

# **Teacher Leaders Supporting Sound Assessment Practices in High School Mathematics Classrooms**

**Final Research Report**

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Submitted by Richelle Marynowski, Researcher  
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## Project Overview

### Introduction

In October 2013, the Alberta Assessment Consortium (AAC) received a grant from Alberta Education to support secondary mathematics teacher leaders and teachers in implementing formative assessment strategies in their classrooms. The intent of this proposal was to build on the project that was implemented from February 2012 to June 2013 with secondary mathematics teachers in schools throughout Alberta.

Rather than providing coaching support for individual classroom teachers as in the previous study, the current project sought to build capacity by focusing support for teacher leaders. These teacher leaders held a variety of formal and informal roles within the various school sites. The intent was to model effective coaching practice with the teacher leaders and then to support the implementation of that practice as the teacher leader engaged in a coaching process with his/her teacher colleagues.

As part of the Terms of Reference for the current project, AAC was required to conduct a research study to explore the impact of formative assessment practices and professional learning practices on teacher practice, student engagement, and student achievement and to make recommendations regarding the sustainability of a coaching model of professional learning.

### Project Outline

With these goals in mind, the AAC seconded an individual with expertise in mathematics, assessment and coaching to serve as the facilitator/coach to guide the project. A sustained coaching model of professional development (PD) was used as the frame for working with the teacher leaders and teachers.<sup>1</sup>

Professional development within a sustained coaching model has the following elements:

- situated within the teacher's school setting;
- responsive to individual teacher needs and understandings;
- focused on enhancing specific aspects of professional practice; and
- provided over time.

Teacher leaders from schools that were part of the previous project were invited to participate. Two additional school sites were also included. The AAC coach initiated contact with the schools and the teacher leaders to coordinate the initial phase of the coaching process. Six teacher leaders agreed to participate in the project and formal coaching sessions occurred during the first semester of the 2013/14 school year. The formal coaching sessions consisted of the following types of professional learning activities: demonstration lessons; one-on-one planning sessions; and a coaching sequence of lesson pre-conference, lesson observation, and lesson post-conference with the teacher leader and the coach.

During the second semester of the 2013/14 school year, the teacher leaders replicated the coaching process with secondary mathematics teachers within their school. The AAC coach observed and

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<sup>1</sup> A review of literature on supporting teacher professional learning using a sustained coaching model can be found on the AAC website at: [http://www.aac.ab.ca/wp-content/uploads/2014/09/Lit\\_Review\\_Supporting\\_Teacher\\_PD\\_Using\\_Sustained\\_Coaching\\_Model.pdf](http://www.aac.ab.ca/wp-content/uploads/2014/09/Lit_Review_Supporting_Teacher_PD_Using_Sustained_Coaching_Model.pdf)

provided guidance to the teacher leader as he/she conducted lesson pre-conferences, observations, and post-conferences. One additional step was added where the AAC coach and the teacher leader would meet to debrief between the lesson observation and the lesson post-conference. During the debrief, the AAC coach and the teacher leader would discuss how to proceed with the post-conference.

### **Research Outline**

The intent of the research study was to determine the impact of the sustained coaching model of PD on teacher practice with respect to implementation of formative assessment strategies. Additionally, teacher leaders were provided with support in developing their skills as a coach within the school. The intent of including teacher leaders was to build capacity within the school to encourage continuation of coaching once the project was complete. The initial research design included student survey data regarding their perception of teacher assessment practices. However, due to difficulties obtaining ethics approvals for including student data, student surveys information is not included. The AAC coach was the liaison between the researcher and the teachers to minimize the inconvenience for the teachers. The AAC coach recruited teacher leaders and teachers and obtained ethics permissions from those who agreed to participate in the research portion of the project. The researcher obtained research permissions from the school boards and schools within which the teacher leaders and teachers worked. Each of the interactions between the AAC coach and the teacher leader and between the AAC coach, teacher leader, and teacher were video recorded. The video recordings were later transcribed and analyzed. The following is a description of the research methods used to collect and interpret the data and a description of the findings.

### **Research Summary**

Teacher leaders from six schools agreed to participate in the project. Within those schools, 18 teachers agreed to participate with the number of teachers in each school ranging from one to six. Each teacher was teaching at least one secondary mathematics course during the second semester of the 2013/14 school year. The number of times the AAC coach interacted with the teacher leaders varied from one to four times in the first semester and from four to eight times in the second semester. Each teacher received coaching from the teacher leader from one to four times. The AAC coach coordinated each of the interactions with the teacher leaders and the teachers. The researcher and the AAC coach had multiple conversations over the course of the project to confirm research questions and processes.

Each participant in this project participated in a baseline interview where the AAC coach asked him/her to describe current understandings of formative assessment. At the end of the 2013/14 school year, each teacher and teacher leader participated in an exit interview where he/she was asked to address particular topics. The teacher leaders were asked the following questions:

- Thinking back over the whole process, can you please tell me if and how your personal idea of formative assessment has changed?
- Thinking back over the whole process, can you share some of the formative assessment strategies you are personally using?
- Thinking back over the whole process, can you please tell me if and how your department's idea of formative assessment has changed?
- Are you seeing any changes in student learning (your class and/or your department) as a result of embedding more formative assessment?
- Has the coaching (demo lessons, observation) available to you around formative assessment been useful? Has it changed your practice?

- In this process, you had support as a coach. How has this support affected your coaching ability?

Teachers were asked to address similar topics and responded to the following questions:

- Thinking back over the whole process, can you please tell me if and how your personal idea of formative assessment has changed?
- Thinking back over the whole process, can you share some of the formative assessment strategies you are personally using?
- Thinking back over the whole process, can you please tell me if and how your department's idea of formative assessment has changed?
- Are you seeing any changes in student learning (your class and/or your department) as a result of embedding more formative assessment?
- Has the coaching (demo lessons, observation) available to you around formative assessment been useful? Has it changed your practice?

In addition to the baseline and exit interviews, transcripts from the interactions among the AAC coach, the teacher leader, and the teacher were included as data for analysis.

### **Data Analysis**

Each video collected for research purposes was transcribed verbatim. The information included in the transcriptions was then coded to highlight both the coaching process and the integration of formative assessment. The following codes were used:

#### Formative assessment

1. Teachers' beginning formative assessment ideas
2. Teachers' ending formative assessment ideas
3. Benefits of formative assessment as noted by the teacher
4. Challenges implementing formative assessment
5. Strategies used by the teacher as formative assessment
6. Adjustments that teachers would make to strategies they tried
7. Changes in students or learning that teachers noticed

#### Coaching process

8. Description of the coaching process in coaching teacher leaders
9. Description of the coaching process in coaching teachers
10. Benefits of the coaching model of PD
11. Challenges with coaching process
12. Changes teachers made in teaching practice due to PD

Information that did not relate to any of the above themes was not included in the analysis. If a section of a transcript was potentially viable in more than one category, a decision was made as to which category was most appropriate for the excerpt to be included, thus sections of the transcript were not included in more than one category.

## Research Findings

The findings from this research study are presented in two major sections. The first section presents an analysis of the information learned from the teacher leaders and the second section presents an analysis of the information learned from the teachers. Within each section, both formative assessment and the coaching process are addressed.

### Findings with Respect to Teacher Leaders

The teacher leaders that participated in this project included both formal leaders within the school and informal leaders. Three of the teacher leaders were in department head roles and had between two and eight years of experience in that position. Two of the teacher leaders were in school coaching roles and had between zero and one year experience in that role. One teacher leader was not in a formal leadership role in the school. The teaching experience of each of the teacher leaders ranged from five to 20 years. Only two of the teacher leaders had experienced any previous formal professional development on coaching. The following represents overall findings from the teacher leaders regarding formative assessment and being involved in the coaching model of PD.

#### Formative Assessment

Each of the teacher leaders participated in the coaching process with the AAC coach, as well as engaged in coaching colleagues in the implementation of formative assessment strategies. Of the six teacher leaders, four of them indicated that their understanding of what formative assessment was and looked like in a classroom evolved through participation in the project. Comments made by the teacher leaders include:

“I don’t think I truly knew what formative assessment meant until I actually went through this process, because I thought it was more formal – more formal than it actually needed to be.”

“I was always trying to find these elaborate ways of getting formative information, but I have learned to take notice of some of the smaller ways of picking up on some of that data...and I now know that formative assessment should be impacting my instruction somehow, if I don’t do anything with the data I have gathered, then what is the point?”

Although two of the teacher leaders did not indicate that their understanding of formative assessment evolved, all six of them indicated that their repertoire of formative assessment strategies has been increased through involvement in this project.

One teacher leader, Jolene, articulated a connection that she made regarding formative assessment through participating in this project. She said:

“I’ve seen how easy it is to incorporate formative assessment strategies into a Math class, and I think [for] the teachers also, maybe that came to their light too. That it’s easier to do than you think, and I guess the big change for me is that if you are doing good formative assessment, that also means that you are doing more student-centered learning and I think sometimes we forget that connection, that if you’re diversifying your formative assessment strategies in your lesson, then you are differentiating your instruction.”

Jolene also went on to say that she now does not separate instruction and assessment. She said:

“...it’s instruction as assessment. We say instruction and assessment all the time, but really it’s using instruction as assessment, and using your instruction to assess.”

She sees the connection between assessment and instruction so strongly now that she does not differentiate between the two of them – they are both an integral part of teaching and learning for her.

Examples of other strategies that the teacher leaders were incorporating into their lessons include:

- Using mini-whiteboards to have students explore questions to identify pre-existing knowledge that then informs the direction of the lesson
- Conferencing with students after formative quizzes to address questions and misunderstandings
- Having students complete entrance slips that are then used to group students for that day's class

Teacher leaders also expressed an increase in confidence in being able to incorporate different strategies into their classes and an increase in confidence in identifying formative assessment strategies within their own practice. For the teacher leaders, the main area of learning was with respect to being able to coach their colleagues in integrating formative assessment, which is addressed in a later section of this report.

### **Effects of Formative Assessment on Student Learning and Behaviour**

Teacher leaders were asked if they observed any changes to student learning or student behaviour throughout implementing formative assessment strategies. Three of the teacher leaders noted specific changes that they saw. One teacher leader noted that once she started encouraging students to engage with each other in class that they were more apt to ask their peers questions before coming to her, even without her specifically asking them to do so. Students felt more comfortable having mathematical conversations with each other without being directed by the teacher.

A second teacher leader found that student ability to self-reflect increased through practice. She found that if students could not identify their strengths and weaknesses well, they were not able to be as successful on summative assessments as if they could reflect on their abilities. She did not have any specific examples, but commented generally about the strength of incorporating self-reflection opportunities for students.

A third teacher leader, Sean, noted both changes in student behaviour and achievement from incorporating conferencing with individual students after a formative quiz. The purpose of the conference was so that he could address student understanding or misunderstanding on an individual basis. What Sean found was that students became comfortable with sitting down with him to talk about their quiz. At first the students waited for Sean to comment, but by the end of the term, they would start the conversation before he had a chance. Students were noting where their mistakes were and correcting them without his feedback. Sean connected the conversations with students after formative quizzes to their increased achievement on unit exams. He observed that this particular class scored 15% higher than the scores have ever been on their last unit exam. He was not sure that this could totally be attributed to incorporating individual conferences, but he did note that the conversations “opened my eyes to realize why they’re making mistakes. Sometimes they are not making mistakes because they don’t understand; if they’ve spotted the mistake and told me before I can tell them, the job is done.” Sean found that the students were catching their own mistakes, which he saw as a positive change.

A second change that Sean noted was that students were less likely to leave a question blank or put a question mark beside a question that they did not understand on both assignments and the formative quizzes. Students were more likely to try as “their risk of failure is not so high” when the task is formative. Sean noted that what students tried “might not have always been right, but they tried

something, and I think it's increased their confidence, more so in weaker students than higher level students, but I think it's helped them as well."

Being able to try out ideas or strategies on a question where the students are not confident is a significant change Sean observed in his students. Students are more relaxed to do quizzes because they are formative and the students know that if they try something, even if they are not sure, they will not be penalized for trying.

The teachers who participated in this project also noted further changes to student behaviour or learning. Those changes will be addressed later in this report.

### **Sustained Coaching Model of Professional Development**

The process that the AAC coach used throughout this project was to initially model both formative assessment and coaching before asking the teacher leaders to engage in the practice. The teacher leaders experienced what the coaching process, with a focus on formative assessment practices, felt like before they engaged with their colleagues in coaching. Each of the six teacher leaders identified that engaging in this project increased both their ability and their confidence in their ability to continue coaching their colleagues. Specific characteristics of the sustained coaching model were identified by the teacher leaders as being key components that contributed to the success of the model. The characteristics are that the

1. AAC coach was experienced in secondary mathematics;
2. modeling of formative assessment practice was within the teacher's own classroom;
3. coaching was embedded in the daily work of the teacher and of the teacher leader;
4. focus of the coaching and observations was on a specific area, and was non-evaluative; and
5. model provided a structure that could be followed by the teacher leaders as they transitioned to coaching on their own.

Each of these characteristics is described further below.

#### **1. Experienced in secondary mathematics**

Sean commented that having a coach that was a mathematics specialist gave credibility to the project which encouraged teachers to engage. He had experienced a "natural dissent" from teachers when they had been offered professional support from non-subject specialists. Particularly in secondary mathematics, the teacher would be less likely to turn over his/her classroom if the coach did not have subject expertise.

Sara echoed Sean's comments about the coach needing to have subject expertise. She said, "If they didn't have experience at a high school math level, how would they be able to model it?"

#### **2. Modeled within the teacher's own classroom**

Sara described that when the AAC coach modeled a lesson for one of the teachers in her school, the teacher was able to see how her students reacted to the formative assessment strategies. She said, "The real power was that it was her kids and she could see how they were reacting to different things. She could see which ones it was working really well for, and she could see which ones it wasn't working so well for, and she understood the dynamics." Sara felt that a teacher observing a different class might not glean as much from the modeling as observing her own class.

Brad also commented that having the practices modeled was a key component of this project and teachers can then “see things in action” in their own space and that is what teachers have been saying that they want.

3. Embedded in the daily work

Brad commented that having a coach come to the school to provide support within his context was effective. He said, “I really think this is the model that works because it was job embedded. We could have easily sent our teachers to a conference for two days and then they come back and nothing happens. But this job embedded approach is the direction we need to go...I think it works.” Brad was seeing growth in his ability to coach his colleagues and their willingness to participate.

Janet commented that “when you were my coach in the first semester, I would absorb what you were doing with me and sort of appreciate your role, and how you did pre and post discussion with me, the kind of topics you brought up, and then it was a fairly quick turn around because then I got the opportunity to do that with teachers.” She found that she could now have conversations with teachers that were non-threatening and help both of them grow as professionals.

4. Focused coaching and observations that were non-evaluative

Because the observations and conversations were centered on formative assessment practices, both teacher leaders and teachers felt more comfortable with being involved in the process. Jolene commented, “It really helps to have something specific to look for when you watch someone teach.” Brad also commented that observing and commenting on specifically what the teacher is doing with respect to formative assessment has “opened up another way to have a conversation” with his colleagues.

Sara also stated, “I’m not here to evaluate, I’m not here to give you all the answers. I’m not here because I am better than you. I’m here as an extra set of eyes to sit and watch. I’m here to give you some feedback, and some ideas to make it better.” She found that she has more confidence and that her colleagues feel less threatened with her going into their classrooms.

Nancy also found that “it was easier to watch teachers and give feedback because I was looking for formative assessment. And it doesn’t have to be formative assessment, it could be classroom management or how you are explaining concepts, whatever, but that targeted observation I found that helpful.” Targeting a specific practice assisted Nancy in her observations and she noted that, whatever the practice was, knowing what she was observing for ahead of time helped both her and the teacher she was observing.

5. Provided structure

Using a consistent framework for the coaching provided the teacher leaders with a process that they could follow and a process that they could have their teachers engage in with peer observations. Sara was planning on having the teachers in the mathematics department complete peer observations in the next school year. With regards to the process, she said, “It’s good for me to know how to coach so I can share that with my colleagues because we are all going to be coaching each other.” Sara felt confidence in being able to assist her colleagues in coaching each other because of her participation in this project.

Jolene commented that engaging in this project was “so much more powerful” than learning theoretically about how to coach. She felt that the practical aspect of this project helped her really understand the process of coaching. Sara said that experiencing being coached “provided me with a framework” for engaging with her colleagues.

Brad clarified what he appreciated about the coaching model.

“I really like the coaching model. I think the benefit of it is that there’s a structure to it. I’ve always struggled with being told to go work with a teacher, but how I am going to work with this teacher so that it is successful? But this model, where we watched, then we planned, then we watched again, then we discussed. It was systematic.”

As a new Learning Coach in his school, Brad found that he now had a way to work together with his colleagues where they did not “feel like their autonomy was being removed from them” and that they were learning and working together.

### **Benefits and Barriers**

Both benefits and barriers of implementing the coaching model were noted by the teacher leaders. Barriers to implementing the coaching model that were identified by the teacher leaders centered around initial uncertainty about the process and the role that the teacher leader was supposed to have within the school. Uncertainty surrounding the coaching process included nervousness on the teacher’s part in having someone come into their classroom and observe his/her practice. Words like ‘comfort’, ‘safety’, ‘threatening’, and ‘fear’ were used by teacher leaders to describe how their colleagues felt about having someone in their classrooms. Those teachers that were comfortable welcomed the teacher leader in; those that felt threatened did not. Ensuring that teachers knew that the observations and ensuing conversations were not evaluative was important for the teacher to feel comfortable being part of the project. Teacher leaders also noted that their colleagues might not have wanted to be a part of the project to protect their students, specifically teachers who were teaching Mathematics 30-1. Those teachers did not want to try something new or to disrupt those students who felt potential pressure in a Grade 12 mathematics course.

Many of the benefits that were noted by the teacher leaders were in conjunction with aspects of the coaching model that were described above. Other benefits included the teacher leaders having more confidence to engage in future coaching. Sean said specifically that “I feel this experience has certainly equipped me with better skills to be a coach.” Sara described that engaging in this experience had a great impact on one of the teachers that participated in this project from her school. This particular teacher “did not have a strong voice” in the mathematics department and through this project she got her voice and “was very positive about the experience and was encouraging others” to talk about their teaching. Additional benefits that were noticed were that teachers in the mathematics departments began talking about their practice and were interested in seeing each other teach.

Teacher leaders were very positive about the experience of having coaching modeled for them, then being able to practice coaching their colleagues. In the next section, findings with respect to formative assessment practices and the coaching process from the teachers who participated in the project are presented.

## Findings with Respect to Teachers

Eighteen teachers participated in this project with the number of teachers in each school ranging from one to six. Teachers had from one to 21 years of teaching experience. Two of the teachers had taught in other countries, two teachers had taught in other provinces in Canada, many of the teachers had taught in levels other than secondary, and two teachers had taught subjects other than mathematics.

Teacher participants in this project had various experiences with and beginning understandings of formative assessment, from being very confident in their understanding to expressing uncertainty with what formative assessment looks like in a classroom. The number of times that each teacher participated in the coaching process ranged from one to three times. Of the 18 teachers, three teachers participated in the previous AAC project. The findings from this project with respect to formative assessment practices and the coaching model of professional development are presented in the following sections.

### Understanding of Formative Assessment

Four of the 18 teacher participants in this project commented that their understanding of formative assessment changed through engagement in this project. Six teachers found that their understanding of what kinds of activities could be considered formative assessment was broadened. Five teachers did not indicate that their understanding of formative assessment was broadened but they did discover new strategies that they could use.

The remaining three teachers did not find that their understanding of formative assessment or formative assessment strategies was influenced by engagement in this project. As two of these teachers participated in the previous AAC project and the third teacher was previously on an assessment leadership team within her school, this finding was not surprising.

Teachers whose understanding of formative assessment changed made the following comments:

“I always thought that formative assessment had to be something that I took in and I took home and then revisited the next day. What I was able to see was more immediate forms of formative assessment, and immediate feedback, which is then of course much more powerful. And just to see how strong it was, made me want to do more of that in my lessons... And it doesn't have to be from me. That was another big thing, my ego has to be put aside. I don't need to tell them what they're doing right or wrong. It could be either themselves or somebody else and that shifted my focus.”

“I used to think that formative assessment was something that was written down, and now I've come to realize that just talking with the students is formative assessment, having them talk to each other is formative assessment, them evaluating themselves is formative assessment. I always thought it was me sort of evaluating them, giving them a mark that didn't count for marks. But now I know that it's not just that, it's much more than that.”

“What I was able to gather through your experience, and sharing with me what I should be looking for to help students become more aware of what their goal is, what their objective is, what are we trying to do, and it changed in the way that I am being more aware, I'm being more reflective as I'm teaching each lesson, and to give feedback, and how each students get different feedback. Normally what we talk about to give feedback, put it on the slip. But, if I give you written feedback, not every student can understand what they're reading. So to give feedback in the form of written, auditory, visual, I think that's all a part of it.”

The idea that students could receive feedback, both from the teacher and from peers, was a key idea that appeared through each teacher's comments. The understanding that formative assessment does not have to be a formal process or has to be written down and recorded somewhere was another major theme that ran through all teachers' comments.

### **Formative Assessment Strategies Used**

Each teacher identified formative assessment strategies that they were either introduced to through seeing them modeled or that were discussed with them by the teacher leader or AAC coach. The three formative assessment strategies that teachers identified as their 'most used' or that best fit their students are described below.

- Using mini-whiteboards or classroom whiteboards

This strategy was the one most frequently mentioned by teachers. Generally, having students answer questions on mini-whiteboards or having students work on the classroom whiteboards was identified as a way to get students engaged in the work and to break down student fear of participating in class. One teacher described how she found them useful in her class:

"The use of the whiteboards worked really well. I had never really thought about it, and it did work well with my students. When you need to do graphing and they have to sketch something, that went really well. Or even factoring, and showing their process and showing a few others. I also used the students going on the chalkboard, doing a question, and then we look at their answer. And I think that they don't feel threatened. I think that it was a good way for them to see that they can show what they know, and that we go from what they know, and we expand on it. Because even just showing their work, they were proud to show that they knew something that helped their learning to actually see: I know that, and he knows that, and so then, I'm not too bad."

A second teacher commented that even though he does not have mini-whiteboards in his room on a consistent basis, when he uses them he finds that every student participates, which isn't usually the case. Having student work more visible makes the students feel like they have to participate even if they don't want to.

- Peer feedback or working together in groups

Another strategy that was frequently mentioned was having students engage with each other in different ways to provide feedback. Students having focused conversations with each other getting feedback on their work and discussing strategies appeared in many different forms in teachers' comments. From having students seated in groups to students giving formal feedback on a specific piece of work, the specific strategies each allowed students to learn from each other throughout the class. One teacher explained how she was getting students to engage with each other more often. She said:

"I think now I'll group the students based on how they did the day before. So I'll put the students into groups, I didn't really do that a lot before. I used to have them sit in rows, look at the front and pay attention to me, but now I have a lot more group work, and put the ownership on them a lot more. Having them discuss with each other, having them help each other out, so the stronger kids working together, but sometimes having the stronger kids helping the weaker kids."

A second teacher explained that having the ability to seek and give feedback from each other instead of waiting for the teacher to give the feedback was a main skill that he was trying to develop within his students. Students initiating mathematical conversations and being resources for each other was a key aspect of formative assessment for this teacher. Other teachers indicated that having students access each other as resources made the class more interactive and dynamic, and that it did not always matter whether the activity was structured by the teacher or if the students initiated their own conversations.

- Bellwork or entrance slips

Several teachers talked about strategies they used to gather information about student learning at the beginning of class. Bellwork, entrance slips, 'do-nows' and mini-quizzes were all names that were used to describe a similar strategy: getting students to answer questions on the last day's topic or as a preview for the current class. One teacher described how she uses this strategy in one of her classes:

"This year my bell work was based on prior knowledge. For my grade ten classes, I looked at the grade nine curriculum and that was what my bell work was based on. When they first walked in to class, there were grade nine questions to try and see who remembered that kind of information. Formative assessment to see if I could move on to the new topic and that worked really well."

Other teachers used entrance slips to identify if students were able to complete questions on the previous day's topic or to determine student groupings for the day's activity. One teacher was using different coloured pieces of paper for each unit or set of outcomes for his entrance slips so that students had a collection of questions that were easily grouped for studying purposes. Teachers also commented that they found entrance slips to be more effective than exit slips because feedback was immediate to the students, not the next day, and then the teacher could engage immediately in providing any necessary remediation.

Teachers in this project were using many other formative assessment strategies including self-assessments, specific questioning strategies, chapter checklists with outcomes and questions related to that outcome given, and walking around while students are working to observe where students were experiencing difficulty and success. Each of the teachers involved commented that they found incorporating formative assessment opportunities for students to get feedback from the teacher and also from each other to be beneficial to student understanding.

### **Benefits and Challenges**

Teachers noted both benefits and challenges to incorporating formative assessment in their classes. One benefit was from a teacher who said that he found his students were taking their work more seriously once they started working together and comparing solutions and answers. Students soon realized who in the class was interested in working and who was not and the students moved to different groups depending on their work ethic. That students were comfortable moving around and were using their time in class more effectively surprised the teacher.

A different teacher, Carl, noted that students seemed to be more confident about their abilities through engaging in formative assessment activities. This teacher said:

"It takes away that sort of scare factor they are seeing. I tie in the AFL's that we're doing to potential exam questions they are going to see so it sort of alleviates some of that test anxiety

for the students. They often will see very similar questions, and so it gets them more confident that they're going to be able to handle a very important assessment later on. I think that confidence piece is huge for students because they're often so opposite, they're not confident in their math skills at all, so AFL's are just a way to sort of coach. Like in Phys. Ed., how we're assessing along the way so that we're not assessing all of Phys. Ed. based on one outcome of one game, we can sort of build them up to that."

Improving student confidence through incorporating formative assessment strategies into the class was a major benefit for this teacher.

Another teacher, Alex, described his classroom as being "more organic" and having more flow where students can get support when they need it, in the area they need it, based on the formative assessment. He said:

"I think formative assessment allows us to flow with the class, flow with the students more than just getting our idea of: this is where I want to be, this is where I want to end up, and I think it helps us realize where students are struggling, and where students are feeling success. There is no reason to spend 40 minutes on an area that our students are mastering, and the same thing, blowing through a lesson and then realizing, oh maybe they didn't catch some of that stuff. I think the biggest part of formative assessment is the pacing and making sure that you start thinking about where students are at, and what they need to work on. It really allows you to individualize the program: a student is struggling with this, give them an extra question to work on, or a group is struggling with this, pull them aside and do some whiteboard work with them while the other kids work. I think that's something that pretty traditionally hasn't been seen in the classroom environment very much. It has been the teacher up in the front, everybody is getting the same content, and everybody's doing the exact same thing. But I think with formative assessment you can start individualizing your practice and helping out students on an individual basis a little bit more."

Alex clearly sees that formative assessment has helped him to identify student needs and to be able to individualize assistance to students more often. He views that being able to attend to individual student needs is one of the major benefits of incorporating formative assessment strategies.

Brian describes that he finds balancing both listening and movement within his class with formative assessment activities benefits his students. He said:

"I don't mind having students sitting down and doing some practice, I think that's really important but I also need to be up, I need to be moving, I need to have some energy in the classroom. And I think, the group work, working on the whiteboards, gets students up and gets some blood flowing to their head. You know this practice of sitting and listening, and then sitting by yourself and doing practice, I feel like there are times where students have to do both of those, but there are also times where they can be up and problem-solving and struggling with things with a partner. I think it's made the class more dynamic, more interesting. As a teacher, you're able to give quicker feedback to students on where they're at and I think there have been some real benefits for students to see a variety of formative practices, that's for sure."

Brian identifies that balancing teaching practices provides students with opportunities to engage with mathematics in different ways. Being able to provide students with immediate feedback on their learning, in both group and individual contexts, benefits students.

As for challenges, one teacher commented that incorporating new procedures into his class after the routines for the class had already been established caused some students to be “thrown for a loop”. He thought that starting the semester with some of the strategies would be more beneficial. A second teacher felt that “letting the kids do their thing and investigate and work together rather than me at the front” was a risk and she had to learn to let go of the control. She realized that students were engaging in the activities and were demonstrating their learning, but she still experienced tension in moving away from being at the front of the classroom.

Having students self-assess was a challenge for another teacher. He noted that one group of students did not engage in the self-assessment activity as he had hoped. Over a couple of months, he stopped asking them to comment on their own work because so few were effectively doing it.

### **Effects of Formative Assessment on Student Learning and Behaviour**

Teachers observed several changes in student behaviours and learning through incorporating formative assessment strategies. Five of these changes were described earlier in this report: 1) students were no longer being fearful of contributing to class discussions and showing their work; 2) every student in the class was participating and answering questions; 3) students initiating their own mathematical conversations with classmates; 4) student confidence in their mathematical abilities increased; and 5) test anxiety decreased. In addition to the changes previously noted, teachers identified that many students did not rely on the teacher as much for information and clarification, that students were more likely to ask each other first, rather than ask the teacher first.

One teacher found that her students asked for more opportunities to engage in different formative assessment opportunities. The students did not want to sit still in their desks; rather they wanted to engage with the content and with their peers in different ways.

A different teacher, Marla, commented:

“I was a little bit worried about the group work, thinking that the students would come in and be like, ‘I don’t want to work with that student’ or just reluctant, and now they come in, ‘Oh who am I working with today?’ I was surprised with how open they were to working with each other, and that they are used to it now. ‘Oh today do we have groups or are we sitting in rows, or what’s going on today?’ They expect different activities and they don’t make a big fuss about it anymore. And they are still learning. It surprises me, it’s awesome, and I like it.”

Marla was surprised that her students were open to working with others in the class and that the students were demonstrating mathematics learning even though they were engaging in group learning opportunities.

James also incorporated students engaging in peer conversations and receiving peer feedback in his class. What he found was that:

“The groups that students were working together with at the beginning of the term definitely split up and then reformed. It seemed like different people really matched up well, some of my kids that were chatting more with the kids that didn’t do the work as much, they really separated themselves; they went and sat with somebody else to focus more. They still chatted but you could tell you were sitting over there with this group, but now you’re sitting with this guy. You’re starting to take it a little more seriously, and even though I don’t think they quite realized that they were taking it more seriously, they, on their own, got up and would move on, just because they were able to. They liked sharing their answers with each other, whereas the

other ones who weren't working, they weren't getting that feedback, so then they, on their own, changed, which is a pretty big difference for these guys."

James was surprised that students were seeking out different groups to work with based on their engagement or lack of engagement with the material. He had thought that his students would stick with their social groups, but some students chose to move, potentially not attending to the reason that they moved was the quality of feedback that they were getting from that group.

Another teacher found that his students demonstrated perseverance with questions that were more challenging when those questions were identified as being for formative purposes. He did not think that students would have persevered on difficult questions if they were being graded. A different teacher, Lin, echoed the above idea of perseverance and commented specifically:

"Students are more positive, more outgoing. They're not afraid to make mistakes. They're not afraid to challenge the questions and make mistakes and see where they're going wrong."

Lin's comments reflect a positive change to the classroom environment that allows for mistakes to be seen as an opportunity for growth instead of punishment.

Each of the changes in student behaviour or learning was identified as a positive change. Teachers noted surprise at some of the student behaviour that they saw as a result of incorporating formative assessment strategies. Some teachers did not expect that there would be acceptance from the students regarding certain practices, for example: working with different peers and individual conferencing with the teacher. The next section presents findings with respect to the coaching model of professional development from the teachers' perspective.

### **Sustained Coaching Model of PD**

Each teacher was positive about the model of coaching that was used in this project. Even though some teachers experienced only one coaching session, those teachers still found the immediate feedback on their teaching to be valuable.

Teachers that had the AAC coach model formative assessment within their classes expressed that seeing their students engaging in the activities gave them information about the effectiveness of those activities for their students. One teacher commented that, had she observed the same lesson in someone else's class, she would not have found the lesson as valuable.

Several teachers commented that they were worried at first about having someone come into their classroom to observe them. Even though the teachers knew that they were not being evaluated, they were still nervous. One teacher commented:

"I think it's intimidating at first to even think about somebody coming in, because you feel like you have to have something exciting to do. Or teach a certain way, but it was really easy. Way easier than I thought it was going to be, even the meetings – 10 minutes here, 15 minutes there – I haven't been stressed out about it at all. Even when I wrote the question down wrong, I was still very comfortable with you being in there."

Other teachers echoed these comments in that they were initially a little afraid, but once they realized that the observation was about helping them grow in formative assessment practice and not to criticize, there was no fear present. The combination of positive comments, as well as areas that could be adjusted being the focus of the coaching sessions, helped the teachers feel more comfortable with the process.

Teachers commented that engaging in this project was more valuable than going to a traditional workshop or professional development session. One teacher said, "I think it is great because it is real." She also commented that having someone observe the class, provide feedback, then come back to see how the teacher is implementing strategies provides for great learning opportunities for the teacher.

Another teacher said that seeing the formative assessment strategies in action and having a conversation with someone about the strategies and how they might be adjusted was of great benefit to him. Specifically, he said:

"Coaching is very one-on-one, which is very good. In a workshop you are going to have maybe 20 to 40 people in a room learning. Whereas you get that really good one-on-one, specific ideas that meet your teaching style, and your specific courses. It is just far more meaningful when it is coaching."

The practicality of the feedback from the teacher leader was important to the teachers. Receiving feedback tailored to their own context was a key aspect of the coaching model that teachers appreciated.

## Conclusions

### Overall Conclusions

From both the teacher leaders and the teachers who engaged in this project, the model of coaching was seen as beneficial by both groups. The teacher leaders found that engaging in being coached helped them learn how to coach their colleagues. Then being able to practice coaching with support helped the teacher leaders to feel more confident in their abilities. Teachers appreciated receiving feedback on their formative assessment practices in their context with their students. Incorporating formative assessment was perceived as being beneficial to the teacher in learning about how students understand and beneficial to the students in feeling more confident when they were engaging in summative assessments. Being able to provide sustained, in-context coaching has been seen to be effective in supporting teachers in their practice yet is potentially costly. However, by working with teacher leaders to build their skills in coaching, the need for an external coach is decreased. Schools can then build capacity within their teacher leaders to support teachers within the school.

### Limitations and Recommendations

Three limitations have been identified regarding this research project, which form the basis for recommendations.

1. The first limitation is that there is a small population of teacher leaders and teachers that engaged in this project. Having approximately 20 teacher leaders with approximate 100 teachers would be a more robust study with generalizable results. Ensuring that the sample of schools participating included rural and urban sites proportional to the school population of Alberta would also increase the generalizability of the results of the study. Also, a larger teacher leader and teacher population can contribute data that will allow for a comparison of teachers who have a solid beginning understanding of formative assessment with those who do not and how coaching influences the practice of both.

2. A second limitation to the current study is that the student voice was unable to be captured. Due to complications obtaining consent forms from students, student data was not included in this report. Hearing from students about their experiences and how formative assessment is impacting their learning is important to further understanding the impact formative assessment has on students themselves. With a recommended approximately 100 teachers, a small sample of 10 – 15 students in each class would provide a substantial sample to provide generalization about the impact of formative assessment on student learning.
3. A third limitation is that the AAC coach both provided support and inquired into the effectiveness of the support. Two teachers commented that they thought having the AAC coach also ask if the model was effective biased the results. Teacher leaders and teachers may not have been comfortable saying that they did not find the professional learning model effective. However, we trust that the teachers gave their honest opinions on the project. Ideally, the person providing the coaching support would be different from the person who interviewed teacher leaders and teachers about its effectiveness. However, due to monetary constraints, this was not possible in this study.

With these limitations in mind, further research into sustained coaching is warranted incorporating a larger sample of teacher leaders and teachers, the student voice, and a separation between the person providing the coaching support and the person collecting the data.