survey was also administered to all the students at the conclusion of the 8 week treatment. The purpose of this was to measure any change in attitude for the students in the feedback treatment group and the higher tier group used for comparison.

During the treatment period, all students in the four classes wrote six tests in mathematics that included questions from previous and recently learned material. The tests used were part of the mathematics resources from the same publisher, so the program structure of interleaving topics and assessment format were similar across grades. The 2page mathematics tests were written by the whole class and they were marked by the homeroom teacher. All the teachers involved in the study provided immediate individual feedback to the five lower tier students, the treatment group, in their classroom. The feedback method was structured using Hattie's feedback model (Appendix B).

The participating teachers met twice weekly, during the 8week period, to collaborate in their grade groups for a total of six meetings. The goal of each meeting focused on the performance of the lower tier students, best practices, and shared ideas about instructional support for students. To enrich the data collection, teachers wrote anecdotal notes and reflections about the process during the 8week time frame.

At the end of the study teachers and students participated in a focus group interview consisting of open-ended questions. Each teacher had an opportunity to share in a round table format and the responses were recorded in written form for analysis. Students in the treatment group were interviewed at the end of the study in their grade groups. Questions about the feedback treatment were open ended and each student was given the opportunity to respond and their responses were recorded in written form.

COLLABORATIVE TEACHER FEEDBACK

Analysis of Results

To determine if the teacher feedback effected student attitude toward mathematics a paired t-Test was performed on the pretest and post-test survey results. Lower tier students were compared to higher tier students in the pretest and the post-test survey to determine if there was a change in attitude scores between the two groups after the feedback treatment and if this change was statistically significant. The difference in attitude on the Presurvey between the lower tier treatment group and the higher tier students of the control was statistically significant ($P < 0.05$) and this is also the case for the Post Survey ($P < 0.05$). (Table 3).

Teachers in the study were also interviewed using a focus group approach. The teachers all agreed that participating in collaborative meetings to discuss assessments of the lower tier students provided them with additional resources to analyze common and reoccurring errors in the mathematic tests. Two teachers reported that collaboration provided them with different ways to teach math concepts. All the teachers said that they found collaborating was beneficial. They stated that they saw improvement in student attitudes toward mathematics during the treatment phase. The teachers mentioned that they noticed that targeted feedback students were showing more confidence and were more willing to volunteer to answer questions during class instruction as the treatment phase continued. For one student, this confidence also transferred into other subject areas as well.

Teachers reported feeling more accountability as they coordinated testing schedules and meetings to collaborate. They thought that time would be a barrier to maintaining this feedback treatment for longer periods of time. The teachers all agreed that students were receptive to the feedback and that the one to one interaction benefitted the students. One teacher noted that the treatment group of students showed an improvement in the accuracy of completed homework assignments.

COLLABORATIVE TEACHER FEEDBACK

All the students in the grade two treatment group reported very positive feelings about mathematics. They also stated they liked receiving one to one feedback from the teacher about their Mathematics test. A common theme for all the students was a feeling of fear about their test results. They were worried about getting low marks but liked that the teacher showed them how to do the questions that they got wrong. They all said they liked that the teacher worked through the questions step by step until they could understand how to do it. However, one student expressed that sometimes after the feedback they still do not understand. One student said that they liked the feedback but did not like that this gave less time to do work in class and therefore might have more homework.

Most of the students in the grade three treatment group expressed a positive attitude toward mathematics, but like the younger students felt nervous about viewing the test during feedback because of how many wrong they might get. Most students agreed that they felt bad if they got a low mark but liked that the teacher helped them understand their mistakes, so they knew how to do it next time.

Table 1

Mathematics Attitude Survey

	Pre Survey		Post Survey	
	Treatment	Control	Treatment	Control
Mean %	59.15	80.10	56.20	79.05
S.D.	23.96	18.66	27.34	19.81
N	20	20	20	20

COLLABORATIVE TEACHER FEEDBACK

Table 2**Mathematics Attitude Survey**

	P	N
Pre Survey	0.006	40
Post Survey	0.004	40

To measure any change in lower tier student achievement, the study compared six pretest assessments with the six posttest assessments using a paired F-Test. There was not a statistically significant difference ($P=0.43$) in student performance on the mathematics test before and after the feedback treatment with alpha set at $P < 0.05$ (Table 3).

Table 3**Mathematic Test Results for Treatment Group**

	<u>Pretest</u>	<u>Posttest</u>
Mean %	72.2	68.15
S.D.	11.12	13.41
N= 20 P=0.043		

At the end of the treatment period, students in the lower tier groups were interviewed in groups of five using six open ended questions relating to their views on learning mathematics and the feedback or treatment implemented by the teachers. This measure was used to gain insight into trends in student's attitude toward mathematics and the feedback treatment process. Teachers in the study were also interviewed using a focus group approach. The teachers all agreed that participating in collaborative meetings to discuss assessments of the lower tier students provided them with additional resources to analyze common and reoccurring errors in the mathematic tests. Two teachers reported that collaboration provided them with different ways to teach math concepts. All the teachers said that they found collaborating was beneficial. They

COLLABORATIVE TEACHER FEEDBACK

stated that they saw improvement in student attitudes toward mathematics during the treatment phase. The teachers mentioned that they noticed that targeted feedback students were showing more confidence and were more willing to volunteer to answer questions during class instruction as the treatment phase continued. For one student, this confidence also transferred into other subject areas as well.

Teachers reported feeling more accountability as they coordinated testing schedules and meetings to collaborate. They thought that time would be a barrier to maintaining this feedback treatment for longer periods of time. The teachers all agreed that students were receptive to the feedback and that the one to one interaction benefitted the students. One teacher noted that the treatment group of students showed an improvement in the accuracy of completed homework assignments.

All the students in the grade two treatment group reported very positive feelings about mathematics. They also stated they liked receiving one to one feedback from the teacher about their Mathematic test. A common theme for all the students was a feeling of fear about their test results. They were worried about getting low marks but liked that the teacher showed them how to do the questions that they got wrong. They all said they liked that the teacher worked through the questions step by step until they could understand how to do it. However, one student expressed that sometimes after the feedback they still do not understand. One student said that they liked the feedback but did not like that this gave less time to do work in class and therefore might have more homework.

COLLABORATIVE TEACHER FEEDBACK

Most of the students in the grade three treatment group expressed a positive attitude toward mathematics, but like the younger students felt nervous about viewing the test during feedback because of how many wrong they might get. Most students agreed that they felt bad if they got a low mark but liked that the teacher helped them understand their mistakes, so they knew how to do it next time.

Discussion

This study was limited by the sample size and is not generalizable to other schools unless they possess similar demographics. The students in the treatment group did not show any change in achievement scores on the mathematics tests during the treatment phase. This may have been due to the short time frame students received scheduled targeted feedback about their mathematics tests. Also, the tests may have increased in difficulty. After the 8week period, the attitudes of the students toward mathematics remained relatively unchanged according to the survey results. The survey may have confused some students as the questions were not all written as a positive statement. Further study with longer time frames and larger samples may offer more insight into the effect of targeted feedback and teacher collaboration on student achievement and attitude. In this study, teachers reported a benefit to providing the targeted feedback to students and they also agreed that scheduled collaboration amongst teachers was worthwhile. As Wiggins (2012) emphasized, descriptive feedback has to be actionable, related to the learnings goals and evidence based.

The collaboration provided a framework for teachers to share resources and expertise to

COLLABORATIVE TEACHER FEEDBACK

further support the lower tier students. However, this feedback treatment has implications for time management and scheduling if it is implemented over longer periods of time. As Supovitz and Christman (2003) emphasized, time for collaboration must be structured, so instructors have quality uninterrupted time in which to have the disciplined conversations about instruction and student work.

During the interviews, the majority of the students in the treatment group reported a positive attitude toward mathematics and they stated they liked getting the feedback from the teacher. However, they also expressed nervousness about viewing their test results because they did not want to see if they did poorly. Further study about feedback about assessment in mathematics and its effect on student attitude and achievement in the primary grades would be beneficial. A closer look at how attitude changes as students in lower tiers move up in grades would add to the current body of research and shed light on how learning environments can shift student attitudes and reduce anxiety about performance and achievement.

COLLABORATIVE TEACHER FEEDBACK

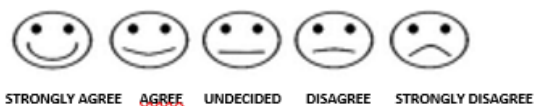
Appendix A

Student Number: _____ Grade _____ Date _____

Aiken Revised Survey

Read each sentence. Think about it and then put an X on the face to show your answer. Choose only one answer for each sentence.

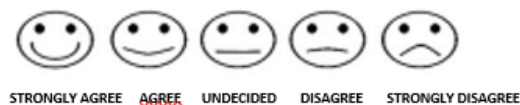
EX: 1. I think recess is fun



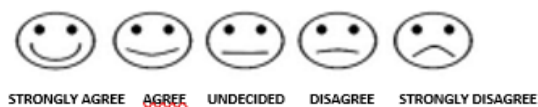
1. I feel stress in a math class.



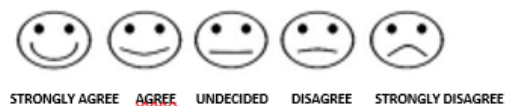
2. I do not like math



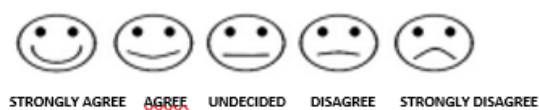
3. Math is very interesting to me, and I enjoy math.



4. Math is fun.

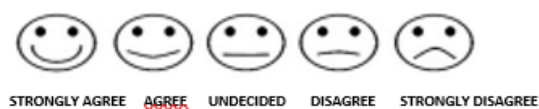


5. Math makes me feel confident, and at the same time it makes me want to learn it.



COLLABORATIVE TEACHER FEEDBACK

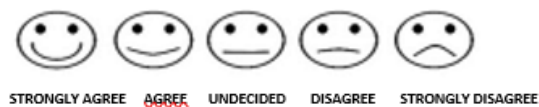
6. I feel confused or mixed up when working on math.



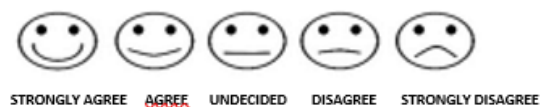
7. I feel confident when trying to do math.



8. I **do not** feel confident when doing math.



9. The feeling I have about math is a good feeling.



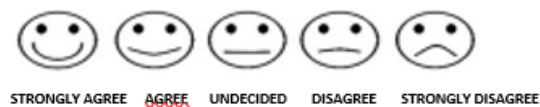
10. Math makes me feel frustrated.



11. Math is something that enjoy a great deal.



12. When I hear the word math, I feel nervous.



COLLABORATIVE TEACHER FEEDBACK

13. I approach math with a feeling of hesitation, because I think I may not be able to do the math.



14. I really like math.



15. Math is a subject in school which I **do not** enjoy doing.



16. It makes me nervous to think about having to do a math problem.



17. I have never liked math.



18. I am happier in a math class than in any other class.

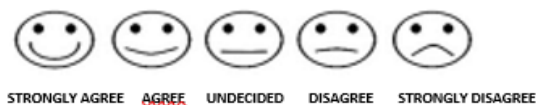


19. I feel relaxed in math and I like it very much.



COLLABORATIVE TEACHER FEEDBACK

20. I feel I have a positive attitude toward learning math and math is enjoyable.



Appendix B

Protocol for Feedback Treatment

1. Administer weekly mathematics assessment test from the Saxon program
2. Give same day feedback to Tier 1 students (5 lower tier students in the class)
3. Record anecdotal notes about error analysis and feedback

Example – process related, undue attention, understanding

4. Meet with grade partner to discuss error analysis, how feedback cycle is going, and plan instructional focus

Steps for Giving Feedback for the Mathematics Test

1. Identify areas of strengths
2. Have student look at errors
3. Discuss how the student can correct the error. Explore thought processes, prompting student to get the right answer.
4. Confirm student can apply new knowledge and-redo question to get the right answer.

COLLABORATIVE TEACHER FEEDBACK

References

- Agodini, R., Harris, B., Atkins-Burnett, S., Heaviside, S., Novak, T., & Murphy, R. (2009). Achievement effects of four early elementary school math curricula: Findings from first graders in 39 schools (NCEE 2009-4052). Washington, DC: National Center for Education Evaluation and Regional Assistance, Institute of Education Sciences, U.S. Department of Education. Retrieved from <https://ies.ed.gov>
- Australian Institute for Teaching and School Leadership, (2017). Spotlight – reframing feedback to improve teaching and learning. Retrieved from <https://www.aitsl.edu.au>
- Burde, M. (2016). The relationship between student achievement and professional learning communities at the middle school level. (Doctoral Dissertation). Retrieved from <http://scholarworks.wmich.edu/dissertations>
- Dufour, R. (2004). What is a professional learning community? *Schools as Learning Communities* (61) 8, 6-11. Retrieved from http://www.ascd.org/publications/educational_leadership/may04/vol61/num08/What-Is-a-Professional-Learning-Community%C2%A2.aspx
- Goddard, R., Goddard, R., & Tschannen-Moran, M. (2007). A theoretical and empirical investigation of teacher collaboration for school improvement and

COLLABORATIVE TEACHER FEEDBACK

- student achievement in public elementary schools. *Teachers College Record*, (109)4, 877-896.
- Hattie, J. & Timperley, H. (2007). The power of feedback. *Review of Educational Research* (77)1, 81-112. DOI: 10.3102/003465430298487
- Hargreaves, A. (2010), Teaching and betrayal. *Teachers and Teaching: Theory and Practice* (8), 3, 393-407. <https://doi.org/10.1080/135406002100000521>
- Larsen, J. (2013). Attitude in mathematics: A thematic literature review. Retrieved from <http://www.peterliljedahl.com/wp-content/uploads/Sample-Lit-Larsen.pdf>
- Literacy and Numeracy Secretariat. (2009). Impact of the literacy and numeracy secretariat: Changes in Ontario's education system. Retrieved from http://www.edu.gov.on.ca/eng/document/reports/OME_Report09_EN.pdf
- Michelli, M. (2013). The relationship between attitudes and achievement in mathematics among fifth grade students. (Honors Theses). Retrieved from https://aquila.usm.edu/cgi/viewcontent.cgi?article=1162&context=honors_theses
- Newmann, F. & Wehlage, G. (1995). Successful school restructuring: A report to the public and educators by the Center on Organization and Restructuring of Schools. Retrieved from <https://files.eric.ed.gov>
- Sims, R. & Penney, R. (2015). Examination of a failed professional learning community. DOI: <https://doi.org/10.11114/jets.v3i1.558>

COLLABORATIVE TEACHER FEEDBACK

Supovitz, J & Christman, J. (2003) Developing communities of instructional practice: Lessons from Cincinnati and Philadelphia. Retrieved from http://repository.upenn.edu/cpre_policybriefs/28

Tezar, M. & Karasel, N. (2010) Attitudes of primary school 2nd and 3rd grade students towards mathematics course. *Procedia - Social and Behavioral Sciences*, (2) 2, 5808-5812. Retrieved from <https://www.sciencedirect.com>

Wiggins, G. (2012). Seven keys to effective feedback. *Educational Leadership* (70)1, 10-16. Retrieved from <http://www.ascd.org/publications/educational-leadership.aspx>

Wiliam, D. (2016). The secret of effective feedback. *Educational Leadership* (73) 7, 10-15. Retrieved from <http://www.ascd.org/publications/educational-leadership.aspx>