How do Students Respond to a Team Based Competitive Starter Activity Across a Course of Six Weeks?

Abstract

A competitive team-based starter activity was implemented in maths classrooms across six Further Education colleges in Lancashire. The intervention period lasted six weeks, with one activity per week. Students completed a questionnaire before and after the intervention period, and teachers were asked to do the same. In addition, teachers were also asked to complete a weekly report on the activity after each session. Observations and focus groups were also planned. The COVID-19 pandemic had a significant affect on our data collection, in particular the quantitative element. However, qualitative reporting shows that the intervention had a positive impact on student-teacher relationships, and communication within the learning environment.

Introduction

The Network

This research was led by Nelson and Colne College Group [NCCG] and Runshaw College [RC] with a network of ten Further Education [FE] providers across Lancashire and Yorkshire. The whole process adhered to the key principles of action research (McNiff; 2013). Development of this research has been undertaken with the wider network attached to NCC and RC since the start of the process.

Why choose Motivation and Engagement as a Theme?

Re-sitting maths GCSE can have a significant effect on an individual's life and progression. Reforms in Britain dictate that students must re-take failed GCSE qualifications, giving FE providers a second chance to change the way students view, engage, and learn in maths classrooms (Anderson 2015).

We, as a network, believe that teachers must strive to develop new and innovative ways to teach GCSE maths to re-sit students. Evidence shows that there is a negative correlation between the number of attempts a student has, and the likelihood of them passing GCSE maths (Rodeiro 2018). Therefore, we must act to reverse the negative attitudes that students have upon entering the re-sit cycle, with the aim of reducing the number of attempts students have within GCSE maths.

Both maths motivation (MM) and maths anxiety (MA) can have a detrimental effect on student learning and progression. Low levels of MM and MA result in low levels of progression; whereas moderate MA and moderate to higher levels MM seem to be beneficial (Wang et al. 2015). Professional judgement and experience helped us focus on MM during our first action research cycle; we felt we could impact motivation more effectively in the short term, subsequently expanding our knowledge to repeat the research cycle, with the intention of investigating the wider field of MM and MA.

Influencing motivation and developing behaviour has a grounding in Skinner's Operant conditioning (McLeod 2018) which states giving positive reinforcement to an individual to encourage a specific behaviour. Isolated, a single reinforcement can cause feelings of anxiety if a student doesn't gain the reward. We must support reinforcement by developing student autonomy and enjoyment. It is critical that reinforcement is stimulating to the specific population it is aimed at, otherwise, it cannot be classified as positive (Johnson 2016). Careful consideration was given to the type of reward that could be used with maths re-sit students; it was agreed that points would provide the initial reward, with a prize for the winning team at the end of the competition. As a network we agreed on the idea of team competition with rewards, removing emphasis on individual success and encouraging peer to peer support.

DiNapoli' s (2018) article suggests that collaborative group activities consistently provide higher levels of student progression compared to individual competitive tasks. He set up an activity whereby students in a year ten class worked in teams to compete within the maths classroom. A synopsis of the rules from DiNapoli (2018) can be found in *appendix one*. Results of this classroom intervention proved to increase student motivation, and statistically improve their behaviours, attendance and test scores.

This article resonated with the research team and provided a guide for the design of a starter activity we could implement. The network felt it was a different approach to starters currently used in their classrooms. Additionally, professional experience led the partners to support this idea as something they felt could have a positive impact on motivation levels.

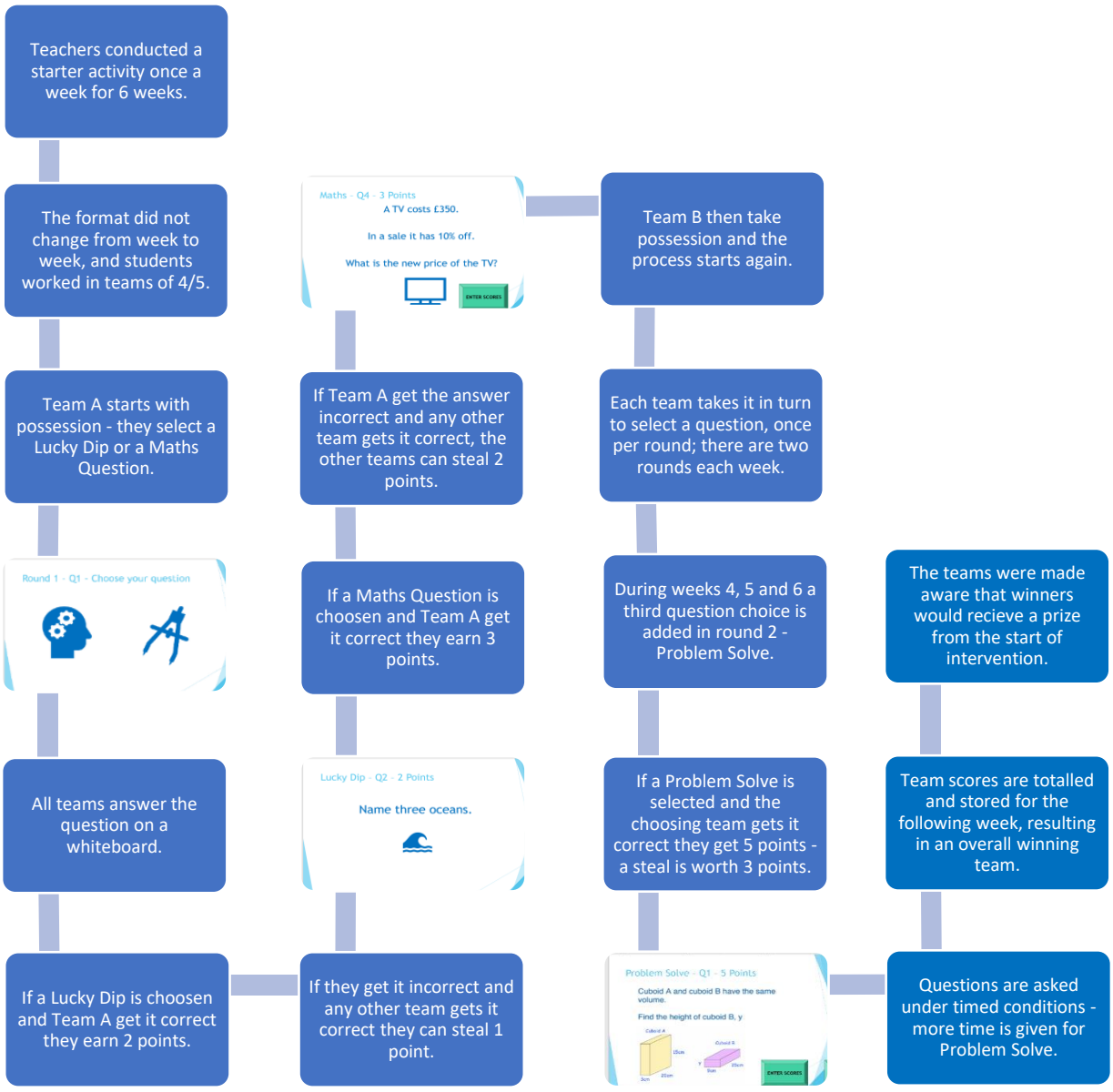
Guiding Sub Questions for Design, Implementation and Analysis

1. What signs do students show of engaging with the starter activity?
2. What behaviours are observed during the competition?
3. How do students' attitudes and opinions alter over the six weeks?

Method

Seven of the ten network partners opted into the implementation phase. Twenty-three teachers then volunteered, and selected one class from their setting. Implementation involved a six-week programme of starters, inspired by DiNapoli's (2018) activity structure. Each teacher was given access to a Padlet where all resources, questionnaires and help aids were located. Teachers were contacted and supported directly by the Project Coordinator to ensure a standardised level of support was received by all.

The Starter



All intervention resources and data collection tools can be accessed via the Padlet;
https://padlet.com/g_ramsden1/r6corxqfb04f

Data Collection

A mixed method approach was taken. A pre and post questionnaire was conducted with both students (*see appendix two*) and teachers (*see appendix three*). These were completed one to two weeks prior to implementation, and following implementation. A weekly report was completed by each teacher following the completion of the activity each week (*see appendix four*). The design of these captured both quantitative and qualitative data guided by the sub questions.

Observations were conducted by the research team in weeks five and six (*see appendix five for observation schedule);* student focus groups were scheduled following the implementation phase, these were to be influenced by post questionnaires and team observations. At this point, it must be noted that due to government restrictions put in place in the wake of the COVID-19 pandemic, focus groups were not conducted as scheduled, and post questionnaire data was not as comprehensive as we had planned. Students took part in the study as they were part of one of the teachers' classes. They were aware that the activities were part of a piece of research and completed all questionnaires voluntarily.

Data Analysis

Motivation is difficult to measure, we rely on an individual's ability to express their personal feelings and thoughts using the measurement tools provided. This type of research provides rich and detailed data (Carter et al. 2014). However, a qualitative methodology can be subject to interpretation, therefore, to increase validity, we triangulated using the below methods;

- Student and teacher – pre and post questionnaires
- Weekly teacher reports
- Observations
- Student focus groups

Once data had been collected, analysis using excel looked at trends in the data from pre and post questionnaires; team members also compared percentage trends across the six weekly reports completed by teachers. A thematic analysis was carried out on the qualitative data.

As previously noted, focus groups were not conducted, and a large amount of post questionnaires were not completed by students. We collected an initial 231 pre-questionnaires from students and just 28 post-questionnaires. To account for this, the team extracted classes that did complete both questionnaires when conducting direct comparisons between pre and post student data.

Results

References to supporting evidence will follow the citation guide in *appendix 6*.

Sub Question 1 – What Signs do Students Show of Engaging with the Starter?

Every teacher that responded to post-intervention questionnaires mentioned that students liked the activity and "enjoyed using them" (*T3; PQ*). They regularly commented that "students enjoyed the competition" (*T13; PQ*), and noted that there was "a good mix of questions which engaged learners" (*T4; PQ*). Teachers felt "the task was well presented and very engaging" (*T22; PQ*).

From week one "learners became competitive and realised that in order to win they would have to answer a maths question as this was worth more points" (T11; W1). They enjoyed the idea of winning so developed strategies, they "started on the lucky dip but did go to maths because they wanted more points" (T4; W1); they developed an understanding of the rules to maximise rewards.

As the weeks continued "students [were] enjoying this activity overall and ask about it… [if it didn't] appear to be there at the start of the session" (T14; W5). This was really pleasing to hear, and provides evidence of students engaging with the concept of competition. However, care must be taken when assuming this was due to the learning taking place during the intervention; this engagement could be a result of taking part in something different to the norm.

Students were equally as positive in their feedback of the intervention. Analysis shows that 58% of students surveyed described the activity using the words 'interesting' or enjoyable'. All other responses included words such as 'good' and 'OK'.

"They were very exhilarating and a great starter to get into the thought of maths and they really helped" (S6; PQ)

"Better than the old ones everyone's more involved and gets the class talking whilst learning things" (S23; PQ)

Although we were not able to collect results from all students who took part, this snap shot of opinions is promising. To further support this, in an observation, it was noted that during round one when students picked maths and general knowledge questions some team members were engaged but others sat back, however, when problem solving questions were introduced in round two entire teams were more involved. It was clear to the observer that the students were actively engaged in the problem-solving questions through body language, team members leaning into one another and discussions were on task.

Sub Question 2 – What Behaviours are Observed During the Competition

During an observation in week five the team reported students looking relaxed throughout the starter, on task, discussing, and offering answers. Only one student portrayed negative body language. All teams picked maths questions in round one and problem-solving questions in round two. This class clearly understood the rules of the activity and how to win; body language from students was overwhelmingly positive, but with one student disengaged.

In another observation of a different class, in a different centre, during week six, the observer reported a relaxed atmosphere. The teacher used this activity as a starter for the second half of a lesson, following a break. This quiz was encouraging the students to return to class on time following the break, suggesting a positive effect on behaviour during the course of the intervention period.

Sub Question 3 – How do Students' Attitudes and Opinions Alter Over the Six Weeks?

Positive comments throughout the intervention increase. There was a dip in week five, teachers noted feelings of frustration from students, and some "losing interest" (T11; W5). Overall, reflections in week six were positive; and teachers found the intervention period engaging for students. The most notable change observed by teachers was that students were more open to asking questions, and communication improved. Students became more vocal "both between each other and myself (the teacher) ...and are more vocal in asking for help" (T4; PQ). The intervention encouraged students to become "more inquisitive and… to ask questions." (T13; PQ). It's clear that the intervention has opened a line of communication between teacher and student. This style of activity, which encourages team work and supports autonomy, would be a great way to start the academic year and build a positive student teacher relationship.

It's interesting to note that teacher's attitudes also altered during the intervention period; in *figure 1*, teacher's attitudes towards students' abilities to achieve became more favourable.

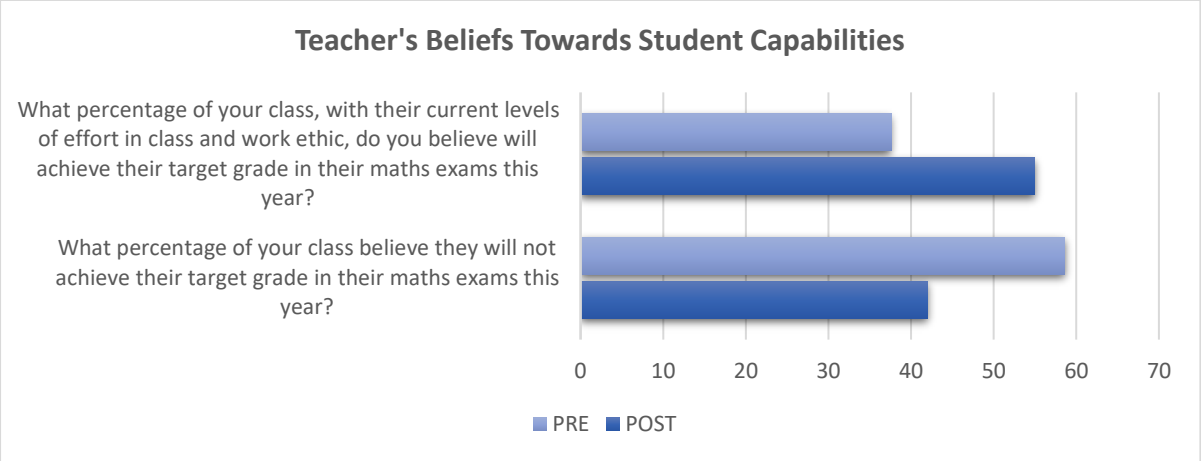


Figure 1; Graph to show the positive change in teacher attitudes towards statements.

Short Term Rewards Result in a Positive Effect

Weekly reports, on multiple occasions, show that "students opted for lucky dip at the start but as the game progressed opted for maths questions" (T4; W2). Teachers found this activity gave students autonomy. They decided whether to pick a maths question, "the choice of questions gave them more buy in" (T4; PQ). "Students were more vocal in asking for help and prepared to show answers on whiteboards; Students worked more effectively with those in their teams, helping other [students that] they would not usually talk to" (T4; W4). This is something we need to capture and replicate to support learning. Student questionnaires support this shift in communication (*figure 2*).

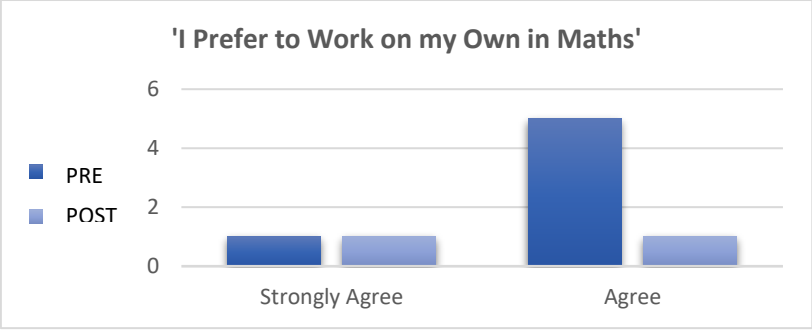


Figure 2; Graph to show the change in student attitudes towards independent working – students in class teacher 19.

Furthermore, one teacher is "planning to add in this type of activity next year to each class group" (T14; PQ). Teacher 14 felt their class responded really well to the immediate reward gained by choosing maths questions, and the autonomy had an excellent effect on this class.

A Positive Impact – Teachers Who Embraced the Intervention

"Interesting that the students were concerned about the difficulty that they perceived of the problem-solving questions so after the end of the quiz we went through those questions and they then thought that these were much easier than they had believed. This has a positive effect on confidence and allows the students to see that their confidence can be raised" (T14; W6).

This represents the feelings of numerous teachers. Notably, those teachers who engaged with the intervention fully got more out of the activity and they completed a full set of teacher data. As a team, we recognised that some classes maybe simply didn't like or enjoy the task and no matter how committed a teacher is, it could never engage them. However, it is important to note that those teachers who stopped weekly reports at week one and two did not report positively on the activity.

Negative Teacher Attitudes and Low Expectations of Students

Prior to the intervention, teachers were asked to describe, in general, attitudes and opinions of their class. The responses were overwhelmingly negative. A third of the eighteen teachers didn't have a single positive comment to make. Only one teacher was completely positive - "Students have a good attitude and opinions towards maths" (T19; Pre-Q). Interestingly teacher nineteen's students were all studying BTEC science, they have chosen to study a maths heavy course; therefore, they can see the benefit of mathematics for their chosen course and career. Only one response mentioned the need to try and change or reverse negative attitudes of students to support learning - "This is something that needs to be worked on in many cases before the teaching and learning can take place" (T11; Pre-Q).

Students questioned prior to the intervention reported low levels of self-belief.

Whilst 66% of students believed they were capable of getting better at maths, only 75% of these believed this would translate to improving their GCSE grade this year.

To some, 66% may be a high percentage, however, as teachers we must encourage self-belief in all students and not only a percentage of them. When students exhibit low levels of confidence in self-growth, a negative teacher belief could have a detrimental effect their mind set. A self-fulfilling prophecy may occur where students begin to behave in a particular way as a result of the persistent expression of negative teacher attitudes, albeit, likely to be unconscious, most of the time. This is not clear cut and requires a deeper exploration.

Some Negative Impacts on the Lesson

It is important to note the negative effects these activities had on some classes. Teachers reported some students were distracted during the remainder of the lesson, and it was "quite hard to get them thinking about maths again and concentrating" (T11; PQ); "they were more giddy and harder to settle" (T12; PQ) after participating. On the other hand, teachers also reported that following the starter the "high energy continued throughout the class" (T4; W4). Upon reflection, during weekly report, both teacher 11 and 12 report high levels of engagement with maths questions over general knowledge, therefore, they experienced the benefits of the activities. Maybe this could be explored further, focusing on the transition from an activity like this and embracing the benefits.

Opportunities for Future Research and Teaching Practices

Teachers regularly noted that "learners do not see the relevance" (T11; Pre-Q), of their maths lessons and fail to "see the importance" (T10; Pre-Q). This led the research team to question what these terms mean, and what students understand by them. One teacher says students "protest about content [of the lessons as] they believe they will not use [it] in life" (T22; Pre-Q), another says students undervalue their maths education, "they do not see the importance of maths qualifications" (T10; Pre-Q). This could be a failing of the system, we must show students how maths is relevant for the future, whilst exploring how we can unpick the ambiguity in terminology.

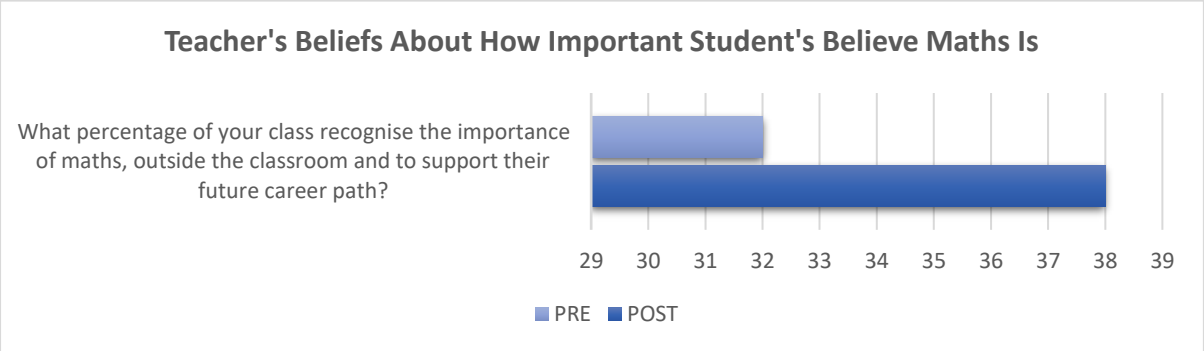


Figure 3; Graph to show the change in teacher belief about students views on the importance of maths for real life.

With this in mind, *figure 3* poses the question of what exactly changed during the intervention period to influence this change, and what do students understand about why maths is important.

There were differing opinions on the logistics of the intervention. One issue was the length of task, one teacher suggested we should "make it just one round rather than two" (T12; PQ); some teachers found it difficult to stick to the time frames prescribed. Maybe future use of this activity should utilise just one round; however, there were teachers who argued it was a great length. Teacher autonomy needs to be utilised here.

Although all students taking part in the intervention were re-siting GCSE maths, "some students found most of the questions difficult… [and] were unable to answer any of the questions" (T22; PQ). The research team asked teachers to conduct these activities as prescribed, however, FE providers differ on which prior grades sit GCSE and Functional Skills. Future research could use similar working grade students, or develop alternative questions to avoid this becoming a barrier to participation.

Issues were also apparent in the scoring system. Students became frustrated, they didn't "see the point in answering the question [if] they [knew] the choosing team [would] get it right and… get the points" (T12; PQ). Additionally, "they were annoyed that they could not score points when another team got the question correct" (T11; PQ). A future possibility could be that students receive one point for a correct answer when the choosing team also get it correct, and a choosing team wins an extra point if no other team gets the answer correct.

Conclusion

Students' current reward system for GCSE is a grade at the end of a 9-month course, and for some students visualising the final outcome is difficult or impossible. This starter activity allowed students to see an immediate benefit (increased points) associated with choosing a mathematics question over a lucky dip. This provided students autonomy within the learning process, and they were able to make the decision to do maths. Giving students a choice, albeit guided by the curriculum, is something that requires further exploration, but potentially has fantastic benefits.

This style of activity, which encourages team work, whilst supporting student autonomy, would be a great way to start the academic year. Teachers could utilise this activity format to encourage communication which may contribute to increased progression throughout the year, if solid relationships are created from the outset. As a result, the team would advise anyone considering trialling this activity in future to run it within the first term, as it could cement class relations earlier, and boost students' confidence in being more vocal.

The activity itself would benefit from a tweak to the scoring system, enabling teams to score half points, or bonus points each round. A minority of teachers raise concerns about the level of the questions asked; this will always present a problem with externally set questions with no prior knowledge of the students. One way to overcome this is, to ask teachers to set appropriate level questions for their own classes.

Any follow up to the research must look at minimising the loss of engagement from some students for the remainder of the lesson whilst simultaneously maintaining the enjoyment, competitiveness and engagement as a result of the starter activity. Reducing the time spent on the starter may be one method to accomplish this as many teachers commented that it was taking longer than the scheduled 15 minutes. It may also be beneficial to observe a class prior to the intervention and potentially after to gain an objective view of class behaviours.

It was noted that teachers' comments, when asked to describe their classes, were overwhelmingly negative, or at least highlighted any negative attributes and behaviours over positive ones. Research into the effects of these beliefs on resit students could be very illuminating, especially given the number of students who felt that they were unlikely to improve their maths grade this year. As a research group we discussed how these negative attitudes might affect the motivations of the classes. We proposed a possible piece of action research to understand whether attitudes of teachers are influenced by a specific class, or whether an intrinsic belief in teachers influences the behaviour of their classes year on year. Research suggests that positive attitudes are required for effective teaching (Stronge & Hindman 2003), and strong relationships increase student learning (Goodman, Orange and Schumacher 2017). Therefore, intrinsically negative teacher attitudes could have a detrimental effect on students' beliefs about their ability to progress, and succeed.

The intervention appeared to have a positive impact on the classes who participated in the full six weeks. Those teachers who embraced the activity, and the process of feeding back to the research team, reaped the benefits. Students found the format engaging, and evidence shows that it encouraged them to choose to answer maths questions. Additionally, this activity elicited an increase in mathematical communication, both between peers, and also between the students and teacher; sometimes leading to an improvement in classroom relationships. These findings support DiNapoli's (2018) findings around collaborative competition and its positive effects on student behavior. Overall, this piece of research had a positive effect on student communication and relationships in the classroom.

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Appendices

Appendix One

Rules of Basketball Activity (DiNapoli; 2018)

1. A class is split into teams A, B, C and D
2. Team A starts with possession of the ball
3. All teams are presented with a Maths problem
4. If team A answers correctly;
    a. Team A receives 1 point AND
    b. Team A receives an additional point for each opposing team who answers the Maths problem incorrectly AND
    c. Team A can earn a further 1, 2 or 3 points by making a 1-, 2- or 3-point basketball shot
5. If team A answers incorrectly;
    a. Team A receives 0 points AND
    b. Opposing teams received 1 point for answering correctly AND
    c. Team A does not take a basketball shot
6. Team B then gets possession of the ball and the process starts again
7. Each team possesses the ball once per quarter and the team with the most points by the end of four quarters wins

Appendix Two

Student Pre-Questionnaire;

https://forms.gle/Y2SCZqAK7CsvMxgaA

Student Post Questionnaire;

https://forms.gle/DpJd8PfkhzD5AnQE9

Appendix Three

Teacher Pre-Questionnaire;

https://forms.gle/dkgitesDTw6d54ZU9

Teacher Post Questionnaire;

https://forms.gle/rfHZ76U9H1E6EnJC8

Appendix Four

Weekly Report 1;

https://forms.gle/g1a9BZEisndzotif6

Weekly Report 2;

https://forms.gle/TzvxrJAq7JuUnA9G6

Weekly Report 3;

https://forms.gle/vxFuQCpNJy8jq84L7

Weekly Report 4;

https://forms.gle/URyJJLpntvPWYCJw6

Weekly Report 5;

https://forms.gle/s7ewYzcjryiWJXtW8

Weekly Report 6;

https://forms.gle/U7wFZeQdJTBnMAkA8

Appendix Five

Class Code: …… Date: ……..

Observer: ……. No of students: ……..

Start of the lesson (before activity): 0 to 5 minutes		
Negative body language Anxious Looking out the window/around the class Mobile phone use Sleeping/Head on desk	Laid back Quiet Some individual participation Some group participation Some looking out the window/around the room	Positive body language Prepared for the lesson Relaxed
During the Activity: 5 to 15 minutes		
Negative body language Anxious Looking out the window/around the class Mobile phone use Sleeping/Head on desk	Laid back Quiet Some individual participation Some group participation Some looking out the window/around the room	Positive body language On task Relaxed Offering Answers Taking a lead/High participation Discussing with others
During Final Phase of Activity: 15 to 20 minutes		
Negative body language Anxious Looking out the window/around the class Mobile phone use Sleeping/Head on desk	Laid back Quiet Some individual participation Some group participation Some looking out the window/around the room	Positive body language On task Relaxed Offering Answers Taking a lead/High participation Discussing with others
Further comments		

Appendix Six

Results Referencing Guide

Reference	Meaning
T1	Teacher 1 Statement
S1	Student 1 Student
Pre-Q	Pres-Questionnaire Quote
PQ	Post Question Quote
W1	Weekly Report 1 Quote
W2	Weekly Report 2 Quote
W3	Weekly Report 3 Quote
W4	Weekly Report 4 Quote
W5	Weekly Report 5 Quote
W6	Weekly Report 6 Quote