



**CENTRES FOR
EXCELLENCE IN MATHS**



Can a gamification strategy enhance student engagement both inside and outside of FE maths classrooms?

Matthew Hanson, Mamta Arvind, Sarah Bond and Jessica Margiotta.

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About CfEM

Centres for Excellence in Maths (CfEM) is a five-year national improvement programme aimed at delivering sustained improvements in maths outcomes for 16–19-year-olds, up to Level 2, in post-16 settings.

Funded by the Department for Education and delivered by the Education and Training Foundation, the programme is exploring what works for teachers and students, embedding related CPD and good practice, and building networks of maths professionals in colleges.

Summary

This action research project is primarily concerned with raising the motivation and engagement levels of GCSE maths resit learners by implementing a gamification strategy in maths sessions. We have chosen this topic as low motivation in maths is an ongoing challenge faced across FE colleges, owing to experiences of underachievement at secondary school which negatively affects learners' self efficacy. The gamification strategy involved awarding points to students for demonstrating certain actions: attending lessons, being punctual, showing positive behaviour in class and providing peer support. Points were given by the teachers but self-recorded on points tables placed inside of students' books.

In this project, we used a mixed method approach of both quantitative and qualitative data, with four staff participants across three colleges in our network (Leeds City College, Keighley College and Calderdale College), and approximately 82 learners involved in our data collection set. We compiled data using an initial survey for students, both teacher and student interviews, teacher reflections and an end point survey for learners, in order to capture whether there were any shifts in the learners' levels of motivation and engagement as the project progressed.

We found the trial of using a points based system to be an overall success, recording positive feedback from both the students and teachers regarding its implementation. Students identified the element of competition to be the most enjoyable aspect of the system. This was a particularly interesting finding as current research is conflicted as to how beneficial establishing competition between students can be. Whilst it carries a risk of demotivating learners, we conversely found that learners' engagement increased.

All of the 4 participating teachers commended the points based system as an effective tool in increasing student engagement within the classroom setting, reporting that the learners were increasingly engaged in sessions, including increased interaction with peers to offer support within class. Indeed, we observed a marked increase in peer support during the course of the project, as we found during the initial survey that only a minority of learners helped others; however by the end of the project this had become a regular feature that was observed by the teachers.

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Background

Introduction

Leeds City College, with more than 20,000 students, is one of the largest education institutions in the country. For the academic year 21/22, we have 3700 GCSE Mathematics enrolments. In comparison, our two network partners, Keighley College and Calderdale College, have smaller cohorts, but their maths policy and attainment figures are in line with ours.

Over the past three years, our GCSE Mathematics results have increased, rising from 15% for grades 4-9, to 30% for grades 4-9. Centres for Excellence in Mathematics has afforded our maths teachers the opportunity to network, learn, share, grow and access FE relevant and high quality CPD, and in-house support alongside expert external guidance has aided this success and grade progression.

College goals

Students are at the heart of everything we do at Leeds City College, and our values put students first. We strive to be an outstanding and market-led further education college that delivers excellence. Our vision, mission and values guide us as we continually improve and expand our offering to learners.

Our vision is, “to be a UK leader in vocational and academic education.” Through our academic and vocational education provision, we continually push to provide our students with their best possible experience as well as exceed expectations of our stakeholders. By delivering excellence, we continue to work towards our vision to be a UK leader in vocational and academic education.

Research Aim

Engagement levels in GCSE Mathematics is one of the biggest challenges we face as practitioners within the FE sector - learners arrive at college demotivated in maths after previously negative experiences of the subject. Typically, we face poor engagement, motivation to learn and attendance. In order to improve this situation, we need the sessions to be enjoyable for students. This in turn will enhance their chance of further progression and achievement.

Our action research project therefore aimed to address this problem and was based around raising our learners' motivation and engagement levels. In order to achieve this goal, we explored how the use of a gamified approach to classroom delivery within an FE maths context could increase our learner's engagement with the subject.

Our plan was to use this idea, across three cycles, with eight controlled groups of learners within Leeds City College, Keighley College and Calderdale College. This gamified approach was linked with both maths mastery and pedagogy teaching methods within the classroom.

Research Objectives

(RO1) To look into previous research and literature reviews to identify if similar Gamification approaches had an impact on the motivation and engagement of learners.

(RO2) To deliver and analyse the effectiveness of using a Gamified classroom strategy with regard to the improvement of learner motivation and engagement.

(RO3) To design and implement the use of a points based rewards system to capture learner engagement within eight maths classrooms.

(RO4) To increase the engagement levels with online learning platforms in maths.

(RO5) To disseminate findings with our network partners and cross college curriculum and make recommendations for future delivery models.

(RO6) To analyse whether the use of a reward based approach adds value to learning of mathematics and has an impact on learner engagement and overall enjoyment of maths.

Literature Review

Introduction

Across our network, one of the most common concerns that teachers have voiced is about the impact and importance of learner motivation and engagement on the achievement of learners. Although this has always been an obstacle particularly regarding learners in Further Education colleges, maintaining levels of engagement has become increasingly challenging due to the disruption of COVID-19.

The challenge of maintaining learners' motivation and engagement has been perpetuated by the Government implementing compulsory maths and English education to learners who did not achieve a grade 4 in these subjects within secondary school. Students often arrive at FE colleges with very little motivation towards maths due to experiences of failure and underachievement at secondary school, where they have had years of experiences that have shaped their opinions about their low self-efficacy. These experiences can negatively affect student perceptions of education and reduce their motivation to learn in the future, and it can become increasingly difficult for teachers to help students change their beliefs. Therefore, research focused on motivation and engagement in mathematics is particularly important, especially given evidence that links low levels of student engagement with academic underachievement (Martin and Marsh 2006).

We at Leeds City College therefore try to incorporate proven strategies to assist motivation and engagement across our cohort. We do this through a variety of methods, e.g. by teaching in smaller groups where possible, and ensuring that personalised help is available through our study coaches and by attending our ILZs (Independent Learning Zones, where learners work on their personalised goals with the support of a coach). However, as aforementioned, this issue with motivation is still one of our principal obstacles in improving student achievement and attendance, and so we are looking to improve on this topic.

Within Hebert's (2018) inspiring TED talk on the power of gamification in education, he talks about how education has not changed since it started. We may have superficially made changes to what's on the surface, but what's underneath has not significantly changed. Hebert (2018) reported that learners think education is boring and repetitive, and suggests that we need to make a change in education to make it more exciting and engaging. As such, we are participating in research around this field, with our own project investigating the impact of using a gamified approach to increase learners' engagement and attitude to learning in GCSE Maths.

Keywords: motivation, gamification, feedback, engagement, FE, GCSE maths resit

Existing research about gamification in Further Education

Although there is a significant amount of research that emphasises the relationship between motivation, engagement and achievement of mathematics in a classroom setting, the majority of the work focuses on students in middle or secondary school. There is limited research around the setting of Further Education, and the nuances and implications that accompany this. Thus our main reasoning for applying the Gamified approach to our maths setting was to both improve the impact on motivation and engagement for learners and to add to the body of gamification research in Further Education.

Our initial desk research allowed us to define gamification as the use of game elements in non-game contexts (Detarding et al, 2011) and how this can be applied in the context of a maths classroom. Existing research explores different gaming elements such as the use of leaderboards (eg a board that shows the names and positions of the leading competitors in a

competition) and point based systems to motivate and engage learners to want to keep learning maths. The existing research around this topic often looks into how gamification can benefit learners studying mathematics and how effectively a teacher implements this in their classroom. It differs from game based learning (use of an app) in that a gamified approach applies aspects of a game in a non-game context. In our case, a maths classroom. Our literature review covers a selection of more than fifteen articles that are overall pertinent to our project. We have observed some common themes across the various articles, which we will detail and discuss below.

Game-based learning vs. Gamification

When learning takes place in a gamified classroom, it can result in active learning, which in turn promotes increased motivation and engagement (Auvinen, Haukulinen and Malmi, 2015). There are several studies which discuss the effects of game playing within maths lessons and the positive impact this can have on learners. Both Fenfeng and Graowski (1997) and Buckheister, Jackson and Taylor (2017), for example, found that playing games within a maths lesson improved students' attitudes towards their maths learning and therefore increased engagement. Both of these studies suggest that this was due to the co-operative nature of game playing, and the opportunities it created for peer discussion and feedback.

There is an important distinction however between game-based learning within a classroom, where maths games are used as part of the learning process to achieve skills and improve knowledge, and where classrooms are gamified. Furdu, Tomozei and Kose (2017) provide further clarification as to how a gamified classroom operates: 'Gamification is used to transform the learning experience into an educational game by using game elements to motivate and keep students active (usually by a system of rewards or by indicating their level of performance)'. Gamification is not therefore about creating games for students to use, but rather making education more engaging and fun for learners. One of its benefits is that the use of gaming elements, such as points and leaderboards, are not only relatively easy to implement, they can run alongside pre-existing and traditional classroom assessments (Dichev and Dicheva, 2017).

A distinction also exists between shallow forms of gamification and deep gamification. The shallow process involves a simple system of points and badges being allocated to learners and therefore a simple form of feedback being provided. Whereas for deeper gamification to occur, there needs to be challenging elements, and interactivity which allows for increased levels of feedback (Dichev et al, 2014).

Key Principles for Gamification

Stott and Neustaedter (2013) suggested that, in order for gamification to be effective and impactful, it should apply four key principles:

1. ensuring learners have the freedom to fail;
2. providing rapid feedback;
3. enabling progression through levels or missions; and
4. having a storytelling or narrative element.

The researchers proposed that including these four pillars in a gamification approach serves to increase feelings of agency and ownership in the user, and ultimately better engagement. These four principles are described below:

1. Freedom to fail

Gameplay frequently gives users a 'freedom to fail' by enabling players to start over from their last saved point, or by allowing them multiple lives. Stott and Neustaedter argue that applying this concept to the classroom is crucial as this encourages learners to make numerous attempts at their work or at certain questions, and provides formative feedback. Lee and Hammer (2011) likewise acknowledge that "keeping the stakes low" helps to foster a positive relationship with failure, so that learners can keep trying until they succeed. Gee (2008) further consolidates this viewpoint when suggesting that the only way to learn how to play the game is to fail at it repeatedly, learning something each time. It thus seems clear that, by framing failure as a necessary part of learning, gamification builds up the resilience for students to have another go, focussing on the process rather than the outcome. In a typical classroom context, the onus is on the end result (eg. a grade 4) and not necessarily mastering areas of the subject.

2. Rapid Feedback

Feedback and praise is widely accepted as being an essential factor at generating positive engagement and motivation amongst students, but within a gamification context, there is a consensus that feedback should be rapid and immediate as the instant feedback acts as a 'stimulus' for further activities (Blohm and Leimeister, 2013). In game-play and gamification approaches alike, earning points, advancing levels, unlocking achievements, earning badges, and moving up on a leaderboard are all forms of feedback about users' progress and behaviour within a system. Stott and Neustaedter (2013) advocate that the use of points is the most motivating means of rapid feedback, as it moves away from the finality of a grade and a sense of failure, whilst also generating healthy competition. This is echoed by Erickson et al (2018) who suggest that an effective method is displaying points visually, ie. on a leaderboard, as this provides recognition and motivates other students to gain more points.

3. Progression

Students typically progress through levels or stages in a gamified classroom, which mirrors scaffolded instruction which already exists in modern day classroom pedagogy (Hogan and Pressley, 1997). This allows for students to have incremental goals, with the notion that their engagement with the process will continue as they can visibly see themselves progress through different levels and stages, and therefore want to continually progress. This has the benefit of providing small, achievable goals for learners, and takes away the emphasis on successful outcomes at the end of their course of study (Dichev et al, 2014).

4. Storytelling

The final gaming element that is recommended in a classroom setting is the use of a narrative. By using story-telling, the experience of the 'player' or learner is enhanced and the length of their engagement with the process increases, as well as having fun when taking part (Kumar and Herger, 2014). Stott and Neustaedter suggest that achieving a goal through an entertaining and interesting way gives the learners experience and an alternative path to achieve specific targets. Whilst acknowledging that the storytelling element isn't necessarily crucial for progression, they recommend this game dynamic because it makes things significantly more interesting and appealing. Erickson et al (2018) also acknowledge that a narrative element can help engage users and compel them to continue, though they argue that a story does not need to be fantastical and may be as simple as providing a meaningful problem to solve with the learned material.

Considerations when using gamification

Using a gamified approach in the classroom carries with it a risk of demotivating students, as some learners may be discouraged from participating from the outset, or motivation may be reduced as they compare their performance to their peers. Blohm and Leimeister (2013) found that whilst the use of leaderboards improved motivation, they warned against making it mandatory for students to take part, as they believe 'the effort, not mastery, should be

rewarded, and the students should learn to see failure as an opportunity, instead of becoming unmotivated or fearful.' If learners are not scoring highly in comparison to their peers, they may wish to withdraw from the process, and if unable to, will be increasingly demotivated. The learners therefore need to be willing to engage in the gaming process if we are to see an impact on their motivation (Dichey and Dicheva, 2017).

It is also important to note that competition is not a motivator for everyone, and there is some disagreement amongst researchers regarding the effectiveness of a competitive gamification approach in relation to engagement. For example, Le Bouc and Pessiglione (2013) found that competition leads to an increase in effort and attempts, suggesting an increase in motivation towards a task, whereas Toda et al (2018) found that some learners became demotivated during their study. They concluded that a competitive gamified classroom involving leaderboards and awarding points can in fact have a negative impact, resulting in indifference, loss of performance and resulting undesired behaviours. Conversely DiMenichi and Tricomi (2015) proposed that while competition may increase attention, the presence of a competitor may have detrimental effects on memory and performance.

Gaps and limitations in the literature

The majority of research seems to focus on outcomes and achievement. Our approach differs in that we are concerned with motivation and engagement. It is widely considered in the literature that these attributes have a direct link to achievement.

Research also places more emphasis on game based learning (eg the use of an app), rather than a classroom based gamified approach. Many of the above findings cited sources largely pertain to secondary schools or universities, with data somewhat lacking in regard to the impact an FE environment has on motivation and engagement, so often the different contexts can make the findings difficult to apply to our own cohort and research.

Some studies, such as Auvinen et al (2015), found that the students who were most motivated by their gamification-style approach were those that were already high performing students. Auvinen et al also argued that these high performing students were motivated by a visual leaderboard. These visualisations are important - not only to our high performing learners - but also our less able. Although initial tangible rewards are on offer, the project will ideally steer the way that Auvinen et al observed, this is without giving tangible rewards. This FE based maths project, therefore, belongs to learners of all abilities and backgrounds.

Conclusion

The purpose of this review was to examine researchers' commentary on learner engagement with learning maths in a gamified environment, and the various concepts which may influence that level of motivation and engagement. This is an extremely relevant topic because in FE maths we classically suffer from poor engagement, attendance and motivation to learn. College continually reminds us that our sessions need to be 'fun', which in theory leads to better attendance. This also enhances the chance of further progression and achievement, and has led us to a particular drive in wanting to better understand how we can improve learner participation in maths.

The literature we have reviewed accentuates that for a Gamified approach to be successful, this requires both full teacher and student buy in. This is a particularly relevant finding for our research project, as this backs up our plan of trialling gamification with eight groups of learners. Indeed, we have shaped some of our initial discussion questions to the student participants around their feelings of playing real online games, to analyse how this is viewed across these cohorts. So, it will therefore be interesting to verify if our own learners correlate with the research.

Also as part of our project, we are aiming to analyse whether the use of a leaderboard adds value to learning of mathematics rather than be used just to encourage competitiveness amongst the groups. This was also discussed during the articles we read, though with conflicting opinions regarding whether all students (regardless of ability) are actively engaged by visual results. We have therefore incorporated this concept into our data collection also, creating questions that target whether value and merit is actually achieved through gamification. Overall, our project, and largely the articles we have reviewed, details the reasons and factors why learners might not engage with a gamified approach in the classroom. It is crucial to understand this, so that we can better plan and adapt our teaching strategies in what has - due to the pandemic - been a tough two years for FE and wider education. Strategies such as Gamification, are therefore seen as key in freshening up maths delivery in the future.

Methods

Overview

Our research project used a mixed method approach utilising both quantitative and qualitative data across three research cycles. We had four teacher participants across three colleges in our network: Leeds City College (Printworks campus), Keighley College and Calderdale College, with 82 learners involved in our data collection set, though we did experience a decline in learner responses towards the end of the project. In terms of data collection methods, we decided to compile data using an initial student survey, teacher and student interviews, and an end point student survey for learners in order to capture whether there were any shifts in the learners' levels of motivation and engagement as the project progressed. Our staff participants also wrote a reflection piece to substantiate our data further. Our students provided consent during the initial survey and were informed about how we would securely and confidentially store their data, confirming that any sharing of data with our network partners for dissemination would be entirely anonymous. We also gained consent during the interview process, in which they stated if they agreed for the interview to be recorded, and whether it should be audio only or visually recorded. The learners were able to withdraw from the study at any point.

Data collection methods

- A verbal '**initial**' **short discussion** was undertaken by each teacher with their participating maths students across the three college sites in our network (Leeds City College (Printworks and Keighley campuses) and Calderdale College). The six discussion questions were designed to gauge initial feeling and understanding of what gamification is and to ask for experiences of playing games. After the discussion, the teacher then completed a short summary of the findings.
- An **initial survey** for students received a 100% response rate. This survey was created via Google Forms because this is a familiar platform to our students, with a succinct design (13 questions with an approximate completion time of 5 minutes). Where possible we used multiple choice or tick box style questions, with only one open-ended question as we noticed in previous projects that these questions are often left blank.
- Four individual face to face **teacher interviews** were conducted at the end of **cycle 2**. There were 11 open-ended questions that aligned with our research objectives.
- A total of 13 face to face **interviews with students** were also conducted at the end of **cycle 2**. These 13 learners were chosen at random based on their responses from the cycle one survey. We began the interview with introductory questions about their general experiences of Maths to open a dialogue. We then asked 9 questions that corresponded with our research objectives. Some questions overlapped with those asked in the teacher interviews, however we rephrased the questions slightly to ensure the learners' understanding, and asked follow up questions to the learners if they had any difficulty answering.
- An '**end-point**' **online survey for students** received 75 responses from a total of 82 learners. The final survey was also conducted via a Google Form. We collected information about their experience of the project and if there was a shift in levels of

engagement and motivation towards their maths session. We also ascertained feelings towards a continuation or expansion of the gamification process.

- **Teacher reflections** were gathered from the four teachers via google docs to triangulate the data and identify similarities and differences between the teachers and students perspectives of the project.

Thematic coding

For the qualitative data from the interviews and from various survey questions, we thematically coded our results. We did this one question at a time, and used a different tab on Google Sheets for each question for clear organisation.

We simplified each part of the answer from the participants into a condensed summative statement or 'code'. Once we did this for all the responses, we then began to tally and count how many of each code there were. We were then able to clearly see that certain codes had some overlapping or similar qualities, and we were able to group these into thematic codes. We then used a filter to rank the frequencies so that our data was ordered from most common code to the least common code.

This process was helped by transcribing the interviews, as we became very familiar with the data and this certainly helped to facilitate our identification of common strands. The fact that we transcribed the data for the interviews also meant that we had little cleaning to do in terms of correcting typos for example, and we were also able to convert speech into proper English as we went along, e.g. by transcribing the students' "cos" as "because" etc.

Results and Discussion

Participants

Of the 82 learners initially involved in the project, 44% had a Minimum Target Grade (MTG) of a grade 4, and 30% were working towards a grade 3. A small minority of learners were working towards a grade 5, grade 2 and grade 1. By the conclusion of the project, there were 75 active participants. This type of baseline data provides an insight to the subsequent findings, so that we can contextualise the overall ability of the learners' we were investigating.

Intervention

Three research cycles were conducted between November and April. Students were awarded points by their teachers, which were self-recorded on a points tables placed inside the front cover of their exercise books. This was to make students self-autonomous in collecting their points and limited the impact on workload for the teachers. Students received points for the following consistently across all three cycles: lesson attendance, punctuality, positive behaviour in class and providing peer support.

Cycle 1 ran for five weeks, and during this cycle, students also received points for mock exam attendance, acting on feedback from the mock and returning any additional mock papers outside of their normal maths sessions. This was altered for the second cycle, which took place over 9 weeks. We wanted to further assess the impact outside the classroom, so awarded points for homework tasks completed through any online platforms. As this project was being conducted across three different sites / colleges, we did not specify a particular online platform that students needed to use. For the final seven-week cycle, in response to observations made by the teachers about the significance of points for mock exams attendance and feedback, we replicated the first cycle to focus again on mock exams as opposed to online homework.

Findings

From all the data collected, we have identified the below themes to be the most significant findings:

Points Based System

The points based system was well-received by both students and teachers. In the final student survey, we asked learners which activities they received the most points for during the project. The majority of learners said they received the most points for 'attendance', with a slightly smaller proportion saying 'behaviour'. The third most popular response was 'helping others', whereas only a small number of students said 'tasks outside the classroom' (See figure 1).

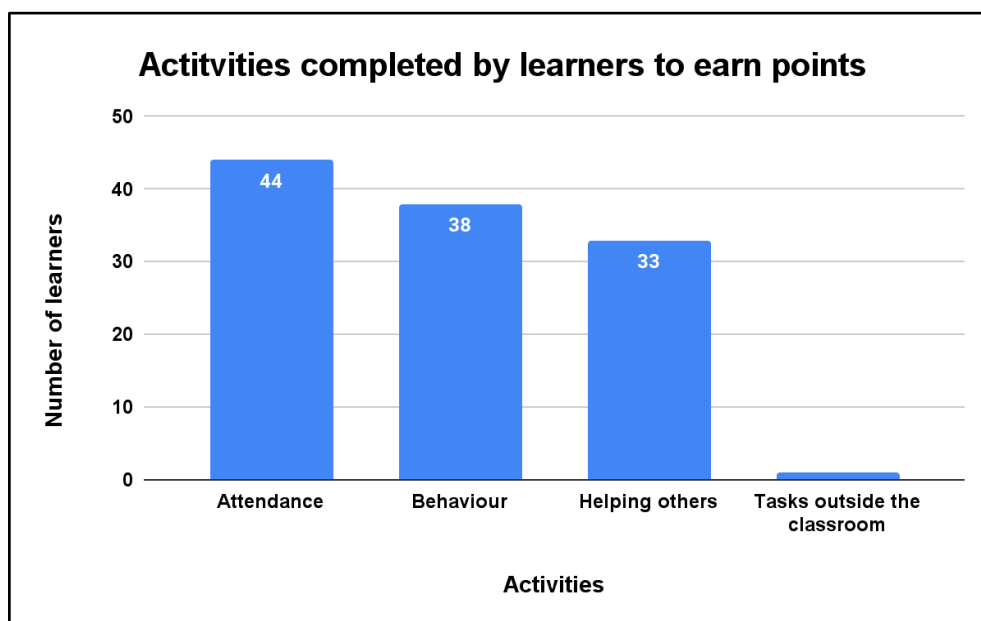


Figure 1

In the student interviews, learners were asked what they had done to gain more points during the first and second cycle. Responses supported the findings from the survey demonstrating that in order to obtain more points, students improved their attendance and behaviour in sessions (Figure 2).

Student A	<i>Yeah I've been more motivated than at the start of the year... I go to more sessions, and the more I am motivated to just get it done.</i>
Student B	<i>"I've tried to have a better attitude... And learn, and pay more attention."</i>
Student C	<i>"Yeah, I've not been wasting time, I'm trying to get on with the lesson."</i>

Figure 2

Although we did not include negative points in our points based system, at the end of our second cycle, we wanted to establish both teachers' and students' views on the potential impact this could have introduced. All of the teachers said that they did not want negative points being used as they believed it was *'better to award more to the ones who are doing what they're supposed to do'*, or they would rather *'give no points'*. The data from the students however, suggested they would like to see its introduction: 8 out of 13 students interviewed were for introducing negative points, with 4 being against it and 1 unsure. Due to the teachers' feelings about it however, we decided not to include negative points into our research.

Motivation and engagement

When asked whether the learners enjoyed participating in the project, 88% said they enjoyed it (66 out of 75 learners). Motivation with maths played a huge role behind our project. Figure 3 highlights that the vast majority of our learners said the points based system increased their motivation as it *'helped me to make progress'*. A smaller proportion of learners answered either that *'it was fun'* or that the points based system allowed them to *'get a*

reward'. Although not highlighted on the chart, a minority of learners mentioned other features, such as, *"helping others if they are stuck in a question"*.

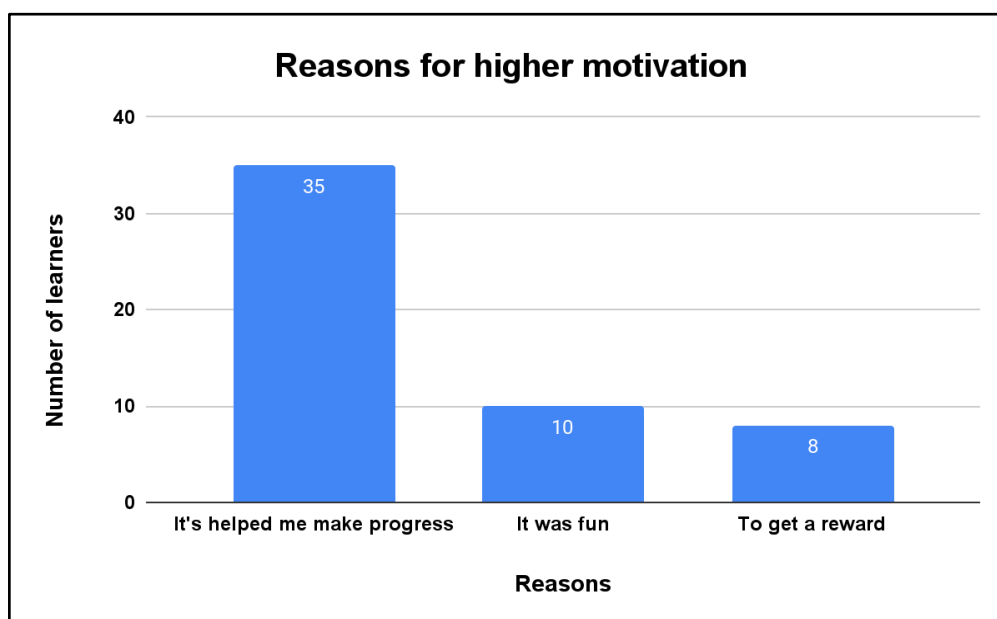


Figure 3

When asked about the points system, learners responded with their aspect they liked the most. Almost half of the 75 learners said *'competition'* and a quarter expressed gaining *'rewards'*. Half of the remaining 32 learners said *'achievement/progression'*.

The findings from the final student survey with regards to the most liked aspect of the system, are supported by the responses in the student interviews, where the element of competition was identified as a motivating factor to occurring more points within the points based system. It also supported our findings that learners could make links between their active participation in earning points and how it would help them to make progress (figure 4):

Student A	<i>"I don't mind it at all, but then I'm quite competitive, but I'm not winning right now. It annoys me that Stacey is. It motivates me a bit."</i>
Student B	<i>"Re-attempting questions, watching maths videos, completed an additional exam paper and attended on time. This can help and improve for getting high grades."</i>
Student C	<i>"I like the competitive aspect of the system because it makes me want to be ahead of everyone else."</i>

Figure 4

Teachers were asked about the differences they had witnessed regarding motivation and engagement of their learners who were part of the project. They all agreed that they had noticed an increase in the level of engagement within their experimental groups, suggesting

there were improvements to attendance, punctuality and engagements with tasks. One participating teacher also commented on an increase in engagement with tasks outside of the classrooms (figure 5).

Teacher A	<i>"I think the main thing is that they are hot on the attendance - I don't mean they're just turning up. They're timely and attending in a way my other groups aren't. In some cases, they turned up for me and not other classes during the day."</i>
Teacher B	<i>"When I asked them to do something outside of class, I had three submit it so I reminded them 'well done, that's worth so many points', then there was a rush to do it by everyone else."</i>
Teacher C	<i>"I was pleased with the level of engagement with the ideas behind the project, which we had selected due to their indirect positive impact upon learning, in particular the importance of the attitude students bring to class, helping out other learners and following up feedback from mock papers."</i>

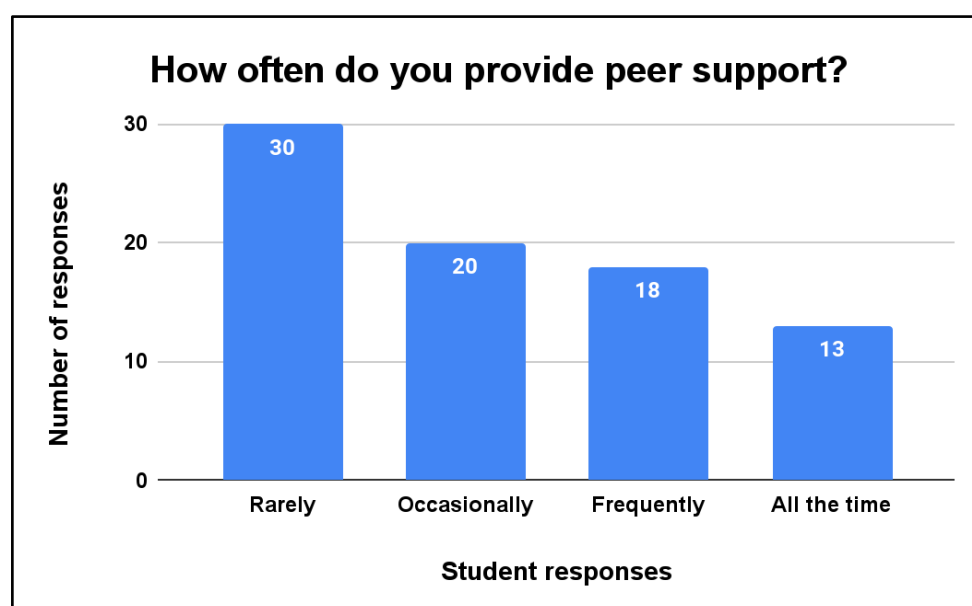
Figure 5

Peer support

In our initial survey, we asked students about how often they provided peer support during their maths sessions, as we wanted to establish whether this was normal practice. The majority of our students said that they '*rarely*' or '*occasionally*' provided peer support which suggested that it was not commonplace in sessions (figure 6):

Figure 6

Our teacher interviews conducted at the end of our second cycle, suggested that following the awarding of points, providing peer support had become a regular feature of their



sessions (figure 7).

Teacher A	<i>"The project has been great at promoting peer support and some students who would normally work on their own are now working with others."</i>
Teacher B	<i>"They enjoyed the element of competition and worked collaboratively to support each other."</i>
Teacher C	<i>"A learner in my Level 1 group moved to the other side of the room to join a group and offer support to their friends. There was another instance where I gave work to a student to complete outside of class, they then came back in, and asked to help another student with the task to show how he had understood it."</i>

Figure 7

The observations by the teachers regarding peer support, was further supported by the responses collected in the student surveys, with one student commenting, *"I now like helping out other students and getting to know them in my class. Like I find myself talking to other students in my class more"*.

Leaderboard

As part of a project, we did not formally implement the use of a leaderboard; students collated their points into individual points tables instead. However, some teachers adopted the use of a leaderboard and therefore we collected data about their usage to see if using a leaderboard had any value.

Where a leaderboard had been used by the teachers, this was positively received by the students as it aided the feelings of competitiveness which students previously indicated as a motivator for taking part in the project. Figure 8 below, details the students' typical responses towards the leaderboard:

Student A	<i>"The rewards and the leaderboard, because the reward gives you something nice to look forward to, at the end of the day. The leaderboard is also good, because it tells you how many points someone has and their position on the leaderboard."</i>
Student B	<i>"I'd want to get up there, I'd want to be in the top 5."</i>
Student C	<i>"Yeah, alright, I could see where I was up against everyone else. It'd be alright being on a wall somewhere in college but could be online as well..."</i>

Figure 8:

We also asked the teachers their feelings on using a leaderboard, receiving a positive response. One teacher commented: *"I think there should be one, I think it would keep students motivated. A lot of them are competitive, especially as there are more males than females in the technology side where I teach, I think they would get competitive and try to get on the leaderboard."* Where teachers had used a leaderboard, this was only used inside the classroom environment. In our teacher interviews, we also asked how they would feel about having a leaderboard publicly displayed. This received a mixed response; all the

teachers agreed a leaderboard would be beneficial, though only half wanted this to be publicly displayed. One teacher commented: *“I think that would be a good thing, especially with older learners. We do have the leaderboard on the board in class, I think it’s the best way of doing it. If it’s not displayed up there, then you’re not rewarding the ones who try... I’ve had no pushback, I’ve not had anyone saying they’re embarrassed about it or anything like that.”*

Teacher Advocacy

In our teacher interviews, when asked about the value of the points based system within their maths sessions, all four teachers agreed that it had been a valuable process which they would continue to use following the completion of the project. They all agreed that its main benefit was increasing students’ motivation levels.

Teachers also suggested that using the points based system across vocational sessions, as well as maths sessions, would be beneficial for learners (figure 9).

Teacher A	<i>“I intend to continue using the points based system in the final formal lessons leading up to the exams as it is motivating for learners.”</i>
Teacher B	<i>“ I would like to start using the point system from the beginning of the next academic year so that students are set high expectations and are motivated and engaged from the start of a new academic year.”</i>

Figure 9

Feedback from the students supports the feelings of the teachers with regards to continuing to utilise a gamified classroom approach. 64 out of 75 learners wanted to continue using the points based system in their maths sessions, with 48 learners also wanting it to be adopted within their vocational sessions. The reasons that the students provided, for wanting to continue the project, are indicated in figure 10.

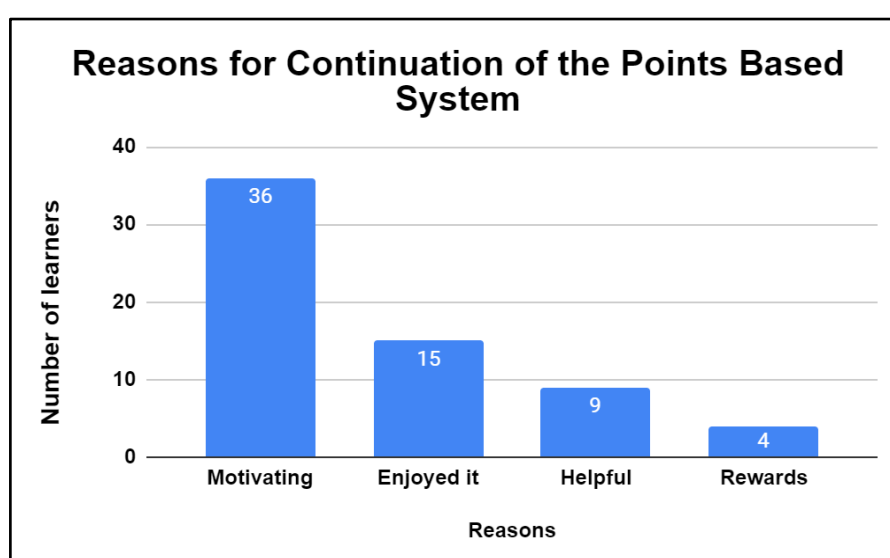


Figure 10

Conclusions and Recommendations

Conclusions

Our main aim for the project was to raise learners' motivation and engagement levels inside and outside of the classroom, by adopting a gamification strategy.

Learner engagement

Engagement levels within the participating GCSE Maths cohorts improved during the course of the project, demonstrating the success of the gamification strategy. The points system was a positive addition to maths sessions, providing an effective element of competition for our cohort. The points provided learners with immediate feedback which was not focussed on attaining a final overall grade, and therefore supported previous research about using a points based system (Stott and Neudstaedter, 2013). Our project was aimed at 16-18 year old learners who were having to resit their GCSE Maths qualification and were therefore, potentially already demotivated viewing themselves as 'failures' for having to retake. Auvinen et al (2005) found gamification to be the most effective strategy where students were already high performers, however the results from our study demonstrates that it can also have a positive motivational impact on students not traditionally deemed as 'high-performing' having to resit their GCSE Maths qualification.

There were no reports of students feeling demotivated by the process as suggested by Toda et al (2018) who claimed it could result in undesirable behaviours and a loss of performance. Rather, it supports Le Bouc and Pessiglione (2013) where students demonstrated an increase in effort inside the classroom. Overall, students taking part in the project felt that the points system had a positive impact as they recognised how it helped to progress their maths skills. They enjoyed taking part in the process. Whilst there was some acknowledgement of the benefit to being rewarding at the end of the process, the majority of learners' main motivator for increasing their points total was due to wanting to compete against their peers.

Impact inside the classroom

The most interesting findings from our research was the effect the points based system had on peer support within the classroom. We saw a clear difference between the level of peer support taking place at the beginning of the project when compared to the end of the research cycles. Where teachers previously struggled with the use of peer support and collaboratively working, feedback from teachers evidenced that the points system was an effective vehicle for increasing peer support within maths sessions. It is widely recognised in the research that student collaboration can be key to improved attainment.

Impact outside the classroom

The adoption of the gamification strategy demonstrated an increase of engagement within the classroom, however we could only tentatively draw conclusions over its impact outside of the classroom. Teachers anecdotally observed an increase in participation in independent tasks completed outside of the classroom setting, but this was not always supported by the responses given by the students. Completing online work outside of the classroom was the least popular response from students in how they obtained points, which therefore demonstrates a limited impact of the process outside of the classroom environment.

Recommendations

The recommendations raised from our Gamified approach, are based on student behaviour, rather than achievement.

- Whole department or college approach

As the gamification strategy was successful in increasing engagement levels of GCSE Maths resit learners, we propose continuing to adopt this strategy in post-16 classroom settings. The responses from students also supported the implementation of a points based system being adopted in their vocational sessions. Teachers taking part in the study felt they were doing a disservice to those students who were not part of the project and would have benefitted from taking part. We therefore recommend a whole department or college approach to trial the impact of a points based system where it is embedded across departmental practice.

- Timings

We propose establishing a gamification strategy in sessions from the beginning of the academic year. The teachers involved in the project observed improvements to engagement over the course of the project, but as the first cycle only began in November, they could not assess the impact it may have had on learners if the project had started from the beginning of the course. For those with poor attendance, where typically their attendance drops after the start of the academic year, the benefit it could have for those learners is unknown. We would therefore recommend implementing a point based system at the beginning of the academic learner to increase the impact it would have on potentially a larger cohort of students.

- Consistent use of leaderboard

Where a leaderboard was used in class, it was seen as beneficial by both teachers and students alike. However, this was not implemented with any consistency across the participating groups in our project to determine its overall impact. Student feedback also supported the idea of a leaderboard being displayed publicly outside of classrooms to increase competition, whilst teachers remained unsure of this approach. As the research suggests that it can aid in increasing motivation levels (Erickson et al., 2018), we propose that it would be a worthwhile addition to any future trials to increase the competition levels between learners.

- Use of negative points

As competition was suggested as the most motivating factor, the inclusion of negative points and the impact this has on motivation levels would be an interesting addition to the system adopted by staff using a gamified approach in their sessions. When we consulted with students on how they felt this would affect their motivation levels, they provided a mixed response. There is limited research on the impact of being awarded negative points as part of a gamification strategy, so this would be a worthy area of further study, although it would require careful monitoring to prevent it having a demotivating effect on students.

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Appendices

<u>Appendix 1.</u> List of questions used during initial discussion with learners. This was focussed on understanding learners' perceptions towards games in general to help us formulate our points table, and to introduce the concept of our project.	Questions for initial class discussion
<u>Appendix 2.</u> Google form used during the first cycle. Containing questions to capture learners' initial motivation levels towards their maths GCSE.	First cycle student survey - TEMPLATE
<u>Appendix 3.</u> List of questions used for the teacher interviews. These questions were asked at the end of cycle 2 and mapped to our research objectives. They were designed to understand the teachers' experiences with the project thus far.	Copy of teacher interview questions
<u>Appendix 4.</u> List of questions used for the student interviews. These questions were asked at the end of cycle 2 to understand the learners' thoughts on the project so far and to target our research objectives.	End of cycle 2 student Interview questions
<u>Appendix 5.</u> Google form during the final/third cycle. This survey was designed to understand the learners' opinions towards the project as a whole to help determine if it was a success.	Final student survey - TEMPLATE
<u>Appendix 6.</u> Teacher reflections A list of prompts given to the teachers to help write their reflections at the end of the project.	AR Project 1 - Teacher reflections Cycle 3
<u>Appendix 7.</u> Blank points tables and example tally chart for learners' books. The tables containing the points and corresponding levels, as well as rules of conduct for each cycle.	Copy of Points table for AR Project 1
<u>Appendix 8.</u> Completed points charts from learners' books. Examples of completed points tally charts for each cycle.	Examples of completed points charts

Appendix 9.

A leaderboard used by one of the teachers to display her cohorts' points.

[Copy of leaderboard](#)