RIS Cohort: 2016
Research Leader in Education Review

Researchers in Schools
Introduction

Researchers in Schools is the only dedicated route into school teaching for post-doctoral career changers in the world. Over three years, participants on the programme achieve our Research Leader in Education (RLE) award. The RLE award is designed to ensure that Researchers in Schools teachers are trained and supported to deploy the knowledge, skills and networks they have gained from their PhD to benefit pupils, schools, and universities in three important ways; by championing university access, increasing subject expertise and promoting educational research.

While working as a classroom teacher they have one day a week of protected time to complete the award in conjunction with Sheffield Hallam University and OLEVI. By partnering with world class organisations, The Brilliant Club has created a unique programme to meet the needs and build on the strengths of its teachers.

As part of the award participants were tasked with identifying a need or challenge within their school, devising an intervention to address it and designing a rigorous evaluation. The following review collates and summarises the projects that a selection of the participants conducted during the 2018/19 academic year.

As you will read, participants identified challenges ranging from preventing exclusion by building empathy through the analysis of foreign language film and improving problem solving in mathematics with the introduction of a Maths Laboratory. Participants also found a range of methods to analyse the impact of their interventions such as individual interviews or statistical regressions. The range of projects demonstrates the unique opportunity the RLE offers and the initial findings show great promise for its impact.

To ensure that participants projects were carried out with rigour and had a lasting legacy participants completed the Research and Development in Educational Contexts module delivered by Sheffield Hallam University and received personalised leadership training and coaching on the Outstanding Leadership in Education course facilitated by OLEVI. The Sheffield Hallam University module supports practitioners to design, implement, evaluate and disseminate small scale research and development projects. Successful completion of the module is awarded with 30 masters credits.

Please note that due to the timing of this publication some participants were only able to report interim findings as further data collection and analysis was ongoing. This is noted within the individual summaries.
## Research Leader in Education summaries

<table>
<thead>
<tr>
<th>Participant name</th>
<th>Summary</th>
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<tbody>
<tr>
<td>Adeolu Adegbulugbe (Maths)</td>
<td>Can the use of practical mathematics lessons improve students’ ability to problem solve? Students followed a 2-week interactive, lab-style curriculum, while a control group continued with lessons as “normal”. Math activities included experimenting with GeoGebra and a Pythagoras Wheel. The study found that students test results in the sample group improved.</td>
<td>Dearbhla McGrath (Modern Foreign Languages)</td>
<td>The aim of this project was to raise the aspirations of boys at risk of exclusion. A six-week intervention designed around the thematic analysis of a foreign language movie that includes opportunities for group and independent work aims to increase language, leadership and empathetic skills. The successful completion of the course ends in a trip to a highly selective university. Semi-structured interviews before and after the intervention were used to assess its impact. The project is still ongoing.</td>
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<tr>
<td>Alice Len (Biology)</td>
<td>Peer-to-peer mentoring and a Biology Olympiad were used to see if Year 12 biological language mastery and exam question decoding improved. Students took a baseline test and an end-of-experiment assessment. Students all self-reported feeling more confident with biological language and achieved improved test results.</td>
<td>Hannah Somers (Maths/Science)</td>
<td>This project aimed to understand and create a route for BTEC Applied Science students to be more successful on their course, specifically by targeting two areas of difficulty: maths in science and exam confidence. This was done through a weekly-intervention, coupled with independent practice and specially designed lessons that followed the format of live-modelling, guided practice and independent practice. Pre and post coded interviews along with external assessment data were used to analyse the efficacy of the strategy.</td>
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<tr>
<td>Ben Reid (Physics)</td>
<td>By using a checklist to quickly facilitate the learning of lower-order Physics skills (AO1, AO2), can lesson time be freed up to work on higher-order skills? This study used a combination of questionnaires and pupil interviews to highlight changes in learner self-perception of their ability to work independently. The results indicated that students were more likely to identify as “active learners” following the intervention.</td>
<td>Lucie Bowden (Maths)</td>
<td>Pre-teaching subject vocabulary for an upcoming unit can theoretically reduce cognitive load and improve performance, particularly with students with lower reading ages. New subject vocabulary was pre-taught by exploring word etymology and creating semantic maps. Initial findings show that these lessons have improved students confidence using mathematical vocabulary.</td>
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<tr>
<td>Catherine McEvoy (Physics)</td>
<td>Students engaged in a practical activity in every lesson during the Year 12 topic of electricity in order to test the hypothesis that engaging in real-life applications of physics on a regular basis improved knowledge and understanding. The midyear mock results will be compared to the end of year results to see if any improvement occurred.</td>
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Students displeasure towards learning maths is on the rise (Nickerson, S.D. et al., 2017) and following reforms in GCSE maths, students achieving a pass grade of 4 have dropped nationally (BBC News, 2017). While some suggest a shortage of Mathematic teachers across the UK is partly responsible (Busby, E., 2018), others call for a nationwide adoption of teaching strategies like the Singapore-style to boost standards (Warrell, H., 2018). One thing is clear, new reforms at GCSE level now require student’s mastery of problem-solving techniques together with proficiencies in mathematical reasoning. There are currently increased calls for developing mathematical reasoning and problem-solving competencies in students and experts suggest that teaching mathematics in a meaningful context challenges students to apply the subject in practical situations. Discussions with colleagues in the sciences, suggest that students learn effectively from practical activities and therefore, laboratory lessons are commonplace. My research investigates the effectiveness of adopting a math laboratory approach as a teaching intervention in developing “mathematics reasoning” and “problem-solving” skillsets in students at secondary level.

All three GCSE examination boards have highlighted the increasing number of problem-solving questions since the revised new examinations specifications were conducted in 2017 and this is because reasoning is an important tool for everyday life. Tamalene, H. (2010) suggested that the reasoning skills of mathematics are a mental process that must be built continuously through interactions in various contexts. Sumarmo, U. (2010) further highlighted that one of the characteristics of mathematics is its emphasis on the deductive process that requires logical and axiomatic reasoning, that begins with the inductive process which includes the preparation of a conjecture, a mathematical model, analogy or generalization, through the observation of a number of data. Hence, to building mathematical reasoning in students, this study adopted a number of laboratory style classes instead of the conventional classroom learning style. Students are given a laboratory manual with contain the experimental objectives for the lesson. Students through inductive reasoning work through the tasks, making conjectures and developing data which they reflect on to determine facts from their observations.

Research methods and findings

The study commenced with a pre-intervention session designed to set measurement benchmarks such as, what is measured, how it is measured and in addition, defines the desired outcome for which all results are assessed. In the pre-intervention session, test subjects were shown a series of problem-solving questions and asked to grade questions from levels 4 to levels 9 with 9 being the most challenging. An answer (Sanchal, A. & Sharma, S., 2017). Discussions with colleagues in the sciences, suggest that students learn effectively from practical activities and therefore, laboratory lessons are commonplace. My research investigates the effectiveness of adopting a math laboratory approach as a teaching intervention in developing “mathematics reasoning” and “problem-solving” skillsets in students at secondary level.

The result showed that there was significant difference between the effectiveness of conventional teaching method and math laboratory method in teaching mathematics at secondary level. The study recommended that math laboratories are effective initiatives capable of improving mathematical reasoning and problem-solving competencies in student. This methodology should be encouraged in schools and adapted to teaching mathematical concepts.

Table 1: Results for Pre & Post Intervention Assessment For Both Experimental And Control Groups

<table>
<thead>
<tr>
<th>Groups</th>
<th>N</th>
<th>M</th>
<th>SD</th>
<th>SE,0</th>
<th>t-value</th>
</tr>
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<tbody>
<tr>
<td>Experimental</td>
<td>11</td>
<td>31.39</td>
<td>9.31</td>
<td>2.14</td>
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<tr>
<td>Control</td>
<td>11</td>
<td>31.32</td>
<td>9.20</td>
<td>3.2</td>
<td>3.442</td>
</tr>
</tbody>
</table>

1 Not Significant with df = 20 & t-value at 0.05 level= 1.99
2 Significant with df = 20 & t-value at 0.05 level= 1.99

BERA’s ethical guidelines for educational research were adhered to. In compliance, written consents were obtained from all participants.

Findings and analysis

Pre and post intervention test results were compiled and analyzed using mean, standard deviation and t-test. From the findings, it was observed that the use of math laboratory sessions enhanced the capability of the students to successfully answer higher order self-graded problem-solving questions requiring a substantial degree of mathematical reasoning. The result showed that there was significant difference between the effectiveness of conventional teaching method and math laboratory method in teaching mathematics at secondary level. The study recommended that math laboratories are effective initiatives capable of improving mathematical reasoning and problem-solving competencies in students. This methodology should be encouraged in schools and adapted to teaching mathematical concepts.

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References


Sumarmo, U. (2010). High level mathematical thinking: experiments with high school and under graduate students using various approaches and strategies.


The mastery of biological language becomes significantly more difficult as many keywords for concepts being taught at A-level are complicated (most are in Latin) and therefore difficult to remember and possibly also to define. The A-level Biology curriculum introduces more and builds on the concepts taught at GCSE level providing a greater depth of biology information. This coincides with a significant increase in the prescription and learning of biological names that are often not easy to remember and are difficult to define and explain. The combination of these two issues can lead to subject disengagement and subject misconception.

Aims of the project:
1. To improve biological language mastery
2. To improve confidence with exam question approach/understanding and answering using the right biological and scientific language

Strategies/intervention:
1. Peer to peer (P2P) mentoring (Year 13s teaching Year 12s) with a focus on keywords for biological concepts taught. This strategy has been demonstrated to have moderate to high effectiveness and positive impact on learning, with an average positive effect equivalent to approximately five additional months progress (https://educationendowmentfoundation.org.uk/evidence-summaries/teaching-learning-toolkit/peer-tutoring/).
2. Hold a ‘Biology Olympiad’ with an element to also boost oracy skills along with increasing biological language confidence by using ‘game show’ style quizzing (recall of keywords and definitions), debate (oracy) and practical report writing (use of biological keywords to describe processes, results and discussion of results). This will also help the students to see it as a fun and stimulating exercise to help them learn and engage.

Research methodology
1. One to one (or two) tutoring year 13 to year 12 pupils, mentoring for debates and being an A-level science ambassador.
2. All to attend biology club tutorial session (coach year 13s on providing optimal sessions) and have an optional second session once a week. This will run for 12 weeks (2 terms).
3. Survey on effectiveness, confidence in tutoring and subject knowledge given before and after the program to both year 13s and 12s.
4. Baseline, midway through tutoring and post-tutoring mock exam for year 13s.
5. Year 12s will partake in an A-level Olympiad once a full term.

Findings to date:
Survey results to the following statements and on a scale of strongly agree (1) to strongly disagree (7):

<table>
<thead>
<tr>
<th>Question</th>
<th>Weighted average - before</th>
<th>Weighted average - after</th>
<th>Difference</th>
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<tbody>
<tr>
<td>1</td>
<td>3.78</td>
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</tr>
<tr>
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<td>3.78</td>
<td>5</td>
<td>1.22</td>
</tr>
<tr>
<td>4</td>
<td>3.33</td>
<td>5.5</td>
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</tr>
<tr>
<td>5</td>
<td>2.33</td>
<td>4.75</td>
<td>2.42</td>
</tr>
<tr>
<td>6</td>
<td>2.33</td>
<td>4.38</td>
<td>2.05</td>
</tr>
<tr>
<td>7</td>
<td>2.56</td>
<td>4.5</td>
<td>1.94</td>
</tr>
<tr>
<td>8</td>
<td>2.44</td>
<td>4.88</td>
<td>2.44</td>
</tr>
<tr>
<td>9</td>
<td>2.33</td>
<td>5</td>
<td>2.67</td>
</tr>
</tbody>
</table>

Conclusions and recommendations
• Improved keyword recall and definition Increasing the chances of mark gain in exams
• Improved engagement in A-level Biology Reducing fear and improving confidence with the subject
• Improved conceptual understanding Improve long term knowledge of the subject
• Improved organisation (preparation for lessons and revision) The completion of more home tasks led to more consolidation of subject material and exam practice
• Improved ability to convey concepts to peers using different methods Led to improving consolidation of subject material

All of this has led to, in particular for the students who were very proactive;
• Increased independent learning
• Improved mastery of A-level Biology language and content
• Improved exam preparation and resilience

On average there was a 1.94 increase in points for all statements indicating there was a marked improvement in:
1. time management / study skills
2. participating in student group/ team work
3. leadership
4. communication and interpersonal skills
5. confidence in A-level biology knowledge
6. explaining A-level biology concepts precisely and concisely
7. explaining A-level biology concepts precisely to lower year pupils
8. confidence to answer A-level biology questions precisely
9. evaluative skills in debatable topics

What strategies can be used to improve A-level biology language confidence and mastery?
In 2018, A-level Physics students achieved higher mean marks than GCSE combined science higher tier students in AO1 (recall) and AO2 (apply) style examination questions, but lower mean marks in AO3 (evaluate, analyse) style questions. [1,2] AO3 questions are the only group to show lower scores at A-level, indicating higher demands of AO3 questions at A-level compared to GCSE. This is also supported by the AQA examiner report on the 2018 A-level Physics exams, “AO3... Questions of this nature tend to be of high demand” is the opinion put forward by examiners. [1]

That the average A-level student has stronger AO1 and AO2 skills, we might expect as the Physics A-level cohort is presumably a more motivated/interested subset of the GCSE science cohort. However, this improvement is not present in higher demand questions, and this trend of a struggle with higher demand questions exists both nationally [1,2] and within my own school context.

A survey of teacher’s attitudes to the new specification of A-level Sciences (introduced in 2016-17) I conducted at my school revealed that most teachers anecdotally found it difficult to adjust to the increased demands of the new specifications while the amount of content remains similar.

From the student perspective, the proportion of study time spent on Physics has increased more than 5 times in the transition from GCSE to A-level, but much more time is expected to be spent learning independently – A student who completes 25 hours of timetabled GCSE lessons and a further 12.5 hours of homework each week will have to double their time spent on independent study in the GCSE to A-level transition.

A strategy to aid this transition is therefore essential, but we must be mindful of student’s struggles with higher demand questions, and the pressure on teachers to complete all the content of an A-level course in the time available to them.

In order to address the problem of lower scores in these higher demand questions, I thought to introduce an intervention targeted at improving independent learning skills – in particular, if students are able to work on lower order skills before a lesson, this could free up lesson time to work on higher order skills.

The intervention involved a 5-point checklist designed to help students make a start on the particular AO1 (e.g. recalling definitions) and AO2 (e.g. applying formulae to simple problems) skills required for the lesson topic. The checklist included: Title (given to the students at the end of the previous lesson), specification reference (to increase student’s awareness of how much of the course has been completed, and which specific areas of the specification are strengths and weaknesses for them), all key definitions in the topic, all key equations in the topic (to start building AO1 skills), and a set of summary questions from the text book (aimed at building AO2 skills). These summary questions demand far less than examination style questions and should be accessible to students without much support.

Independent learning is a hot topic in educational research, Hockings et. al. (3) used a large-scale qualitative study across several higher education institutions to suggest that “students initially use low level reinforcing and organising skills” and later “develop higher level extending and applying skills”.

Thoonen et al. (4) are among those to question whether teachers can affect student’s motivation to learning independently, and along with Stoten et. al. (5) put forward that teachers should reflect more on how to facilitate independent learning.

Lau [6] suggests that evaluating perceptual changes, in particular self-perception of learner type is a useful tool in evaluating student’s success when learning.

My primary group of students were year 12 and 13 students, but I also conducted some research with a year 7 group, and 3 year 11 groups. I selected these groups to conduct a preliminary investigation into how to build students independent learning skills from a younger age.

Research methodology
Following a similar approach put forward by Lau et. al., I chose to use a combination of questionnaires and pupil interviews to try to elucidate any changes in learner self-perception of their ability to work independently. As well as tracking student progress throughout the year using results from pre-public examinations.

Findings and analysis
I surveyed a range of students across Years 7-13 using structured questions to self-assess their independent learning skills, two major trends were evident from the data:

Students are more likely to identify as active learners in “exam season” than part way through their courses.

Student descriptions of independent work are 5 times more likely to be matched up to AO1 than AO3.

Most student’s survey answers matched up with quotations from longer form interviews, with the conclusion that most students found the intervention made a positive difference to their confidence to work independently, and their confidence and focus in lessons. Most students identified themselves as more active learners than before the intervention, and this change in attitude is matched by an upward trend in exam results, although a more comprehensive analysis of the data is needed!

Conclusions and recommendations
My analysis of the data so far suggests that the intervention represents a helpful way of structuring student’s workload in the sixth form. Being explicit with students about how their workload is being structured, and how this mirrors how an experienced learner would go about studying a topic (preparation before the lesson, consolidation after the lesson) has made a positive change to student’s ability to learn independently.

References
AQA Exams Analysis GCSE Science (2016) retrieved from https://results.aqa.org.uk/eAQA
Lau, K. (2017). ‘The most important thing is to learn the way to learn’: evaluating the effectiveness of independent learning by perceptual changes. Assessment & Evaluation in Higher Education, 42.3, 415-430.
Can changing the nature of practical work in the classroom, and making it more applicable to real life effect attainment in A-level physics?

Nationally, students sitting A-level physics gain the lowest average percentage in paper 3. This paper includes short and long answer questions on practical experiments and data analysis and is worth 18% of the overall A-level grade. The average percentage nationally in this exam was 40% (AQA Exams Analysis GCE A-Level Physics, 2018).

The main aims of the project are to improve students’ confidence and attainment in practical and applications skills questions.

Students performed more small practical tasks during all lessons on electricity to allow them to better understand the topics and how they relate to the real world. This helped them to see the topics as less abstract and more applicable to real life.

Practical experiments have been long established as a means through which to teach physics (Sneddon et al 2009, Gee & Clarkson 1992). Hodson (1996) discussed the benefits of practical work in a classroom, concluding that teachers want to teach science in an environment that mimics how science is performed in research and industry – in a laboratory. He assessed that practical activities can be used to learn science, learn about science and to learn to do science. They can be used to stimulate interest, gain laboratory skills, improve concept acquisition and development, understand specific scientific inquiry and develop the skills necessary to carry out and enquiry. These are the same skills that AQA wish to assess in students and so including practical experiments beyond those that are assessed and prescribed by the practical skills endorsement included in the AQA A-level physics course should improve the results obtained in paper 3.

Research methodology

Students carried out shorter practicals throughout their electricity course – as far as is possible they built the circuits that they were studying and drew and interpreted the graphs that represent their findings in each experiment, while interpreting uncertainties in all of the experiments. These are the skills that they are lacking and that have produced poor results both in a baseline test and their Christmas mock. This intervention should help the students in their ability to interpret graphs and compare them to the corresponding equations. It also familiarised them with the practicalities of error and uncertainty calculations and has given them practice in working on such calculations and allowed them to see how these uncertainties apply to the actual experiment.

Findings and analysis

Students sat a base line test, and a Christmas mock, both of which included questions on practical skills. The natural progression as the students became more settled into their A-level studies can be measured between these tests. Students are currently sitting their end of year 12 exams, having completed the set of lessons which include more practical activities and analysis. The results of these tests can be compared with the earlier exams to see if there is any significant difference. Students also completed questionnaires to establish how confident they felt about practical activities and exam questions. This was completed before the set of lessons, and students will be asked to complete it again after they have done their exams to see if there is any significant change in attitude towards this aspect of physics.

Conclusions and recommendations

Students should have a better understanding of the topics (electricity) that will be supplemented with extra practical and application activities.

Students should have a better understanding of analysis of experimental results and calculations of uncertainties, specifically in the A-level electricity topic.

Students should gain confidence in their ability to answer application/practical style questions. Students may change their attitudes towards physics, and no longer see it as an abstract subject, but one that applies to the world around them.

Students will broaden their knowledge and understanding of complex physical concepts.

Physics teachers will also gain a better understanding of the applications of each topic (project still ongoing).

References

Sneddon P H et al 2009 Perceptions, views and opinions of university students about physics learning during practical work at school Eur. J. Phys. 30 1119
This project aims to address poor attitudes to school and lack of aspiration in boys at risk of exclusion through a targeted intervention programme. In a broader sense, the project aims to raise aspirations of these students in order to avoid the significant social costs later in life that are related to exclusion. The social cost of school exclusion is grave. There is a link between child and adolescent mental illness and exclusion and the majority of UK prisoners were excluded from school. Only one per cent of excluded young people achieve five good GCSEs including English and Maths. What’s more, IPPR research estimates that the economic cost of exclusion is around £370,000 per young person in lifetime education, benefits, healthcare and criminal justice costs (Gill et al. 2017). The practice “problem” that this project will tackle could be broadly defined as a lack of specific intervention that aims to raise aspirations within this cohort.

Target audience
Students spend one hour a week for 6 weeks in a small group working together on a cross-curricular project (French and English). The focus of each session will be to allow students to develop their linguistic ability and to develop students’ capacity to work independently and collaboratively on a shared project and to learn how to discuss and present ideas and develop leadership skills. The focus is also to promote languages generally and, through this, understanding and tolerance of others. The film to be studied has been chosen as the prominent themes in the film such as racism, tolerance and friendship are pertinent considering the context of the school (further outlined below). Au Revoir les Enfants has also been chosen as it is on the A Level specification. In each session students will watch part of the film, have the opportunity to question and discuss together and will be given a research task for the next session.

At the end of the six-week intervention it is envisaged that the students will have the opportunity to present their project to the Headteacher and furthermore, students will be invited to visit Oxford University.

This part of the project aims again to increase confidence within students regarding their academic ability, and to improve students’ attitudes towards school and their future aspirations.

Scheme of work (content of sessions and independent research tasks)

Session 1: Introduction to context of WW2 France.
Research task 1: Research the French Occupation and Resistance.

Session 2: Introduction to Au Revoir les Enfants
Theme: Friendship
Research Task 2: Research the director of the film, Louis Malle.

Session 3: Film analysis.
Theme: Difference / Otherness
Research task 3: Research a holocaust survivor.

Session 4: Film analysis.
Theme: Students’ choice
Task 4: Start planning final presentation.

Session 5: Planning final presentation.
Task 5: Work on final presentation.

Session 6: Rehearsal of final presentation.

Findings and analysis
Potential ethical issues / negative effects:
1. There is the potential negative effect of ‘labelling’ boys as ‘at risk of exclusion’.

Considerations & steps to avoid this:
The project title could be presented to boys in a slightly more positive way eg. ‘boys who are not reaching their potential’.


Considerations & steps to avoid this:
On-going monitoring of boys throughout the intervention and liaising with behaviour support workers.

Research methodology
Participants’ views will be recorded through qualitative interviews at the beginning of the project and again at the end. Through this, changes in their perceptions can be analysed.

A semi-structured interview technique will be favoured as the research questions to be investigated here are somewhat broad and it may be necessary to depart slightly from pre-planned questions in order to allow participants to fully express their thoughts and to allow for participants’ elaborations and digressions. A semi-structured approach rather than unstructured has been chosen in order to guide participants towards the main topics that the research addresses (Bryman, 2016, 429).

Interviews will be recorded and transcribed to allow in-depth analysis and to avoid bias/misremembering when recalling participants’ comments.

Findings and analysis
The project is still on-going but initial tentative findings would suggest that the boys are engaged and enthusiastic towards the project. This is already an improvement with regard to their attitudes towards school.

Conclusions and recommendations
This project is an important step in beginning to target students who are under-achieving, not because of ability, but because of their difficulty in adhering to school rules. Also, this project aims to affirm the importance of languages for our students and encourage them to see studying languages as attainable and rewarding.

Hopefully, this project will serve as a starting point for the development of a larger strategy that could work across the school for improving selected boys’ attitudes towards school, thus helping to raise aspirations and therefore, engagement and attainment also.

Further conclusions and recommendations to be added on completion of project.

References


Polar 3 Map of Young Participation Areas
This project aimed to understand and create a route for BTEC Applied Science students to be more successful on their course, specifically by targeting two areas of difficulty: maths in science and exam confidence.

BTEC courses were originally introduced as coursework-based qualifications, in which students could produce portfolios of work for internal assessment (Studental, 2018). However, due to the introduction of new courses, aiming to address student inability to prepare for higher education examination, 35% of BTEC content is now assessed through external examination, a common source of student potential for success in science (MacKay, 2016). The disconnect between maths and science has long been identified in research literature (Bialek and Botstein, 2004; Dweck, 2008; Speth, 2010) and is a key area of interest personally, and I wanted to design a project that would enable students to develop their maths skills and understand the importance of maths in science, while enabling them to improve their attainment and confidence in exam scenarios.

The pupils were selected as part of the Year 12 Applied Science cohort, and all students were included in order to understand the application and efficacy of the project across a range of student backgrounds. GCSE attainment levels and needs. Students were chosen for interview randomly in order to reduce any teacher-bias. I chose to work with this group as I wanted to target these issues early in the Applied Science course, and I felt it would be more appropriate moving forward for these students to have consistent teaching across both years of their course, as opposed to Y13 students who have now followed alternative teaching methods from their initial year on the course.

The intervention involved the teaching of all mathematical content using live modelling, guided practice and independent practice within lesson time. Students then had to attend interventions once a week to consolidate the method, and complete practice at home on a regular basis to solidify this foundation. Independent practice was designed to be akin to exam conditions with students unable to ask peers or teachers for support, in order to assimilate with the ways in which their exams will be run, and to reduce anxiety about working independently in silent rooms with others.

Research methodology

Reading literature on student learning, I came across Rosenshine’s Principles of Instruction (Rosenshine, 2012) and identified that a number of these techniques had been implemented successfully in my school already e.g. recapping prior learning at the beginning of each lesson to revisit and solidify foundational knowledge. I had previously carried out analysis of the exam papers sat by Year 12 students last summer and identified that across both externally assessed units, students achieved marks either lower than national average or very close to the national average in mathematical and data handling content questions. Having read the Principles of Instruction I decided to use a subset of these principles to create a standard teaching thread for teaching data handling and mathematical content; Modelling of a method or Statistical Test; Guided Practice using short questions and reinforcing “why did we do that?” to build a theoretical knowledge base; and finally independent practice and independent working has increased student marks in associated question types.

Myself and two other teachers in my department responsible for teaching these externally assessed units, developed resources to ensure these principles were followed, and to standardise vocabulary to create a pattern in the students’ brains so they would be aware of, and engaged with, this teaching method.

I decided to use student interviews at the start and end of the project, focussing on student attitudes and confidence in exams and towards answering mathematical questions. I analysed the results of these interviews using coding, to identify common themes among student answers. The reasoning for this was two-fold: firstly to access qualitative data to understand student approach and affinity for these methods; secondly to triangulate attainment data and to ascertain whether improved confidence and improved attainment were seen consistently, or whether one aspect could improve without the other.

Findings and analysis

Preliminary attainment data has shown that the live modelling process with subsequent guided practice and independent working has increased student marks in associated question types compared to last year’s cohort of Year 12 students. The predominant increase has been found within the Physics section of the exam, an area that students have typically found difficult (as found in initial interviews). The live modelling process appears to have had more of an impact on some students than others: some of the steps can be clearly seen in student exam papers, suggesting the modelling has embedded at different levels with students. This will be explored further and will inform teaching practice and resource design for the incoming Year 12 cohort of students. Full data analysis cannot yet take place as the full comparative exam will take place shortly before the real exams themselves.

Pre-project interviews indicated that students had some apprehension when approaching exams, and that the new design of the BTEC course has had further reaching impacts than previously recognised; one major theme from the analysis of these responses indicated students predominantly chose the course due to a belief there were no exams involved. While this is communicated to Year 11 students, this will be stipulated more strongly in all communications in order to ensure students enter the course fully understanding the requirements.

Conclusions and recommendations

The significant learning from this project is that students follow models well and can learn topics they have identified as difficult when following a structured teaching method which is consistent across the taught units. The post-project interviews are yet to be analysed fully, however the preliminary analysis shows that students are more confident in their exams and in their own ability as they have had the opportunity to practice their skills and embed the methods in lesson and at home. I believe however, that it is also worth recognising that the level to which students have engaged with this has varied in preliminary data and that this is an area for focus in exam preparation, to ensure all students can fully access these concepts independently and apply these where necessary to new questions and content.

References


Lucy Bowden

Improving problem solving of KS3 mathematics students through vocabulary pre-learning interventions.

The new mathematics GCSE specification has seen an increase in ‘problem solving’ questions on the examination. Analysis of GCSE mathematics papers revealed a reading age of 15 years and 7 months, whereas the average reading age of GCSE students was found to be only 10 years and 7 months, 5 years below that of the examination (Teaching Times, 2015). This reading age analysis suggests that students must rely heavily on their reading, comprehension and decoding skills in order to access the mathematics GCSE.

Problem solving is more accessible to students with a good knowledge of subject specific vocabulary. The project involved pre-teaching a group of Y9 students the necessary vocabulary for an upcoming unit of work. When vocabulary is taught at the point of use, words are lost or misunderstood as students are focussed on learning the new method of procedure (Chard, 2003). Therefore, pre-teaching as a strategy for delivering new vocabulary removes these cognitive barriers and frees up working memory for learning new methods.

Research methodology

New subject specific vocabulary was taught by exploring word etymology and creating semantic maps. Word etymology was explored since many words in mathematics have a clear Latin or Greek root (Rubenstein, 2000). Decoding these roots helps learners link new words with their current vocabulary knowledge. Semantic mapping is a familiar strategy used by the students in their English lessons.

Findings and analysis

Initial findings have shown that students in the vocabulary intervention group have increased confidence in their own mathematical ability and have more willingly contributed in class by asking and answering questions in front of their peers.

Conclusions and recommendations

Further analysis is of students’ attainment in the intervention group relative to the rest of the class is to be carried out to determine whether pre-teaching vocabulary as a strategy to improve confidence and attainment would beneficial. This could be continued as an intervention prior to each unit of work or extended to integrating vocabulary lessons within the current scheme of work.

References


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We hope you enjoy reading this review and if you have any questions about the RLE or the content in the review please get in touch with us at: hello@researchersinschools.org.