Fostering Engagement in a Year 10 Girls' Biology Classroom through Development of a Collaborative Culture

Claire Saxon

Wycombe High School, Buckinghamshire, United Kingdom

Abstract

Whilst girls demonstrate a propensity for social learning, classroom collaboration does not always lead to positive outcomes. Working together can lead to dissatisfaction, a reduction in engagement and a reliance on formulaic presentations rather than embracing a love of learning in a Year 10 Biology classroom. Girls at my school have been observed to collaborate effectively in Drama or Physical Education lessons but unable to transfer this skill to Biology. The aim of this action research project was to enable girls to change the perception of success in Biology and gather evidence of any change. This was the inspiration for an examination of re-addressing the balance in a more teacher-led classroom by adapting Ritchhart and Church's (2020) routines in *The power of making thinking visible*. Girls in a Year 10 Biology class at Wycombe High School were participants in a study where deliberate routines were planned and delivered in a sequence of Biology lessons to engage students in learning and working together to achieve a common goal. Data were collected as part of a mixed methods approach. Data analysis suggested an increase in feelings of belonging and inclusion. Themes of academic trust, and the ability of students to use and organically apply the skills they learned during the collaborative learning activities were identified. Initial evidence also suggests that anxiety decreased as students were able to build critical relationships and trust with their peers whilst exploring more abstract ideas. The findings also indicate that girls were more likely to participate in robust learning conversations after the action. The intended outcomes served to challenge the apparent predominant pedagogy in different contexts which had been observed in a high-achieving, single-sex girls' school and to foster a collaborative culture in areas where this is not usually expected. To develop this study further, there is a need to explore the relationship between collaboration, academic trust, and metacognition.

Glossary

5 Bs Routine: Brain, Board, Buddy, Book (or device), Boss. Students use this routine when they find they are "stuck" with their learning and need to work out how to move forward.

Active Listening: Students in pairs, allocate themselves as A or B. A partner listens to B and asks clarifying questions or prompts while B describes a concept. A makes notes on a whiteboard. Students swap roles.

Collaboration: Students engage in working together to achieve an outcome greater than what they would if they were working individually.

Engagement: Active listening, sharing of ideas and collective decision making.

Gallery Walk: Students move around the classroom, look at other students' work, and decide what information needs to be brought back to their own table to add to their own.

Project Zero: A Harvard project, initially founded to research education in the arts, which strives to understand and nurture human potential including learning, thinking, ethics, intelligence and creativity. Researchers produced resources to support learning, including collaboration, in a range of topics and age ranges (Ritchhart et al., 2011).

Splurging: Students work together on a mini-whiteboard and write down every word or phrase they know about a topic. This is usually followed with a gallery walk. Sometimes this is done after teaching a particular concept or idea to check learning.

Student Agency: Capacity to set a goal, reflect, and act responsibly to effect change.

Visible Thinking Routines: Classroom strategies that physically capture students' thinking and are designed to promote engagement with others, ideas, and action.

GCSE: General Certificate of Secondary Education. National qualification in the United Kingdom (UK) taken by Year 11 students (16 years-old).

Key Stage 3: This refers to the UK National Curriculum stage that students are in at school which covers Years 7 to 9.

Year 10: Students who are in the penultimate year of the GCSE course.

Fostering Inclusion: Creating a Collaborative Culture with Year 10 Girls

Science teachers will agree that "Science education is one of the keys to social mobility" Holman (2018) p4. This means that we need to be empowering girls in Science classrooms by using collaborative skills to level the playing field. The "Improving Secondary Science Guidance Report," first published by the Education Endowment Fund (EEF) in 2018, outlines seven recommendations for enhancing secondary Science learning. These recommendations involve the development of metacognitive and collaborative skills to move learning forwards. For students, this complex recipe of science pedagogy was challenging to navigate during remote learning, which took place during the Covid -19 Pandemic of 2020, and the Year 10 cohort who were participants in this project would have been impacted by this.

Remote learning dehumanised the learning process, which seemed to be perceived as a contract rather than built on developing relationships. My experience of remote learning was that student learning was autonomous and driven by the use of content heavy PowerPoint presentations. Engagement in learning appeared to be low, and there were limited opportunities for feedback and for students to engage with their peers. As a result, confidence in high content subjects seemed to decline. Since returning to school, some students appeared to give higher weighting to Microsoft PowerPoint presentations, didactic teaching methods, autonomous learning, and making detailed notes. Many of these students also seemed to struggle with decision making and appeared to be unable to take part in robust conversations as part of the learning process. Also, in a high performing selective grammar school, where the perception of academic pressure is high, these factors led to more weighting being placed on individual student agency whilst collaboration was considered inferior in a Biology classroom. This study aimed to use a different approach in the Biology classroom, which was centrally focussed on collaboration to facilitate greater engagement.

Krechevesky et al. (2013) outline that girls can be left feeling dissatisfied and disengaged with the learning experience. Whilst girls demonstrate a propensity for social learning, which may reduce anxiety (Costa et al., 2023; Stannard, 2022), it was observed that at Wycombe High School, the girls' engagement was selective, based on context. This phenomenon was noticed and observed particularly with Year 10 students and conflicted with what we know about how girls learn. Gill et al. (2016) report that this dissatisfaction limits the development of Mueller and Dweck's (1998) "growth mindset," which is an essential component of collaboration.

In order to change the way success was perceived in a Biology classroom, Ritchhart and Church's (2020) thinking strategies, based on Harvard's Project Zero (1967), were adapted to physically capture students' thought processes. To be a part of a change in the learning culture, these routines provided deliberately planned opportunities for students to collaborate and make decisions about collective learning.

Engagement is a complex concept, which has a number of factors (Jansen et al., 2023). The aspect of engagement being explored was defined in this study as active listening, sharing of ideas, and collective decision making. The aim of the research project was to contribute to a change in the culture of learning in Year 10 and, for this reason, was the inspiration for my research question : *How do collaborative thinking routines strengthen engagement in a girls' Year 10 Biology classroom?* An action research mixed-methods approach (Mertler 2020) was considered appropriate to investigate this question. This approach provides a holistic method to address complex issues with a comprehensive toolkit. It is more accessible to a broader audience including practitioners, policy makers and other stakeholders.

Literature Review

The passage from girl to womanhood is a visible journey that is a turbulent attempt to equilibrate looking too clever and not clever enough, not trying and trying too hard, being quiet and having a voice, with the aim of maintaining relationships and avoiding the risk of loneliness. Brown & Gilligan (2013) describe this conflict as the "dancing at the crossroads of adolescence" (p. 219). The literature suggests that in a classroom context, girls in a girls-only environment thrive with social learning compared to a co-educational context. Bugler et al. (2015) and Damour (2020) observed higher levels of anxiety in girls and, therefore, a reduction in risk taking. Damour (2020) also argues that harnessing anxiety and stress can provide the tool to stretch girls beyond their comfort zone, making this a fine balancing act for success. Strengthening engagement through collaboration (Costa et al., 2023; Stannard, 2022), taking measured risks in learning (Saujani, 2020), and having a growth mindset (Mueller & Dweck, 1998) are some of the ways in which the overwhelming effects of anxiety may be countered. This study is an exploration of the effect of collaborative routines on this struggle. The hope being that my action will enhance collaboration in my classroom and to overcome barriers to learning.

As Krechevesky and others (2013) conclude, group work does not necessarily mean effective collaboration or social learning. Although Stannard (2022) suggests that girls have an innate affinity for group work, Krechevesky et al. (2013) outline that girls can be left feeling dissatisfied and disengaged with the learning experience and may in fact serve to reinforce the closed mindset and self-sabotage that has been reported by Gill et al. (2016). Mueller & Dweck (1998) highlight the importance of a growth mindset to the learning experience; achieved by praising effort rather than intelligence and having allies in learning.

Babakr et al. (2019), Barfield (2016), Griffiths et al. (2020) and Paterson (2021) all agree that, when learners work together towards a common goal, new knowledge is acquired more than could be achieved by an individual, which can be defined as collaboration. Barfield (2016), Griffiths et al. (2020) and Paterson (2021) conducted a deep dive into this type of learning by defining fundamental principles for authentic and successful collaboration. Whilst Griffiths et al.

(2020) explore collaboration in adults, Barfield (2016) and Paterson (2021) focus on the classroom and young people. Griffiths et al. (2020) also identify collaboration as a dynamic and iterative process where individuals enhance the personal characteristics for the overall good of the team. Paterson (2021) also explains how creating a culture of collaboration can help to mitigate the emotional issues and feelings of isolation brought on by Covid 19.

The literature suggests that there is a positive correlation between collaboration and girls' engagement (Stannard 2022). Engagement is defined as a multi-dimensional construct taking into account cognitive, emotional and behavioural factors (Jansen et al 2023). Assendorf (1990) noted that participation in the collaborative process and therefore learning is impeded by self-consciousness or embarrassment. An approach-avoidance conflict was observed, where, in the case of collaborating, the event had both positive and negative effects that made the situation both appealing and unappealing simultaneously. Assendorf (1990) also notes that shyness can be misinterpreted as being not interested or not willing to participate.

Jansen et al. (2023) identified and described cognitive and social engagement. The significance of this aspect of research is that girls have a natural tendency to follow instructions and follow the expected pathway (Saujani, 2020). The hypothesis is supported by the literature that indicates promoting girls' engagement through well planned and meaningful collaboration, also decreases anxiety. In my context, I have observed variation in how the same students engage and collaborate in different subjects, such as Drama and Biology. This variation inspired me to explore this topic further as an action research project.

As an additional outcome, one component of engagement which I wanted to develop in students further was cognition, or more specifically metacognition. In my context, metacognition is a familiar and supported pedagogical construct; however, it is inconsistently applied across the curriculum and therefore has limited impact for all students. The significance of metacognition has been well-documented and researched by Ohtani and Hisasaka (2018), Hessels-Schlatter et al. (2017), Marulis et al. (2020), and Donker et al. (2014) to the effect of empowering the user to analyse, evaluate and, therefore, make decisions about their own cognitive processes, which is linked to improved academic outcomes. Järvelä et al. (2021) and Çini et al. (2020) explored this link between metacognitive awareness and collaboration. Metacognitive monitoring can serve to mitigate the transactive costs around collaboration in computer-supported collaborative learning (Järvelä et al. (2021). Çini et al. (2020) conclude that students with higher metacognitive awareness are able to understand tasks quicker and find completing them easier. Metacognitive skills can also be developed by using visible and collaborative thinking routines (Ritchhart et al., 2011).

One way to counter the lack of engagement is by using adapted visible thinking routines, which are also collaborative. These are strategies implemented in the classroom that enable

students to engage and explore what, and how, thinking is taking place. They capture thinking so that it is tangible, which allows students to reflect and improve. Ritchhart et al. (2011) outline a number of routines, which are built to promote engagement with others. The strategies are aimed at building confidence in thinking and to encourage active learning. One example was used by Mendelsee (2021), who proposed that the "Think, Pair before Share" strategy decreased anxiety and increased students' participation in class, particularly for shy students, emphasising the importance of peer work in the learning process. This has inspired me to better support and understand social and cognitive engagement in adolescent girls who have a natural affinity for reflection and working with peers. As the literature suggests, there are multiple elements of engagement and my action research focussed on active listening, sharing of ideas, and collective decision making, rather than co-operative participation.

Research Context

Wycombe High School is a girls' state selective school established in 1901 and located in Buckinghamshire, England. At the time of my research, the school had1321 students enrolled from Year 7 (11–12 years old) to Year 13 (17–18 years old). Students start their GCSE studies in Year 9, although they are still termed Key Stage 3. As a class teacher of 24 Year 10 Biology students in the target class, I was suitably positioned to explore the impact of collaboration on girls learning in this cohort. A letter was sent to all students and their parents explaining the research context. Parents or guardians were asked to complete a Microsoft Office 365 form to give permission for anonymous data collection. An opt-in system was used in line with UK GDPR (General Data Protection Regulation) policy. Parental permission was gained for student video sound bites. Identities were anonymised by ensuring students were referred to as Student A to Student Z and names were changed or redacted from video transcripts or focus groups. The data collected were kept secure in a password-protected device that required double authentication.

The Action

Thinking routines were adapted from *The power of making thinking visible* (Richhart & Church, 2020) to engage students in learning and enable them to work together to achieve a common goal in a Year 10 Biology classroom. Planned collaborative routines were incorporated into the delivery of nine Year 10 Biology lessons in the Autumn term of 2023. The length of the intervention period was 6 weeks. Previously, lesson delivery was more didactic, based on high content PowerPoint presentations and students relied heavily on this resource, rather than relying on themselves, each other, or teacher talk.

As Krechevesky et al. (2013) state, group work does not necessarily mean collaboration; therefore, the action was to implement deliberately planned collaborative moments in each lesson. The type of routines used depended on the nature of the learning required for each lesson. The making meaning routine was used to set the context, whilst splurging and gallery

walks were used for retrieval activities. When students conducted a gallery walk, pairs worked out together what they agreed as being the most important learning points, which encouraged discussion and debate. Active listening alongside paired notetaking was used in a lesson looking at the journey of water and mineral ions from the soil to the leaf. After each lesson, with planned collaborative activities, students were encouraged to reflect using Microsoft Teams Personal Channels.

The thinking routines were also delivered in such a way to ensure that all students were given opportunities to articulate their learning in a series of six lessons covering Topic Six (Plant Structure and their Functions) of the Edexcel Biology GCSE curriculum. Examples of routines used included Splurging with Gallery Walks, Active (paired) Listening, and the Five Bs. The latter was aimed to help students develop resilience and find strategies to overcome blocks in learning to find a solution to a scientific problem.

Active Listening was a strategy where pairs were asked to label themselves A or B. The teacher decided whether As or Bs would take the role of the listener, which meant they were required to listen actively, ask clarifying questions, and prompt sensitively, whereas B took the role of the speaker. Partner A noted down key points on a mini whiteboard. The roles were then reversed after two minutes. Splurging became a common feature with retrieval starter activities. Each student in a pair wrote on a shared mini whiteboard as much information as they could remember from previous learning. Once the teacher judged the splurging process complete, students walked around the room in a one-way system, evaluated work from other groups, and decided what was important to add value to their own work. Students used this information later in the lesson and took photographs for their own revision. In this way, students were making decisions about what was relevant for their learning and prioritising what to remember and add to their own whiteboards during the lesson.

Data Collection

The data collection for this action research project used a mixed methods approach with polyangulation, a critical component of ensuring rigorous and valid data (Mertler, 2020). An initial baseline qualitative learning survey was conducted using Microsoft Office 365 Forms with 16 questions. The initial learning survey included a mixture of closed, open, and Likert scaled statements to gather student perceptions on collaboration, working with peers, and engagement in Biology as a baseline for this project. The aim of the survey was to capture attitudes to learning in Biology. Mertler (2020) shared that there are arguments for and against including a neutral choice on the Likert scale. A decision was made to include a neutral response option on the Likert scale to ensure that if students had a genuinely neutral stance, then students would be able to select this. To measure engagement, I asked students to complete the same learning survey at the end of the project.

Student reflections were recorded on Microsoft Teams personal channels after each lesson which helped to establish patterns in attitudes to learning and also in engagement, as well as what students had learned. Focus group discussions of small groups of students were conducted at targeted points throughout the intervention. The focus groups of between five and seven students were conducted at the beginning and end of the project. These interviews were recorded using Microsoft Stream and a transcription was automatically generated. Photographs of the collaborative thinking routines were taken to capture the collaboration and thinking.

Class observations of Drama lessons were focussed on student engagement and how collaborative routines were planned and delivered, as well as the attitudes of students to collaboration. Teacher observation of facial expressions and body language, as well as listening to student conversations provided evidence that would support or contradict student attitudes reported in the learning surveys.

Data Analysis

Qualitative data analysis followed Parson and Brown's (2002) protocol of organisation, description and interpretation. The data were categorised into themes, described and then interpreted for relationships. These findings were then cross-referenced with the Likert Scale pre- and post-learning surveys to provide further insights into student perceptions and learning behaviours. Mean averages were used for the Likert scale perception analysis of confidence levels, as well as five bar gates, which established frequency of responses where a range of choices in responses were given. The data were analysed using an inductive approach where patterns and themes were identified to create meaning.

Discussion of Results

After analysing my data, I identified the following themes that helped to shed light on my focus on the impact of thinking routines on engagement in the Year 10 Biology classroom.

Use of Collaborative Thinking Routines Highlights the Significance of Academic Trust

My analysis suggests that academic trust plays an important role in student engagement and, therefore, learning. There was a strong sense that note-taking was personal and that academic trust is fragile and critical in the learning process, which in turn impacted how the students engaged with collaborative thinking routines. Of the 24 students in the target class, 21 students recorded that they would trust their own notes more than those made by others. When asked to record the issues with collaboration on a post-it note at the halfway point of the project, 20 out of 24 students referred to the attitude of their learning partner, which needed to match theirs for it to be successful. In a post-intervention focus group, students A, B, C and D collectively agreed that working collaboratively relies on trusting their peers and that note-taking is personal. If their partner does the "bare minimum," this means collaboration is

not enjoyable. This group of students also agreed that they did not enjoy collaboration with notetaking as it meant they have to rely on others to take notes and they prefer to take their own.

Student A found the collaborative listening and thinking routines "forces you to pay attention," further explaining that she didn't want to let her partner down. Student I felt that splurging and active listening helped her and her partner to stay on track. while Student L enjoyed not working in silence but felt that the active learning collaborative routine was challenging.

Collaborative Thinking Routines Reduce Academic Anxiety and Strengthen Feelings of Inclusion

Prior to this action research, collaborative routines tended to be delivered ad hoc and were not deliberately planned into Biology lessons. Collaborative tasks were delivered with clear instructions to ensure all students were involved and to mitigate the issues that could arise due to some students dominating conversations over others. The data suggest that there is a correlation between the intervention and reducing academic anxiety as well as strengthening the feeling of inclusion.

Student voice collected on post-it notes at the start of the project recognised that work efficiency aspect of collaboration, reduction of stress as well as strengthening focus and engagement. The mean confidence levels in Biology increased from 3.17 in a pre-survey to 3.32 in a post survey.

Reflecting on the research question, reducing anxiety and strengthening inclusion contribute towards increasing engagement in the context of a Biology classroom. Student voice collected on post-it notes identified that 22 out of 24 students at the start of the project recognised the benefits of collaboration. These benefits included work efficiency, reduction of stress and strengthening focus. Four students out of 22 scored a higher confidence level in Biology between the pre- and post-survey. When asked to identify the actions best describing them when working with teacher-selected peers in biology, in both the pre- and post-survey, one of the top three answers with 12 responses was, "likes to know what the teacher is looking for." In the post-survey, 15 students selected to ensure "everyone is involved," whereas this did not appear in the pre-survey in the top three. This change in ranking suggests that the intervention increased inclusion and decreased anxiety.

In the post project focus group of six students, a theme evolved during questioning: the importance of flow, trust, inclusion and class morale. Student R stated that collaboration in the classroom as a class really helped with the flow of ideas and how people related to each other: "And this really boosts class morale as well." Student S when asked how her confidence levels had changed, stated that they had improved because of the "classroom atmosphere" and "it's much more trusting since we're all working towards the same goal and we all want each other to

succeed," and "I feel much more included because when I participate in class, I feel like I'm really helping other people's learning journeys." These comments suggest there is a correlation between the use of the thinking routines and how students felt about engagement in Biology, and also inclusion.

When Student T was asked how she had overcome potential anxiety answering questions in class when working with a partner, she responded that, "it builds your confidence because you can compare ideas and it makes answering questions and is a lot less scary." Student U supported this by saying in a reflection of the lesson, "I think this worked quite well as working in a group made me feel less stressed and I was able to share the work and learn from others." These comments support the theme that the collaborative routines reduce anxiety and strengthen the feeling of inclusion.

One student exclaimed after the start of the Active Listening Routines that it was "like magic." Students worked in pairs and labelled themselves A and B – each selected which part of the information to focus on. After I had spoken for 3 minutes, students worked together on the mini whiteboards to retrieve the information required. The student commented that it raised the stakes for her listening and made her more accountable for her actions, because not only she depended on her learning but her partner did also.

Although this intervention had a positive effect for most students, Student F enjoyed splurging so that she can then identify "What I know and what I don't know"; however, she found listening to lots of content meant her brain was full and wanted shorter listening sections before having to share with her partners. So although the student identified that splurging was really effective, she felt that because she wanted to remember all of the information and was a perfectionist, this then meant that her anxiety increased during one of the collaborative thinking routine activities. Student Q also commented in the final focus group about active listening that "there's a lot of information which can cause cognitive overload."

When reflecting on the routines with the class, students also identified that when chunks of information were large, they felt more anxious. In response to this feedback, I repeated this activity with smaller chunks of information. Students then stated that they were able to engage better in the activity and commented that this reduced their overload.

Students Apply Collaborative Thinking Routines and Skills Organically

A positive impact of the intervention was that, by the end of the project, the explicitly taught collaborative skills appeared to have become organic in their use. Engagement levels during tasks would usually have reduced prior to the completion of the intervention. As a result, much of my time would have been spent monitoring students to ensure they were on task. This meant that I was able to have learning conversations with groups of students. For one question, I guided students who were struggling to those that had received help to provide peer support.

When students had a follow up theory lesson to a Core Practical, all students demonstrated collaborative skills without consciously recognising that was what they were doing. Students were working with their peers and used the five Bs routine when a barrier to their learning was faced and were able to collaborate to find a solution.

Teacher observation showed that students were able to collaborate with their peers effectively and my role was a facilitator or pollinator, providing intervention to groups that needed redirection in their learning or additional support. A reflection from the focus group developed this idea further when Student U stated that "I felt confident knowing that I could tackle the practical and analysis questions together. I knew that we were all wanting to try to solve the problem together." This further supports the theme that the intervention increased engagement.

Conclusion

With the aim of strengthening engagement, I found an increase in understanding of what a good collaborative classroom looked and felt like. With this in mind, I found that the class I worked with had a greater understanding of how to work together to recognise their own strengths and weaknesses. The implication for future practice is that there are thinking routines deliberately designed to facilitate engagement and collaboration for the Biology team to adopt when delivering Topic 6 of the GCSE Biology course. These resources can also be used for other topic areas in Biology and more widely across Science in Years 7 and 8 ,as well as in older year groups. My action has been shared with colleagues across different subject areas also. Overall, the action research project served to provide support for contributing to a culture which uses collaboration as the predominant pedagogical practice across the school. As the lead research teacher in the school, it is important to continue the legacy of action research and support others to conduct their own research in their chosen areas.

There was a positive relationship between the intervention and level of engagement in Year 10 girls. As I was trialling new strategies, I made additional efforts to ensure that there was a positive student teacher relationship with the target class. One of these factors was the positive teacher bias generated because of the strong relationship developed with the target class.

Reflection Statement

I have relished the opportunity to develop as a practitioner and take a deep dive into the world of educational research. By applying for this fellowship with the International Coalition of Girls' Schools, I have opened up a network of similar minded professionals to collaborate with. This is a professional pathway that I can see myself having connections with to enhance my pedagogical practice and understanding of how girls learn as well as supporting others to do the same.

Qualitative data analysis challenged my scientific and quantitative mindset as I progressed through this project. Education practitioners are skilled at evaluating impact on student learning through observing, interpreting and drawing conclusions. The formal research process has enabled me to further develop my own metacognitive skills to articulate more clearly the justification of many pedagogical decisions during the course of a lesson. During the analysis of the data I collected, I found it difficult to sort into discrete themes as there was overlapping ideas which reminded me of the complexity of pedagogy and of the interactions between different aspects of everyday classroom practice from assessment for learning, to academic trust and adaptive teaching. As part of the process, I have noticed that the teacher-student relationship is stronger and that I have an authentic understanding of how students in my class learn. Discussing the research process with both the global and local educator communities has had the impact of re-invigorating my pedagogical enthusiasm and drive to make further improvements to the way a collaborative and inclusive learning culture can be fostered.

I would like to thank my Year 10 students who were willing to try new ideas, complete surveys, participate in interviews and focus groups as well as regularly reflect on their learning. They shared constructive and thoughtful feedback and I learned so much from them as a result. They were vulnerable and brave with their shared reflections. I would like to thank my school leadership group, who supported me through the process and were critical friends from the outset. I would also like to show my gratitude to my global network of colleagues in the ICGS and GARC family.

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