CENTRES FOR EXCELLENCE IN MATHS

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EDUCATION & TRAINING FOUNDATION

How do we embed contextualised learning through collaboration to support progress in maths learning?

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Thanks go to Lincoln College vocational and maths tutors for their time and input into what we believe will bring about positive changes to our maths delivery model. We anticipate the project output will bring about better attendance, better success rates and better opportunities for education and employment for our students, and practitioners, willing to embrace change.

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

At the last time of students sitting traditional exams (2019), the post-16 students had an added value of +0.9 points which means most students were not making sufficient progress in their maths resit environments. To bring about change, the Government set up the Centres for Excellence in Maths (CfEM) which provide funding for the improvement of maths delivery in the post-16 environment. We would like to acknowledge the opportunity that such funding has given the College in terms of expanding future opportunities for the benefit of students and local workforces.

This document explores the potential value of contextualising lessons to bring about improvements to the success rates of students sitting GCSE Mathematics.

We used resources which were tailored to vocational courses and real-life situations, delivered over three learning cycles between January and April 2022. 80 students and four tutors were selected to be part of the project.

Quantitative and qualitative data collection methods were used to try and assess the impact of project delivery, and comprise a combination of student and tutors' surveys, interviews and feedback.

Our initial findings are that contextualisation has the potential to provide longer term benefits of increases in engagement, effort, interaction, understanding and, ultimately, grades. The feedback collated from students and tutors confirm a favouring of this approach as the majority preferred this style of lesson (for delivering and receiving the information).

Contents

Background

Introduction

Lincoln College is a Post -16 Further Education College with three campuses - the largest site is in the centre of the city of Lincoln, the second largest is in Newark-on-Trent, and the third site is in Gainsborough. All thee colleges cater to the training needs of their local areas and one of the College's corner stones is "workforce ready".

Our learners

We offer GCSE maths to all of our study programme learners, but anyone who does not have a grade 4 in maths is required to study for it with us. This, therefore, means that we can have a wide range of abilities in our lessons due to the differing starting points that students will join us from. All students are a baseline test at the start of the programme so we can look at how best to help them with their mathematics studies. Students attend one two-hour maths lesson each week and are expected to do at least one hour of homework each week using the online platform, called Century (which has recently been adopted by a number of colleges).

Over the last two years the students have been in very difficult circumstances due to the Covid pandemic and, depending on their individual access to technology, they could have potentially missed out on large amounts of learning.

During the last two years students have not sat official exams, and have been given predicted grades, which may not have been accurate some cases (in crude language, some have had over-inflated grades, as seen by maths and vocational tutors who have seen students come in with grades higher than abilities show). This means that, in this academic year, students have sat formal exams, in the traditional format, for the first time. It is also important to acknowledge that, depending on their schools, students will have had much less face-to face contact that normal which has adversely affected abilities to build trust and positive relationships with tutors. This year's students have been more of an unknown quantity, compared to previous years, due to a lack of actual exam performance evidence.

Why did we choose contextualisation as the project focus?

After listening to our students, it was evident that many:

- didn't appreciate / understand the importance of maths.
- couldn't see how or why it actually mattered to them.
- had pre-conceived ideas about lessons.
- undervalued their own ability / capability to learn.
- were less able to use maths to problem solve.

For example, when asked about wallpapering, learners said they would buy more than they needed, and return what they didn't use, rather than working out the amount they did actually need. With a little persuasion and showing how maths can save them the time, money and hassle of having to drive miles back and forward to the shops, students generally start to see that working with numbers might pay off.

After listening to our vocational tutors, it was evident that they:

- wanted to improve students' ability to make meaningful links between key areas and the 'real world'.
- needed to fill knowledge gaps and develop confidence (of students).
- preferred a more tailored approach to teaching and delivering.

We decided to look at how we could work with vocational tutors to look at how to make maths more relevant to vocational courses, so that students could then see that maths is important and meaningful. We then hoped that this would bring about a change in students' mindsets so that, once they could see the relevance, they would start to engage.

The largest problem we have with students is that they feel maths is a subject that they have not managed to grasp in the years that they have attended school and that it's pointless to continue. Some students refer to themselves as the "resitters", and often have very low levels of self-confidence and motivation when they arrive with us.

Students need hope and encouragement …encourage not discourage.

We have found, as a general observation, that students who can see some relevance to what they are being taught tend to engage with maths far better than those that are trained to remember a series of steps to get a required result for which they may, or may, not see any relevance to.

This, therefore, gave us the motivation and drive to look further at how we can contextualise maths to a practical use, that will then give students an awareness of how to problem solve for themselves. The current economic climate is challenging for everyone, so we owe it to them to help them understand values, context and how maths can make a real difference to their day-to-day living.

Literature Review

How do we embed contextualised learning through collaboration to support progress in maths learning? Improving outcomes for learning in both GCSE maths and vocational study programs by deepening understanding of maths concepts that underpin GCSE exam questions.

Current position – (why) is change needed?

In August 2016 only 26.9% of learners aged 17+ achieved A*-C in their English GCSE and 29.5% achieved A*-C in GCSE maths (JCQ, 2016). Government saw this as a huge blow following the introduction in 2015 of the policy of mandatory GCSE re-sits for under 19-year-olds who haven't yet achieved a Grade 4 or above. However, it was enough evidence to show that getting learners to constantly do the same type of assessment does not work, despite English and maths being viewed as the most vital skill for economic mobility (Dawe, 2016).

Colleges are supporting learners that have been unsuccessful in achieving the required maths grades for 11 years in school. As a consequence, many learners start maths in College feeling dejected and devalued.

Devalued people are "badly treated, accorded less esteem and apt to be rejected and treated in ways that diminish growth, dignity and competence" (Wolfensberger, 1983, p.132). Furthermore, it could be argued that low levels of maths and English stop people from being economically prosperous, leading to social isolation (Hillier, 2005).

Many students at Lincoln College, like in the wider FE sector, have negative attitudes to mathematics, often influenced by unsuccessful prior learning experiences at school. Engaging with mathematics both in general real-world situations and in situations directly relevant to specific vocational pathways have demonstrated some success in improving students' learning experiences in mathematics. However, the weight of evidence suggests that context, in itself, is not the main factor that influences performance in examinations and that other factors such as content, question style, and word count are better determinants of difficulty.

Nevertheless, there are expert-authors from organisations such as the University of Nottingham, and movements such as Realistic Mathematics Education, that argue the case for contextualisation. Contextualisation has the potential to encourage the use of technologies relevant to real-world practices and facilitates engagement with the types of concrete resources and problem-solving experiences facilitated in Mastery pedagogy. Furthermore, studies examining approaches to learning mathematics in which learners develop mathematical thinking in ways that draw on initial understanding of a realistic or realisable situation have been shown to improve students' attitudes and beliefs about the value of mathematics, their capacity to engage with multiple representations and methods, and their problem-solving skills (University of Nottingham, 2021).

Contextualisation

According to the University of Nottingham (2021), contextualisation of mathematics that relates mathematical structure to real-world situations should be a key element of mathematical courses that aim to prepare students for effective and successful engagement in daily life, workplace settings, and broader social, economic, political and environmental activities. Capacity to successfully engage with such mathematics should be considered essential to FE students as they become young adults with many having vocational concerns and aspirations. A contextualised approach to mathematics is consequently likely to motivate students as they realise its practical relevance and usefulness to their other studies.

One way in which contextualisation can be achieved includes the use of Realistic Maths Education (RME). In RME, progress is indicated when students start to see the similarities between 'models of' situations and are consequently able to generalise the use of these models and apply them to other problems. At this point they are, for example, able to make a shift towards using a bar to represent a situation which is *not* obviously 'bar like', using a bar as a 'model for' solving a problem (See *For mathematics education researchers - Realistic Maths Education* at rme.org.uk)

RME pedagogy aims to enable students to connect their informal representations of the world to formal mathematics, building from shared understanding of imaginable contexts to recognition of the mathematical sameness of different problems and the ability to choose an appropriate model to solve a problem (Van den Heuvel-Panhuizen, 2003).

Potential outcomes of using contextualisation

Traditional teaching strategies in mathematics often perpetuate the gap between learning and not learning by failing to stimulate interest and engage students in purposeful activities. Whilst educators and researchers are aware of the shortfall in learning, changes in curricula and teaching practices have been slow in coming. At Leicester College, we believe that mathematics will be learned by more students (1) if taught with other subjects in a real-world context, (2) if practical learning apprenticeships are developed, and (3) if educators articulate and challenge their own beliefs and values about mathematics, learning and teaching. Furthermore, we maintain that the intellectual practice of teaching mathematics in the abstract serves to limit the learning of students of lower socio-economic status, a position supported by Hackman and Weissglass (1983).

Experience of the researchers following the RME approach shows that when students stay connected with the underlying context of a particular problem type, they are able to make sense of what they are doing, without memorising rules and procedures which have no meaning for them. Even when students move into more abstract maths—dealing with ratios, gradients or circumferences—they are able to go back to contexts that help them unpick and explain formulae (See https://rme.org.uk/what-is-rme/about-rme/ and Dalby, 2013).

'Students' intended destinations become influential in their value structures, and they are more likely to view mathematics in relation to their primary goal of a vocational occupation. Mathematics becomes a part of the preparation for employment rather than a subject with intrinsic worth.

The place of mathematics in vocational education, therefore, depends on the mathematical demands of the workplace' (Dalby, 2013).

'A mathematics curriculum that addresses the needs of the workplace, as outlined above, may place the subject in a more harmonious relationship to the values and goals of vocational students. An understanding of these values, from a student perspective, is a key factor in the process since student views do not necessarily reflect the same values as those who shape the curriculum, either at national or classroom level' (Dalby, 2013).

'Many of these students were disaffected by their experience of mathematics in school and overcoming negative attitudes was an important part of preparation for using mathematics confidently in the workplace. Failing to see the relevance of mathematics is a common reason for disaffection (Nardi & Steward, 2003)'.

'These students saw the relevance of the functional mathematics they learned in college when the links to their current values were explicit. Using scenarios that related to personal issues or vocational interests was effective because these related to key values and goals in their progression towards adult life and employment'.

Potential challenges include removing preconceptions, and battling previous bad experiences, to enable students to become more open minded about their ability to learn and do well.

Zimmerman (1994) suggests that the nature of the classroom context plays an important role in facilitating self-regulating learning. Classrooms that do not allow for much choice or control in use of time, choice of strategies to perform tasks, or even which tasks to perform, limit the opportunities for the development and use of self-regulatory strategies. In addition, classroom studies have shown that differences in teachers' instructional methods, including the type of task in which they ask students to engage, can influence the motivational goals that students adopt for their learning as well as their self-regulated learning (Ames, 1992; Maehr & Midgley, 1991).

Conclusion

Whilst there will always be many ways in which teaching and delivery can be improved, ultimately, it is important to acknowledge that students should have a voice, and that their views should be taken into account when reviewing how to deliver effective lessons. There are a number of theories about how students learn best, but when they themselves are telling us that they find it more helpful when work is relevant, and they can see how they will use maths, then it makes sense to explore this further.

Methods

Student and Tutor Breakdown

The project included 80 students, a selection of vocational staff and four maths practitioners.

Cycles

The project comprised three cycles. Within each cycle, each tutor helped to plan and deliver lessons which had a different area of focus each week. The same shared resources were used, and project members met to evaluate progress during 'Golden Hour' time (Golden Hour' being a protected time slot each week for project members to get together and discuss how the project is progressing). At the end of each cycle, tutors gained verbal feedback from students to sense check how they had found the lessons.

Resources were used to make topics as relevant to vocational areas as possible. Naturally some topics may not be used in every vocational area, therefore resources included 'real life' examples too, to ensure that students had the best chance of understanding how maths is actually used. Resources also included the use of exam style questions to help students know what to expect (please see Appendix 12 for link to resources folder).

Please see appendices 1 and 2 for examples.

Ethical Considerations

The BERA Ethical Guidelines (2018) were used as the main point of reference when reviewing ethical guidelines, so consideration was given to ensuring we were:

- Telling students what would be involved, and why, at the start of the project.
- Treating information and feedback sensitively, fairly and without prejudice.
- Only asking for information that was directly relevant to the project.
- Removing information that could specifically identify individuals (unless consent had been specifically gained as below).
- Holding information only for the purposes of the project, and in line with current GDPR/Data Protection guidelines, providing an opportunity for opting out if anyone changed their mind (without prejudice).

Students, and tutors, were made aware of the project and its aims, and written consent was gained from students where their identifiable personal data would be used for feedback purposes – recorded verbal feedback (please see Appendix 10).

Data Collection Methods

We used a mixed method – of qualitative and quantitative feedback. We asked for students' views at the start and end of the project (please see Appendix 6). We also interviewed a sample of students, vocational tutors who had helped with the project, as well as project members themselves. We compared students' grades on entry with their mock results which were completed at the end of the project (as shown in Results section). Feedback was obtained using a combination of MS Forms, audio and video interviews, with notes being made as required. We also spot-checked students' work which was completed during lessons to check for understanding.

Covid Impacts

In this academic year, a number of lessons were still being held online (using Teams), and we were still affected by staff and student absence due to Covid.

Results and Discussion

Intervention

The maths tutors met with vocational tutors at the start of the project to review the maths curriculum and where we could show examples of maths being used within the context of vocational studies. Where there were occasions of the maths topic not being directly relevant to the course, the maths tutors ensured that every day scenarios were used to ensure that students had a better chance of seeing how maths could be put to use. Resources were created and / or adapted based upon the feedback received and delivered to students in their weekly lessons.

Results

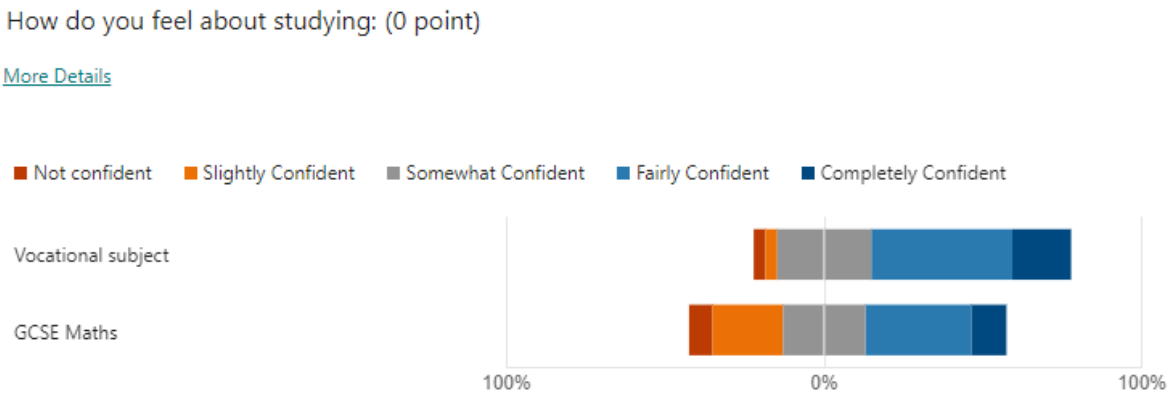
In this section we will review the feedback received through each channel.

1) Student surveys – reviewing results from key questions

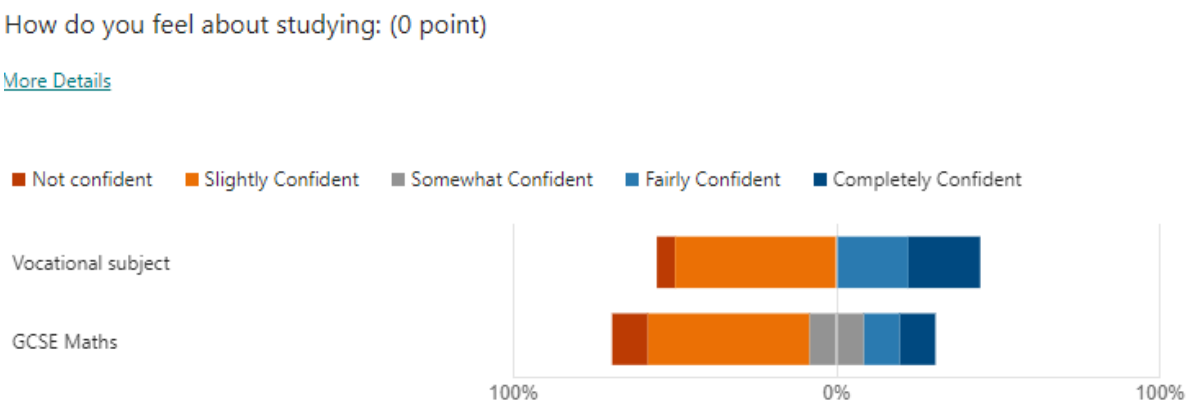
We asked students to complete an online survey at the start and end of the project (please see appendix 6) and established the following key findings:

a) Confidence levels

Before:



After:



The results suggest that students' confidence levels in their studies reduced which is not what we expected to see. However, the fact that confidence levels reduced for vocational courses, as well as maths, suggests that the fact that the AR Project coincided with mock exams may have skewed results as students may have realised, they were not necessarily as well prepared as they thought. This will have been the first time they had to do formal assessments, rather than having teacher assessed grades, so it may have been a 'reality check' and affected comfort levels.

b) Impact on future employment

Before:

After:

When reviewing responses to students' understanding how important maths is to future employment opportunities, the trend was the same when comparing in relation to their vocational course as employment in general. On balance, the number of students understanding the importance of maths improved. Although results show a reduction in students seeing maths as 'absolutely necessary', this could be linked to confidence levels being affected as previously mentioned.

c) *Relating maths to vocational courses*

What topic areas in GCSE maths are specifically relevant to your vocational course, please give examples

Students gave a variety of answers with the most common including: percentages, measurements, ratio, decimals, money, and area and perimeter. Answers were similar across both surveys suggesting students do understand how maths links to the course they are doing.

d) *On track for target grade – student perception*

When asked whether the students felt that they were on track to meet their target grade for maths, the result dropped from 62.9% at the start of the project to 55.6% at the end. Again, the fact that the AR project coincided with the mock exams could adversely impact results as students were feeling pressure in a way that was not familiar to them and making them doubt themselves.

2) Vocational tutor feedback

Vocational tutors from Construction, Joinery and Hair and Beauty were interviewed on an individual basis and the resounding feedback, across each area, was that they would like to build stronger links with the maths team to ensure that students would be able to see how maths is relevant to their course (please see appendix 9). They were able to identify which maths topics would be of most value and provided examples of how they could be firmly cross-linked across both curriculums. In College, we have a system called Workplace which staff members use to share information and updates about news, projects and events. During the project it was noticed that a member of the Construction team had proactively created and posted a resource showing how maths could be used in Construction. This was a good example of the wider impact that the project was having in the College in terms of vocational staff engagement (please see appendix 5). Some also gave examples of resources they used in lessons and assessments which could be of use in ensuring areas were covered in maths lessons. Tutors observed that a greater number of students were quicker to grasp concepts and make correct calculations in lessons. They also said that they felt that during the project they saw a shift in attitude where students were more open to / accepting of the need to attend their maths lessons due to them being more relevant. Please see Appendix 11 for link to interview videos.

3) Maths tutor reflections

The maths tutors who worked as part of the project were asked for feedback (please see appendix 8), using face-to-face interviews, and gave the following responses/quotes:

a) *How has maths teaching been different for you this year?*

- Better bonds with vocational staff.
- More appreciation of how maths fits into vocational subjects.
- Vocational staff identified maths weaknesses within their vocational area and collaborated with maths teachers to improve skills.
- Having time to plan resources and speak with vocational staff on what was working / not working.
- Students seemed more engaged.

- Change in attitude from vocational staff - got invited to lessons.
- “Where will I need maths poster” was added on Workplace from a Construction tutor (showing cultural change).

b) What impact has teaching with more of a contextualised approach had on your experience of delivery and what have you noticed with your learners? How have you felt as a teacher? What are the strengths and drawbacks with this approach?

- Students demonstrated improved behaviour and engagement, for example the attendance for some hair students improved
- Vocational tutors were onboard, as well offering support. It certainly is a worthwhile approach - where learners can see the relevance they seem to be engaged. Students found it to be different it was a change from the norm. Getting learners to think mathematically with contextualised learning at its foundation seems to have worked well.
- It has empowered us to try different things – we have offered sessions across College to spread the message and talk about the project – a good proportion of Vocational staff have asked us to work with them next year and to be involved with learners from the very start. This tells us that the message is being spread through the College.
- It takes a lot more planning – it can be awkward when you have a group comprising different courses, however, when context is relevant, and they can see where it is used they appreciate it. For example, three motor vehicle students in with media.
- Students have been more inquisitive which has encouraged group discussions – there has been less of “where am I going to use this in life?”.
- Getting vocational staff onboard can pose difficulties – some will shut you down and say there is no relevance, where others will be in touch and proactive. We feel this could be down to their own confidence with maths (could we encourage more vocational staff to sit in lessons or complete GCSE maths for CPD - would this have a wider impact on the project?).

c) *How could GCSE maths be changed in future?*

- Start contextualising from the very beginning – in an ideal world you would have a scheme of learning that is planned for every vocational course.
- Is GCSE fit for purpose - could we have contextualised exams rather than just a proportion of A03 questions (much bigger topic to review)?
- Could we offer fast track and slow burn - depending on students’ starting places – ungraded to low grade slow burn over a two-year period with contextualisation at its heart?

d) *If we were to carry on this project, what could we do differently next year?*

- We would continue to build on the work we have started, looking to further develop contextualised resources. Keeping working with slow burn learners - those that will not get to a grade 4 in a year.
- We need to continue project funding to allow us time to create resources and plan, as well as buy equipment for lessons. Could we plan day trips to take the students out to real world areas to perform calculations to see how maths is used?
- Could we think outside the box and have access to virtual reality so that students can visualise 3D shape and space, which they often struggle with?
- Could maths teachers have funds to go out to the workplace and talk to companies about the maths they are using regularly and help build into our resource plans?

- Could we get external people in to talk to students about the importance of 'real world' application of maths?

Tutors also found that by showing an interest in students - in terms of their course, work commitments, and interests – they could further link 'real-life' examples of maths to help to engage them. For example, shopping, DIY, saving money. This further supported contextualisation adding value for students – conversations and approaches in building relationships (not just using relevant resources).

4) Student interviews

We asked a random selection of students to take part in an additional end of project interview (please see appendix 7) where they were asked the following questions:

- How has maths been different from previous experiences?
- How has maths helped you in your vocational learning this year/work experience?
- How could GCSE maths be changed in future?

It was agreed that if learners used words including contextualised, personalised, tailored and relevant this would indicate that the project objectives had been understood and met. Over 60% of students interviewed used these words (please see Appendix 11 for link to interview videos).

Students interviewed felt that they had had a very different experience to that in previous learning environments (i.e. school) and felt that College had provided a much better grounding upon which to go forward into employment / apprenticeships as they could see how they may be able to use certain elements to help them in their roles, and / or everyday life. A number were able to quote examples of where they had used maths when they would not have been able to previously, demonstrating recognition of transferrable knowledge and skills.

Although, realistically, some maths topics may not be appropriate for every vocational area, students were not put off by this and could see how knowledge would translate between courses. For example, a sports student was easily able to appreciate the scenario of building a wall for learning about area and perimeter. Interestingly, a number of respondents said that they would not change anything about delivery, as they felt it was relevant and practical.

An activity which had helped with this was when a maths lesson was delivered to sports students in the Sports Hall. We used a game of basketball as the basis and students used a tally sheet to record information from which to work out averages (please see appendix 3). With this fresh in their minds, they said they were more easily able to transfer the knowledge to other questions about sports-related averages later in the lesson. Their feedback showed they appreciated the chance to experience a different format to classroom-based learning.

Grade improvements

In order to try and assess what impacts the contextualisation project has on grades, we have compared the grade they arrived at College with, against the grade we have predicted them to achieve based on mock exam performance.

Grade change	#No.of students
+2	10
+1	24
0	29
-1	12
-2	6

Looking at the table above you will notice that at least 42.5% of the 80 students in the project showed at least one or two grades movement from their starting position. It doesn't mean that they are all achieving a grade 4 or above, but it does show progression from the grade with which they started. Lincoln College, as mentioned earlier in the report, allows all student to resit maths who do not currently hold a grade 4 which means students could arrive with anything from ungraded to a grade 3. Whilst disappointing to see that 18 may not improve their grade, we have not fully reviewed additional factors which may cause this, such as attendance and disciplinary issues. Additionally, as this is the first year in which grades will be based upon actual exam evidence, it is possible that some starting grades were inaccurate predictions and could not reflect how students would perform under exam conditions as this has been an unknown quantity for this year group.

The data reinforces our overall belief that contextualisation has is helpful in ensuring students are equipped to better understand, retain and apply mathematical knowledge.

Answering abstract questions

As part of tutor discussions, when reviewing mock exam performance, it was observed that more students had attempted to answer an abstract question relating to area, perimeter, and ratio. Although not everyone answered correctly, it was felt that a higher number had tried to answer, including students who had previously achieved lower than a grade 3. This suggests that more students could try to relate the question to somethings they knew about and feel more confident in at least trying to form a response for which they picked up additional marks (please see appendix 4 for examples).

Conclusions and Recommendations

Conclusions

Based on the feedback from vocational tutors, project members and students involved in the project it was confirmed that the concept of contextualisation will add value to student progress and attainment, as supported by mock performance data.

It is acknowledged that there may initially be an impact in terms of time invested in the creation and development of appropriate resources, however, this would provide longer term benefits of increases in engagement, effort, interaction, understanding and, ultimately, grades.

Despite the survey data giving some results that were lower than expected, it is important to remember that it has still not been a typical year of learning and results should be reviewed with that in mind. This is especially so when the verbal feedback received was so much more positive with students feeling more comfortable with maths.

Importantly, the overall theme of interview feedback across the project was that students felt more comfortable and able to engage as they could see how they would apply what they were learning, as long as it was made relevant to a concept they could understand. This is especially positive, and helpful, for classes which are made up of more than one subject area.

Vocational tutors recognised students being able to apply knowledge more quickly and accurately. Maths tutors noted increased engagement, effort and confidence within the delivered sessions. This all demonstrates that it is possible to change mindsets where many have already decided that they can't / won't do maths. You can see from the feedback received, that there are a number of ideas which could be explored further.

Interestingly, feedback from the students also clearly indicated that they preferred smaller class sizes rather than the maximum capacity that many Colleges feel the need to provide. This is something that is worth future consideration, where possible, when reviewing timetabling.

Recommendations

- Use terminology that students can relate to e.g. “this is how you will use…” rather than saying “this is contextualised” – students understand words like relevant and personalised, but should be reminded of how and why maths is important in as many sessions as possible.
- Increase project scope by getting more Colleges involved to better understand wider impacts and benefits.
- Timetable more regular College Golden Hours to allow vocational and maths teaching staff to collaborate.
- Continued CPD for all math practitioners to ensure fresh mindsets and up to date knowledge – motivating staff to find new approaches.
- Develop effective cross-collaborative approaches between vocational and math tutors – share information, ideas, and resources (for example, tutors observing each other’s lessons); review maths abilities and confidence levels of vocational tutors; consider a shared area to review practical information and resources; consider if support staff / LSAs have access to knowledge to better support students.
- Do more research into which courses may combine together more effectively. For example, a mix of Sport and Public Service seemed to work well, however, a group of hairdressers and bricklayer did not work as well together. Although it is acknowledged that maths lessons cannot be completely tailored, the fact that some combinations may work better than others could be a consideration, if feasible to manage.
- Review how to maximise survey participation and quality of responses from students.
- Develop a ‘snapshot’ style process for real time feedback about how students have found topics. For example, each week at the start of the lesson ask students to rate their topic knowledge / confidence on scale of 1-5, then repeat again after lesson delivery, to get a better sense-check of how they have found sessions. This could more quickly highlight those who may need support, as well as re-enforcing positive improvements to students.

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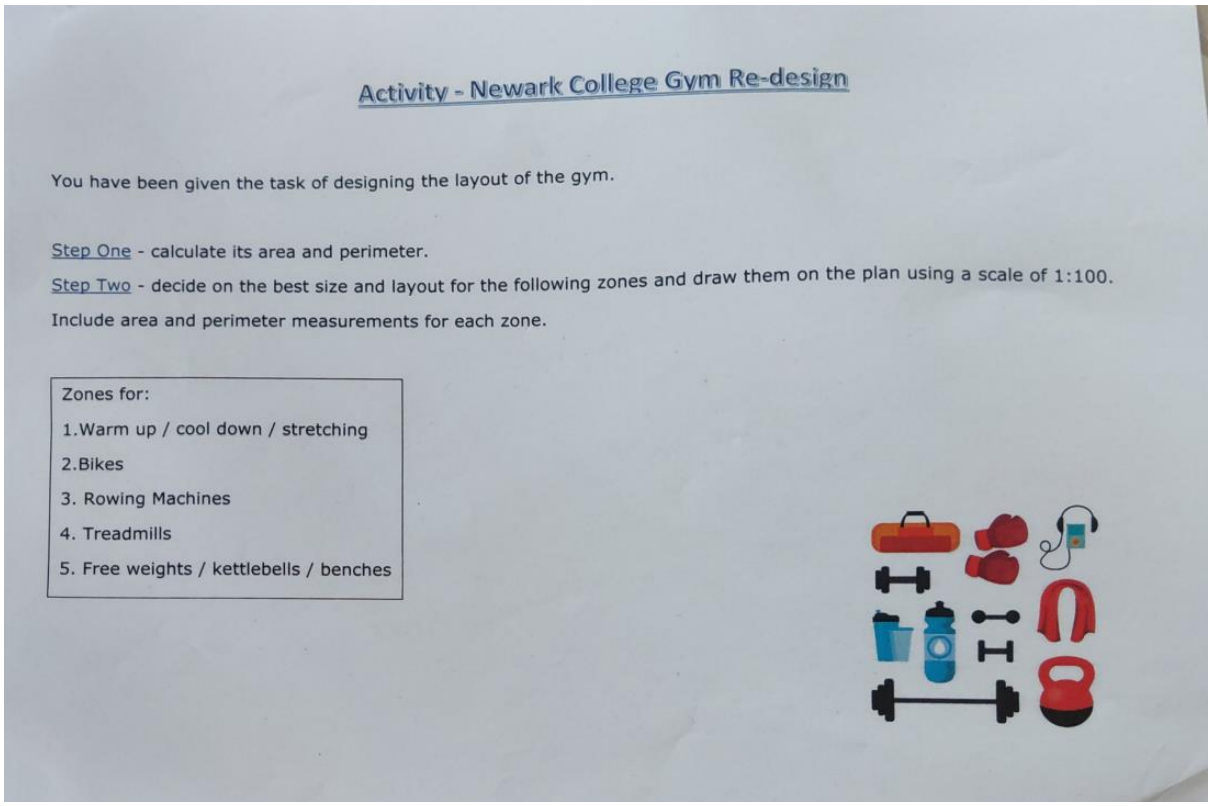
Appendices

Appendix 1 Task for Sports students to plan and design a gym.



Activity - Newark College Gym Re-design

You have been given the task of designing the layout of the gym.

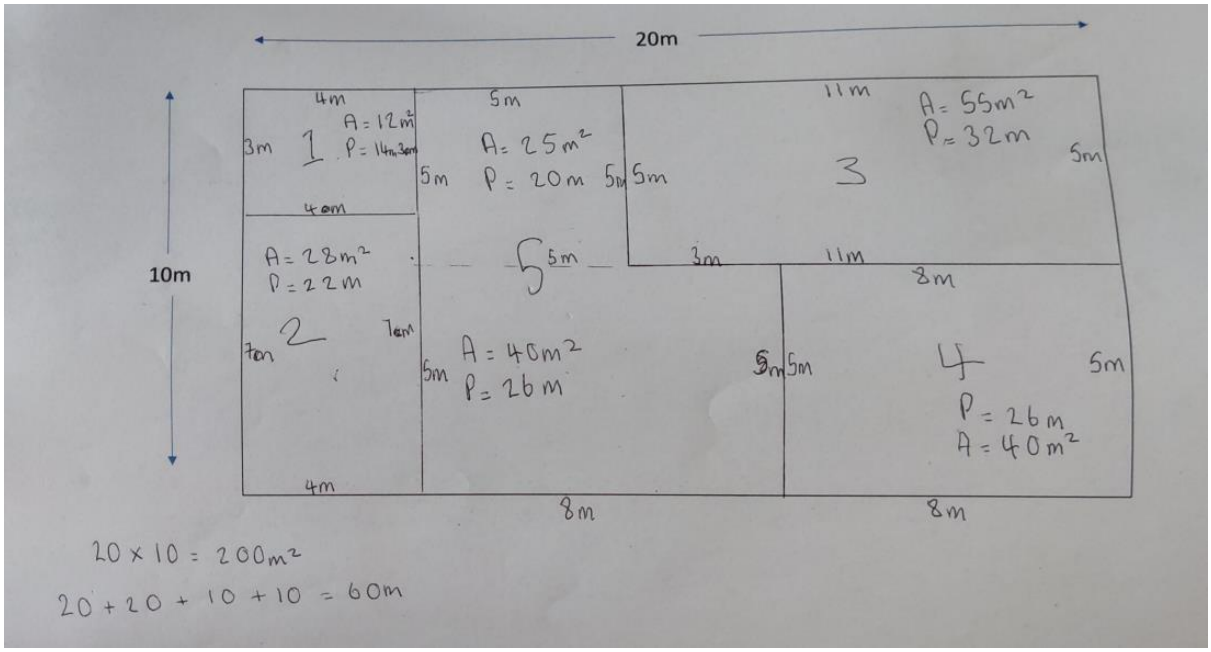
Step One - calculate its area and perimeter.

Step Two - decide on the best size and layout for the following zones and draw them on the plan using a scale of 1:100.

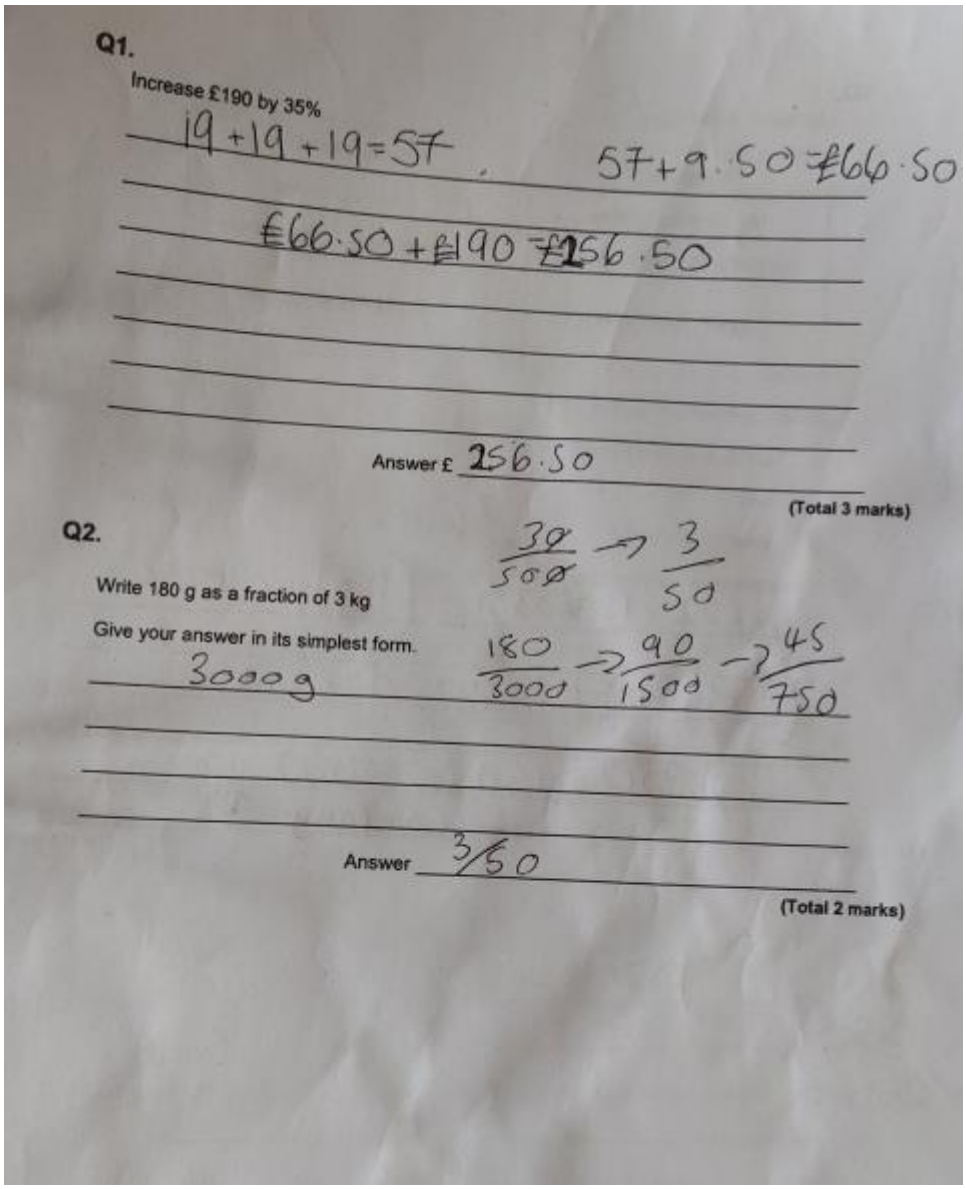
Include area and perimeter measurements for each zone.

Zones for:

1. Warm up / cool down / stretching
2. Bikes
3. Rowing Machines
4. Treadmills
5. Free weights / kettlebells / benches



Appendix 2 Example of using ExamPro for 'real life' scenarios (price increases and proportions)



Q1.

Increase £190 by 35%

19 + 19 + 19 = 57. 57 + 9.50 = £66.50

£66.50 + £190 = £256.50

Answer £ 256.50

(Total 3 marks)

Q2.

Write 180 g as a fraction of 3 kg

Give your answer in its simplest form.

3000 g

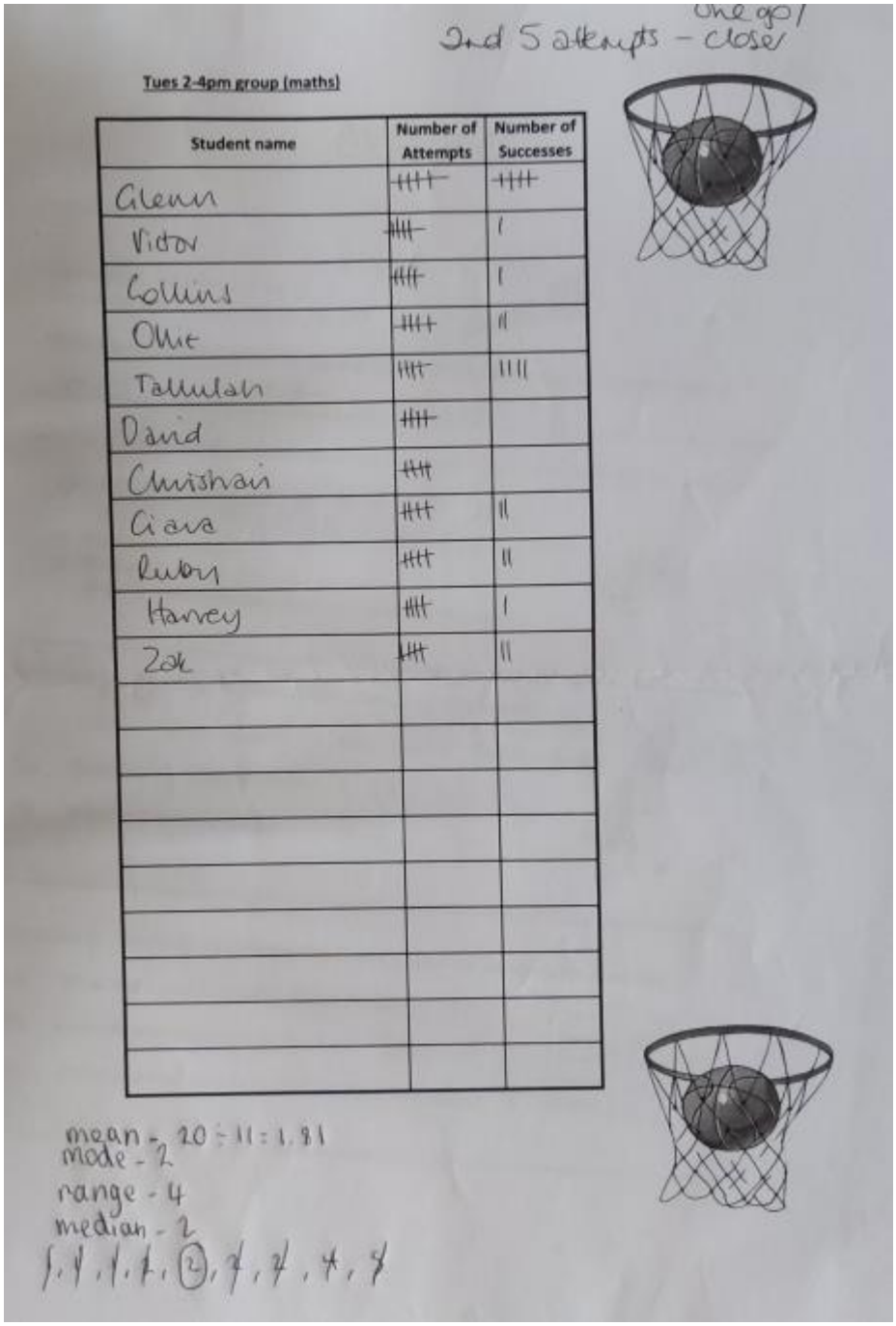
$\frac{30}{500} \rightarrow \frac{3}{50}$

$\frac{180}{3000} \rightarrow \frac{90}{1500} \rightarrow \frac{45}{750}$

Answer 3/50

(Total 2 marks)

Appendix 3 – Basketball in the gym used to create tally charts, and discuss averages, before moving on to look at averages more generally.



2nd 5 attempts – closer one go!

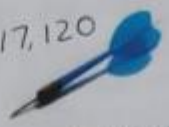
Tues 2-4pm group (maths)

Student name	Number of Attempts	Number of Successes
Glenn	5	5
Victor	4	1
Collins	4	1
Ollie	5	2
Tallulah	4	4
David	5	
Chrishan	3	
Ciara	4	2
Ruby	4	2
Harvey	3	1
Zak	4	2

mean - 20 ÷ 11 = 1.81
mode - 2
range - 4
median - 2
1, 1, 1, 1, (2), 2, 2, 4, 4, 8

AVERAGES

Question 1: 14, 71, 80, 90, 117, 120



James plays six games of darts.
His scores are 120, 71, 80, 14, 90, 117

Should James use the mean or the median to give him the highest average score?

median = 90.4 mean = 73

Question 2: A manager looks at how much has been spent in the Team's shop that morning.

£5 £8 £4 £50 £6 £8 £7.50 £10 £8 £7

4, 5, 6, 7, 7.50, 8, 8, 8, 10, 50

a) Work out the median 7.75
b) Work out the mean 11.35
c) Which of these averages is the most suitable for this data?

mode

Question 3: The height of some footballers are listed below:

1.78, 1.78, 1.79, 1.81, 1.85, 1.86, 1.88, 1.93

1.81m, 1.78m, 1.88m, 1.79m, 1.86m, 1.85m, 1.78m, 1.93m

(a) Work out the median height 1.85?

(b) What is the modal height? 1.78m

Question 4: The tally chart shows the favourite sport of the students in a class.

Sport	Tally
Rugby	IIII
Football	5 5 I
Hockey	5 5 II
Cricket	III

(a) What is the modal sport? Hockey?

(b) How many students are in the class? 30

(c) How many more students liked football than rugby? 7

Question 5:

21, 34, 44, 58, 63, 71, 75, 76, 86, 98

The Protective Services students score the following exam results –

~~34%~~, ~~44%~~, ~~75%~~, ~~21%~~, ~~98%~~, ~~86%~~, ~~71%~~, ~~76%~~, ~~63%~~, ~~55%~~

a) Work out the mean mark 62.3 ?
b) Workout the median mark 71 %
c) How many students scored above the mean mark?

Question 6:

The number of points that Newark Rugby Club scored in eight matches are –

~~24~~, ~~17~~, ~~19~~, 35, ~~9~~, 43, ~~15~~, ~~36~~ 9, 15, 17, 19, 24, 36, 43

Work out the range of the number of points scored. 34 ?

Work out the median of the number of points scored. 19

Question 7:

Newark's Firefighters have been revising for their exams. By calculating the mean, compare the amount of time the males and females spent studying.

Males

Hours	Frequency
0	0
1	2
2	3
3	4
4	5
5	1

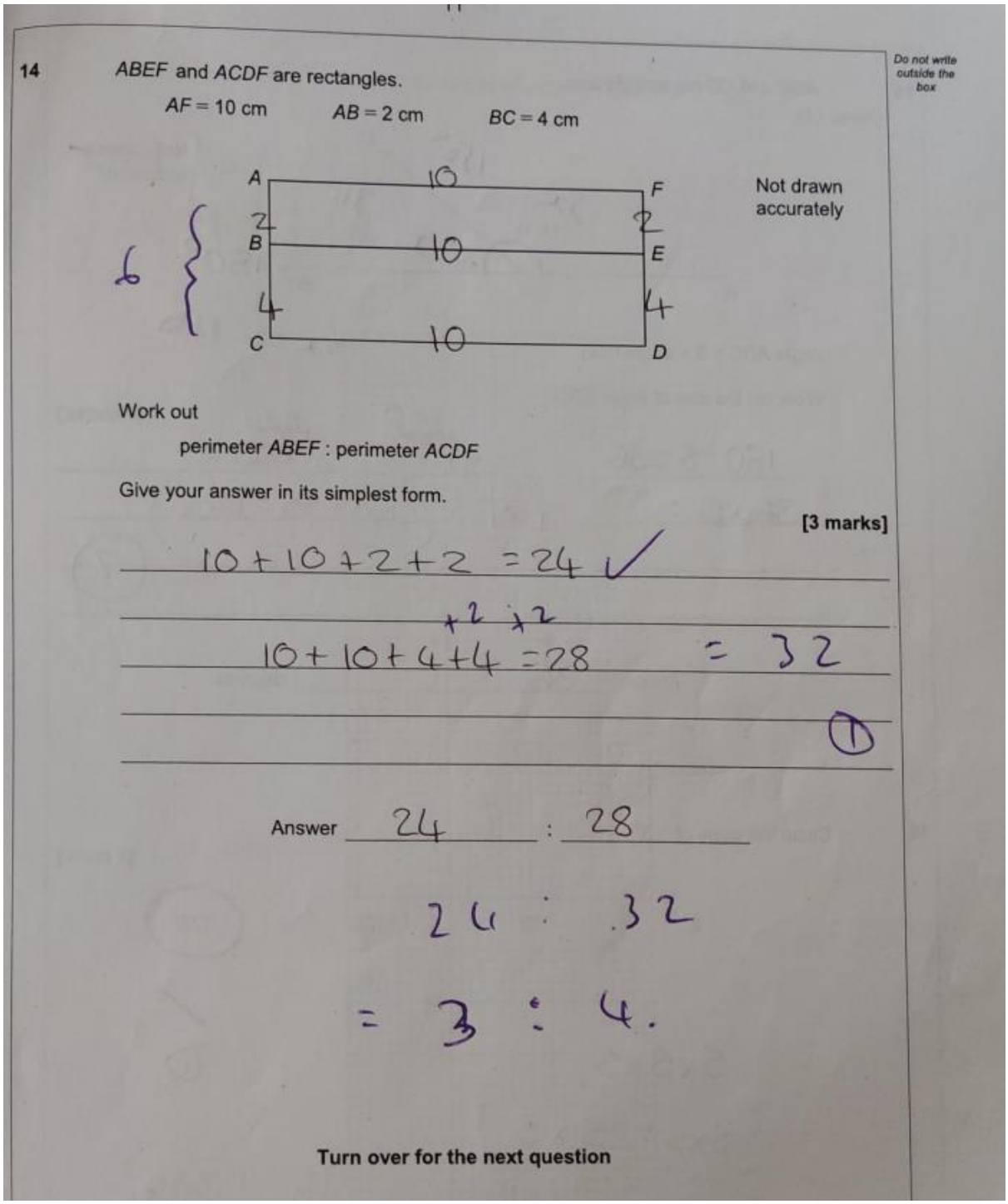
15

Females

Hours	Frequency
0	2
1	7
2	2
3	2
4	1
5	1

15

Appendix 4 Examples of grade 2 students attempting questions they may not normally have tried previously.



14 *ABEF* and *ACDF* are rectangles.

AF = 10 cm *AB* = 2 cm *BC* = 4 cm

Do not write outside the box

Not drawn accurately

Work out

perimeter *ABEF* : perimeter *ACDF*

Give your answer in its simplest form.

[3 marks]

10 + 10 + 2 + 2 = 24 ✓

+2 +2

10 + 10 + 4 + 4 = 28 = 32

(1)

Answer 24 : 28

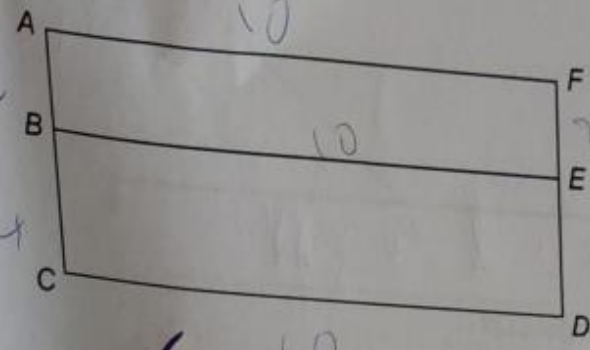
24 : 32

= 3 : 4.

Turn over for the next question

14 *ABEF* and *ACDF* are rectangles.

$AF = 10$ cm $AB = 2$ cm $BC = 4$ cm



Not drawn accurately

Work out

perimeter *ABEF* : perimeter *ACDF*

Give your answer in its simplest form.

[3 marks]

ABEF = 24

ACDF = 32 ✓

24 32
3 4

Answer 3 : 4

✓

Great work

Clothing sizes

...as football shorts are sold in the club shop according to their waist size. The table below shows information ...out 50 customers who bought shorts last month.

size	Waist (w inches)	Frequency
Small	$28 < w \leqslant 32$	24
Medium	$32 < w \leqslant 36$	12
Large	$36 < w \leqslant 40$	8
Extra Large	$40 < w \leqslant 44$	6

720
408
~~608~~ 304
~~504~~ 252
~~1250~~ 1684

TOTAL 50

- Calculate an estimate for the mean waist size. ~~4652~~ 33.68

- Tommy needs to order more shorts - the modal size is small.

  Tommy is going to order 75% (3/4) of the shorts in small.

  The manager of the shop tells Tommy not to order so many small pairs.

  Who is correct - Tommy or the manager? Give a reason for your answer.

75% of 50 = 0.75 × 50 = 37.5

38 pairs of shorts to be sold is way too many

the manager is right.

Appendix 5 Example of a Vocational tutor creating a resource to show students why maths is relevant and sharing it with colleagues across College.

Takeaway Thursday

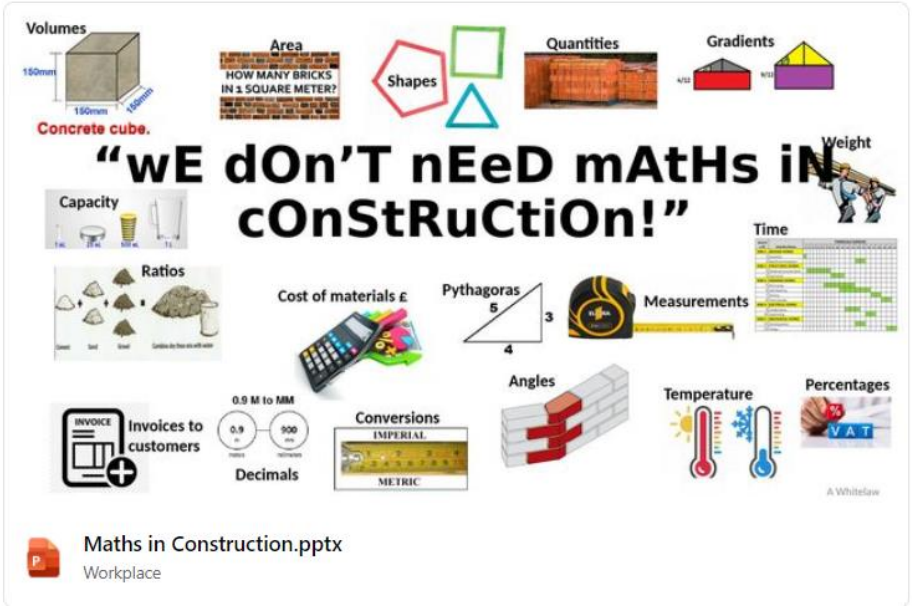
This weeks Takeaway Thursday comes from Andrew Whitelaw in Construction.

Andy has started to create a visual poster to demonstrate the importance of maths in bricklaying. Andy said:

*"Due to the amount of times I've heard "**we don't need Maths to be a bricklayer**", I'm starting to create a poster...I'll be adding to it every time I prove a student incorrect"*

If you like the sound of this, then take it away!

See more



Maths in Construction.pptx

Workplace

Appendix 6 Student survey to capture information at the start and end of the project (using MS Forms).

Contextualised maths session survey - student (Copy)

How do you feel about studying: *

	Not confident	Slightly Confident	Somewhat Confident	Fairly Confident	Completely Confident
Vocational subject	○	○	○	○	○
GCSE Maths	○	○	○	○	○

What impact will achieving in GCSE maths have on your future employment? *

	I will not need GCSE maths to gain employment	Achieving is not necessary, but it could benefit me	I will absolutely need GCSE maths
In your vocational area	○	○	○
Employment in general	○	○	○

What topic areas in GCSE maths are specifically relevant to your vocational course, please give examples *

What is your current target grade for GCSE maths *

- ◯ Unknown
- ◯ Grade 1
- ◯ Grade 2
- ◯ Grade 3
- ◯ Grade 4
- ◯ Grade 5
- ◯ Grade 6 (Higher Tier)
- ◯ Grade 7 (Higher Tier)
- ◯ Grade 8 (Higher Tier)
- ◯ Grade 9 (Higher Tier)

Do you feel you are on target to achieve this grade? *

- ◯ Yes
- ◯ No

What is your attendance in GCSE maths? *

	Less than 50%	Over 50%	Over 80%	100%
(If unknown estimate)	◯	◯	◯	◯

During your maths assessments and exams do you use all of your allocated time? *

- ◯ I finish well before my time runs out (20+ minutes)
- ◯ I finish within time with a some time to spare (5 - 20 minutes before the end)
- ◯ I have just enough time or still have 1 question to finish as time runs out
- ◯ I tend to run out of time and have multiple questions to attempt

In a maths exam, which best describes you: *

- ☐ I answer questions until I get stuck and stop there
- ☐ I don't always understand the longer worded questions, so I tend to leave them
- ☐ I go through all the questions I can do, leaving the ones I cannot
- ☐ I go through all the questions I can do, skipping the ones I cannot, then go back and attempt the others
- ☐ I attempt every question, in order

Appendix 7 Student interview questions

How has maths been different from previous experiences?

How has maths helped you in your vocational learning this year/work experience?

How could GCSE maths be changed in future?

e.g. If you could rip up GCSE maths what will it look like in the future for you?

The future e.g one we are looking for them to say, how it's been this year real life examples contextualised to their area to help understanding and grasping of key principles and applications.

Appendix 8 Project members (maths tutor) interview questions

How has maths teaching been different for you this year?

What impact has teaching with more of a contextualised approach had on your experience of delivery? What have you noticed with your learners? How have you felt as a teacher? What are the strengths and drawbacks with this approach?

How could GCSE maths be changed in future?

If we were to carry on this project, what could we do differently next year?

Appendix 9 Vocational tutor interview questions

What differences have you noticed with your students in regard to maths?

How have you found collaborating with maths staff on contextualising resources for lessons?

How could GCSE maths changed in future?

If we were to carry on this project, what could we do differently next year?

Appendix 10 Consent form

Consent form

We are taking part in a project to look at how we can use contextualisation as part of GCSE maths courses to help students increase knowledge, understanding and success in exams. Contextualisation means making information relevant to vocational courses and everyday life.

The research will review the way in which students learn, resources that can support this, and will involve collecting information through surveys, interviews, samples of work and assessment results.

The research will be carried out across Lincoln College sites and shared with a group of Colleges who are taking part in a national project to focus on improving GCSE math results – the Centre of Excellence in Maths.

Any data will be held in accordance with GDPR / Data Protection guidelines and will be made anonymous so your information will not be identifiable specifically to you. The project is guided by the *British Educational Research Association [BERA] (2018) Ethical Guidelines for Educational Research*.

If you have any questions about the project, or change your mind about being involved, you can let me know at any time.

By signing below, I:

- Consent to take part in the research project.
- Understand that my personal information will be held securely and will not be shared in a way that can identify me.
- Understand that I have the right to withdraw from the project at any time during the study, and for a short period after it.

Signed:

Printed:

Date:

Appendix 11 Link to interview videos

https://tinyurl.com/599jyfwh

Appendix 12 Link to resources folder

https://tinyurl.com/2p92j2r3