2019 cohort

Monday Agi – Physics Teacher

Enhancing Students' Learning Progress in Science using Effective Formative Feedback Technique

Introduction

A formative feedback should answer the following questions: "Where am I going?", "How am I going?", and "Where to next?" (Hattie & Timperley, 2007), Thus, if provided thoughtfully, formative feedback is known to be a highly valuable intervention tool (Schütze et al, 2017)

However, not all feedbacks are effective (Harks et.al, 2013). It is therefore imperative that feedback techniques are robust enough to ensure effectiveness, especially in the study of science among secondary school pupils.

This study therefore seeks to evaluate how teacher-feedback on extended questions in science can be improved to help students master scientific concepts, enough to apply acquired knowledge and skill in an unfamiliar context.

The Problem

According to the GCSE Result Insight Report (AQA, 2019), the performance of students nationwide showed that in the physics foundation and higher tier paper 1 and 2, extended writing questions were attempted by the least percentage of students - 41% and 29% respectively. This indicates a significant lack of confidence or requisite skill to attempt extended writing questions in science.

Also, extended writing questions are often reported as the questions that students often find to be the most difficult (BBC Bitesize, 2021).

In the researcher's school context, data from the summer half-term formative assessment for year 9 students (the case study class for this research) showed that out of a total of 170 students that took the test, 75% of the students attempted question number 3, which was an extended writing question. Out of these, 86% (111 students) of them scored below 3 marks (half of the total score) and 41 students, which represents 24% of the total number of students did not even attempt the question mainly due to lack of confidence.

Research Question

How can feedback on exam-style extended writing questions in science be improved to help students master scientific concepts, enough to apply acquired knowledge and skill in an unfamiliar context?

The main objective is to identify an effective feedback technique that will support the following outcomes among students.

1. Confidence in providing extended response.
2. Better or deeper understanding of scientific concepts
3. Knowledge transfer to new context.

<u>The intervention</u>

There were three steps in the intervention, which allowed for a systematic data collection approach to the study as outlined below.

Step 1: Participant's selection

Consistent with the recommendations of King, (2002) and Hardin & McFarland, (2000), 12 students were randomly selected through a ballot system out of 20 volunteers as adequate sample size given the nature of the research as a small-scale study.

Step 2: Presentation and assessment

After a short lesson on "Thermal Insulation of Homes", the students were given a formative assessment, an exam-type extended writing question (6marks). These students' works were collected and graded accordingly without disclosing the scores to the students. Although 12 students were initially accepted for the research, only six attended the intervention session.

Step 3: Feedback session

Three different forms of feedback were provided to the 6 attending students in groups of two. All feedback followed the strong recommendations of Davies (2011) regarding clear explanations of success criteria.

- **Group 1:** (current technique group), This group followed the current process used in the school's science department, where a green sheet containing generic checklist of "what went well" (WWW) and "even better if" (EBI) is placed on student's work, from which they re-write answers with improvements.
- **Group 2:** (peer marking technique group). This group of students were given a clearly explained mark scheme. Afterwards they peer-marked their work using the mark scheme rigorously.

- **Group 3:** (self-reflection technique group). Students individually marked their work using the mark scheme. Following this, they were also asked to write a reflection, detailing what went well and what could be improved on.

Following these, the students were giving the opportunity to retake the initial assessment as well as answer another question framed in an unfamiliar context.

Gathering the data

To ensure greater validity of the research findings in this study, an integrated or mixed research method was used which involves collecting quantitative data and qualitative data (Hafsa, 2019) - a short and simply worded questionnaire, consistent with the suggestions of Saunders, (2016) for high impact, and a semi-structured interview with the students for more details which helped the researcher to gain better insight for valid analysis (Moriarty, 2011).

The differences in the students' marks in the exam-style extended question assessment before and after the intervention (feedback session), their answers to the questionnaire, as well as the interviews, have provided the data for analysis in this study.

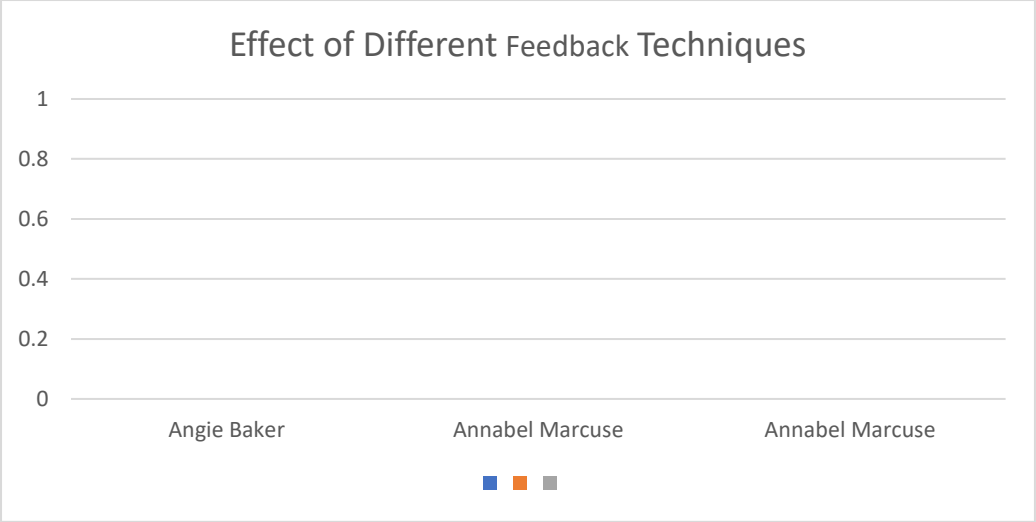
Data Analysis and Discussion

In this study, three feedback techniques were tested in an intervention against three themes or outcomes, which include, Confidence in providing extended response, Better understanding of topic, Knowledge transfer to new context.

Current Technique.

When tested against others in the intervention as presented in Figure 1. below, it showed a low improvement rate among students. While there was marginal increase of 8.7% (1 mark) between the scores achieved before and after intervention, there is however no noticeable change between the scores before intervention and the scores achieved when the different context question was answered. This result directly implies that this technique is evidently not very effective in supporting student to respond to questions framed with a different context.:

Figure 1: Effect of different feedback on students' scores in an extended answer formative assessment (total scores from of students in technique groups from Table 2)



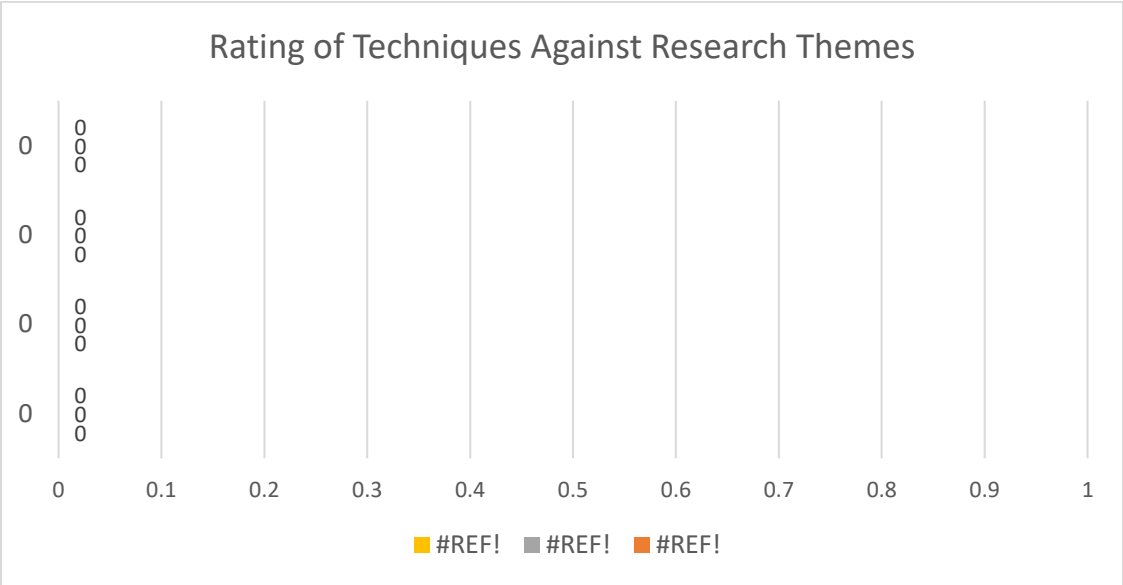
Peer Marking Technique

Also shown in Figure 1 above are the comparative scores for the Peer-Marking Feedback Technique. This reveals a significant improvement in the students score before and after the intervention. An increase of 41%. Also, the figure shows a 100% score on the different context question by the students in this group. This goes to show the potency of this feedback technique with regards to deepening the knowledge and confidence of students. This Technique is therefore seen to be very effective.

Self-Reflection Technique

Again, Figure 1 above also indicates that the Self-reflection Technique records a considerable increase in the scores of students before and after the intervention accordingly by 25% (3 marks). Also recorded was an increase in the students' ability to confidently answer other question on the concept even when framed with a different context. This implies that the Self-Reflection Techniques can be seen as potentially effective.

Figure 2: Rating techniques against research outcomes/themes



Additionally, Figure 2 above from the questionnaire, shows a clearer comparative picture of the impact made by the different techniques tested in this study. Overall, it is evident that Peer Marking Technique proved to be the most effective technique as it scored highest in the three outcomes as well as the overall outcome.

A major characteristic of this technique is the direct involvement of the students in the feedback process.

Conclusions and Recommendations (Slide 12)

This research therefore constitutes an attempt to identify the most effective way of providing feedback to students on extended writing in science. Here are the conclusions and recommendations.

1. The most effective formative feedback technique among the tested was the Peer-Marking Technique. This feedback technique supported students' progress across the three measured outcomes. From the insight provided in the interview, this result can be attributed to the opportunity it provides for student's direct involvement in the feedback process, consistent with the recommendations of Fluckiger et. al, (2010). It is therefore recommended that Formative feedback on extended writing in science include more students' directly involvement.
2. The 'Current Feedback Technique' used by the science department in the school is judged to be the least effective. It is seen to be mostly generic and does not carter for the specific needs of individual students.
3. A combination of peer marking and writing self-reflection on 'what went well' (www) and 'even better if' (ebi) before attempting a re-draft is recommended as this helps the student to take responsibility for both the process and the outcome.

References

Hattie, J., & Timperley, H. (2007). The power of feedback. *Review of Educational Research*, 77, pp. 81–112

Harks, B. Rakoczy, K., Hattie, J., Besser, M., Kliemea, E. The effects of feedback on achievement, interest, and self-evaluation: The role of feedback's perceived usefulness Educational Psychology: *An International Journal of Experimental Educational* Psychology, 33 (2013), pp. 1-22

Schütze. B, Rakoczy K., Klieme E., Besser M., Leiss D. (2017). Training effects on teachers' feedback practice: the mediating function of feedback knowledge and the moderating role of self-efficacy. *Mathematics Education* 49:475–489 DOI 10.1007/s11858-017-0855-7

AQA (2019), Insight report: results at a glance. Retrieved from: Insight report: results at a glance - June 2019 (aqa.org.uk) Accessed on 25th May 2021

BBC Bitesize (2021) Sample exam questions GCSE AQA Trilogy. Retrieved from https://www.bbc.co.uk/bitesize/guides/zs46dxs/revision/6. Accessed on 3rd June 2021

King, T. (2002). Racial disparities in clinical trials. *New England Journal of Medicine*, 346(18), pp.1400–1402.

Hardin, J., McFarland (2000). Avoiding gender and minority barriers to NIH funding. *Journal of Nursing Scholarship*, 32(1), pp.83–86.

Davies, A. (2011). Making classroom assessment work (3rd ed.). Courtenay, BC: Connect2learning.

Hafsa N. (2019) Mixed Methods Research: An Overview for Beginner Researchers. *Journal of Literature, Languages and Linguistics* Vol.58, ISSN 2422-8435

Saunders M.; Lewis P. and Thornhill A. (2016) Research Methods for Business Students Pearson (7th Edition), UK

Moriarty, Jo (2011) *Qualitative methods overview*. Methods review (1). *NIHR School for Social Care Research*, London, UK. ISBN 978085284550

Fluckiger, J., Vigil, Y.T., Pasco, R., Danielson, K (2010) Formative Feedback: Involving Students as Partners in Assessment to Enhance Learning, College Teaching, 58:4, 136-140, DOI: 10.1080/87567555.2010.484031