UNIVERSITY OF CAMBRIDGE

Faculty of Education

A Quasi-Experimental Study into the Effects of Cross-Age Peer Tutoring on Student Attainment

Anne Marie Plumb

A QUASI-EXPERIMENTAL STUDY INTO THE EFFECTS OF CROSS-AGE PEER TUTORING ON STUDENT ATTAINMENT

Anne Marie Plumb
Faculty of Education
February 2018

ABSTRACT

Existing literature heavily speculates on the effectiveness of methods for raising the attainment of underachieving pupils, but evidence of precisely how these methods of intervention could be conducted is sparse. This paper provides a condensed version of a thesis detailing a study undertaken over one year, exploring the effectiveness of a cross-age peer-tutoring programme within a comprehensive 11-18 secondary school. Underachieving Y10 students took part in the programme; with high achieving students in Y11 participating as tutors. Tutors and tutees were paired based on data from a motivation and self-regulation questionnaire, as well as informal teacher knowledge of student behaviour and personality. Tutoring was a seven-session intervention programme, once per week for 30 minutes. A mixed methods approach was undertaken, and the findings contribute to the existing body of knowledge and understanding of the success of peer-tutoring programmes.

Results show that peer-tutoring significantly raises attainment (p=0.000). The most notable reasons for success were; tutors provide explanations, tuition aids understanding, the one-to-one environment is beneficial, tutoring provides opportunity for discussion, uncertainty can be clarified, and confidence is improved. Data demonstrate that peer-tutoring is equally successful in raising attainment for all underachieving students (disadvantaged or not) as there was no significant difference in improvement of the two groups (p=0.770).

Key words: Disadvantage, peer tutoring, attainment, underachievement, science education

INTRODUCTION

With league tables not only including the measure of five A*-C grades, but now the English Baccalaureate [five A*-C in English, maths, humanities, science and a language] ('English Baccalaureate (EBacc) - GOV.UK', n.d.), student achievement is becoming increasingly researched. Differences in achievement regarding sex, ethnicity and economic status are evident from as early as seven years old, and likely to persist over time (Strand, 1999). Schools have a responsibility to promote positive outcomes, ensuring that students from all backgrounds have equal opportunities. The underachievement of all groups of pupils is a topic of great interest, and coupled with the increasing pressure on teachers to deliver continuous success with the recent introduction of performance-related pay; it is becoming increasingly important to provide evidence for strategies which raise attainment.

Peer-Tutoring

In search of an inexpensive but effective intervention which could be used to support underachieving students, I reviewed the Education Endowment Foundation (EEF) teacher toolkit. This led me to their section on peer-tutoring; described as providing moderate impact at a low cost, being based on extensive evidence (L. Bowman-Perrott et al., 2013; Cohen, Kulik, & Kulik, 1982; Cook, Scruggs, Mastropieri, & Casto, 1985; Ginsburg-Block, Rohrbeck, & Fantuzzo, 2006; Jun, Ramirez, & Cumming, 2010; Leung, 2015; Rohrbeck, Ginsburg-Block, Fantuzzo, & Miller, 2003).

Peer tutoring is defined as "*an approach in which one child instructs another in material on which the first is an expert and the second is a novice*"(Damon & Phelps, 1989, p.11), and includes a range of approaches in which one-to-one support is given from one child to another, often involving different ability pairings and training of the tutor (K. J. Topping et al., 2011). Two main types of peer-tutoring are same-age[1] and cross-age[2] peer-tutoring;

---

[1] Same-age peer tutoring involves students of the same age, class or grade level (Robinson, Schofield, & Steers-Wentzell, 2005) working together to provide one-to-one support.

[2] Cross-age peer tutoring involves students at different grade levels; older students tutoring students who are younger than themselves (Robinson et al., 2005).

many areas of the literature have demonstrated the positive attainment effects of both types of peer-tutoring.

Bayne (2013, p.376) describes some reasoning to the effectiveness of peer tutoring "where barriers may exist between student and teacher along the lines of teaching style, age, gender, among others, opportunities for peers to be involved in the teaching process affords synergy and positive emotion that may not exist otherwise". Bowman-Perrott et al. (2013, p.39) state "the success of peer tutoring for both tutors and tutees is likely from incorporated instructional features such as frequent opportunities to respond, increased time on task, and regular and immediate feedback." Vogelwiesche, Grob and Winkler (2006) also conclude that providing immediate feedback about learning progress and mistakes [during tutoring] is beneficial to learning. In addition to receiving immediate feedback, answers, and corrections, tutees also benefit from individualised instruction by the tutor scaffolding information and tailoring instructional strategies to a pace suitable for the tutee (Jacobson et al., 2001).

A report written by Wang, Haertel and Walberg (1997) identifies 28 categories which cover the most significant influences upon student learning. The authors concluded, generally, that direct influences such as the time spent on a topic and the quality of teacher-pupil interactions had a greater impact on learning than indirect influences such as school-wide policies. Using analysis of existing literature, they ranked all 28 influences in order of importance; from most to least influential upon learning; illustrated in figure 1.1. On examination of the authors' descriptions of each of these influences, I have inferred that peer-tutoring is able to impact upon six of the top ten ranked influence on learning. Table 1.1 outlines each category applicable to the scope of this study, its ranking, the authors' description of the category, and my own interpretation of why peer-tutoring could provide a mechanism to assist student learning in relation to each category.

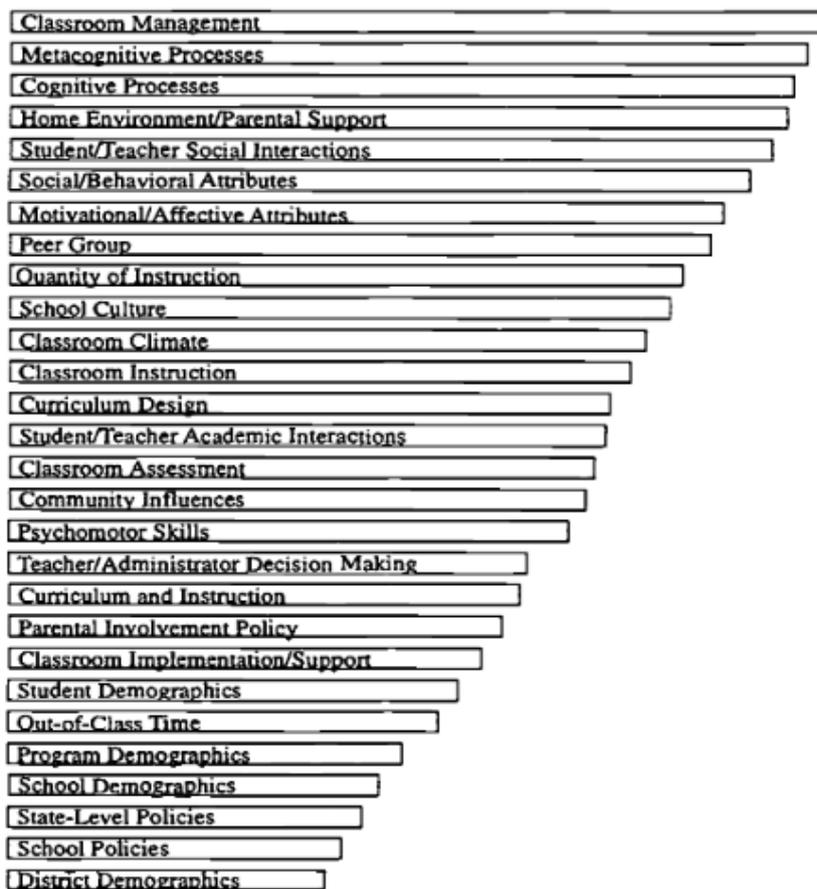| Classroom Management |
| Metacognitive Processes |
| Cognitive Processes |
| Home Environment/Parental Support |
| Student/Teacher Social Interactions |
| Social/Behavioral Attributes |
| Motivational/Affective Attributes |
| Peer Group |
| Quantity of Instruction |
| School Culture |
| Classroom Climate |
| Classroom Instruction |
| Curriculum Design |
| Student/Teacher Academic Interactions |
| Classroom Assessment |
| Community Influences |
| Psychomotor Skills |
| Teacher/Administrator Decision Making |
| Curriculum and Instruction |
| Parental Involvement Policy |
| Classroom Implementation/Support |
| Student Demographics |
| Out-of-Class Time |
| Program Demographics |
| School Demographics |
| State-Level Policies |
| School Policies |
| District Demographics |

Figure 1.1: all 28 categories which influence student learning, ranked from most influential (top) to least influential (bottom). Taken from Wang, Haertel and Walberg (1997)

Table 1.1: Summary of the influential learning categories identified by (Wang et al., 1997) which can be applied to the peer-tutoring process

Category	Rank	Author's description	Application to this study
Classroom management	1	Teacher uses questioning/recitation strategies to maintain student engagement.	Isolated sessions would remove classroom distractions, combined with conversation and questioning by tutor to maintain tutee engagement.
Metagognitive processes	2	Planning, monitoring effectiveness and outcomes of actions; testing, revising and evaluating learning strategies.	Tutoring sessions should involve specific activities to aid learning. This could be implemented by revising content, testing, then evaluating the tutee's answer/s.
Cognitive processes	3	Level of specific academic knowledge in the area instructed	Tutors selected for the programme should have a good knowledge of the subject and suitable skills to impart this on tutees.
Social and behavioural attributes	6	Positive, non-disruptive behaviour	Isolated sessions would remove the presence of disruptive class-mates; fostering a positive environment for learning.
Peer group	8	Level of peers' academic aspirations	Tutors would provide a positive and aspirational role-model for the tutee.
Quantity of instruction	9	The amount of time "on task" (actively engaged in learning)	Tutoring offers one-to-one conversation to help maintain engagement, and the length of sessions would be considered to maintain engagement.

The highest ranked influence in the aforementioned study was the management of the classroom, in order to maintain student engagement; as there is a well-established link between engagement and positive learning outcomes. Although some research goes into depth about the multifaceted and complex levels of *engagement;* whether it be behavioural, emotional or cognitive (Fredricks, Blumenfeld, & Paris, 2004); it can be recognised on the whole that student engagement is believed to be correlated with student achievement (Connell, Halpem-Felsher, Clifford, Crichlow, & Usinger, 1995; Jimerson, Campos, & Greif, 2003; Marks, 2000; Skinner, Zimmer-Gembeck, Connell, Eccles, & Wellborn, 1998). As described in the table, I believe that short, frequent tutoring sessions retain student engagement and on-task participation; and therefore feel this provides a well-founded basis for the use of peer-tutoring as a strategy in raising attainment.

Another concept from the Wang, Haertel and Walberg (1997) study which I found incredibly interesting and applicable to this study is the influence ranked number eight; peer aspirations. Bishop (1989) suggests that a peer pressure against studying hard exists due to the belief of a forced 'competition', and that this decreases student motivation in the classroom. In addition to this, the tutor's role in "modelling of enthusiasm, competence, and the possibility of success (Keith J. Topping, 2005, p.637)" could aid with increasing the self-confidence of the tutee (Keith J. Topping, 2005). Tutees may benefit from tuition sessions due to the combination of the absence of their peers (therefore removing the peer-pressure and competition element) with the pairing of an aspirational and high-achieving student as their tutor (therefore providing a role-model within their education), leading to positive outcomes in attainment.

Critical Analysis of Selected Research

There are many existing studies regarding the effectiveness of peer tutoring, and it is important to reflect upon those which offer valuable similarities, but leave behind implications for further work. Table 1.2 displays a visual summary of the method designs, outcomes, and the implications and challenges when applying a selection of other authors' research to my own. Bowman-Perrott et al (2007) examined the effect of (same-age) class-wide peer tutoring (CWPT) on students with emotional and behavioural difficulties; Allen

and Chavkin (2004) investigated cross-age tutoring using community volunteers as tutors for core subjects; McKinstery and Topping (2003) investigated the effect of cross-age peer tutoring on thinking skills; and Vogelwiesche, Grob and Winkler (2006) compared the effectiveness of same-age tutoring with cross-age tutoring in the teaching of computer skills with disadvantaged adolescents. All of these studies provide a comparable age group to the students who received tuition within my study, and two involve science.

Research Aims

Combination of the above ideas brought me toward an intervention programme which would improve student outcomes (Horwath & Basarab-Horwath, 2010)*; remove elements of negative attainment peer-competition (Bishop, 1989); provide a positive environment for learning based on positive teacher expectations, with allocated time for task completion; and close monitoring of student progress (Brophy, 2006). This research involved implementing a cross-age peer tutoring programme as an intervention strategy for a selected group of underachieving students, with a 'comparison group' involving the remainder of the class members who do not receive tuition. The hopeful outcome was raising attainment for these pupils, and potentially assisting to provide reasoning for why peer-tutoring is a successful strategy.

Table 1.1: Summary of the method designs, outcomes, and the implications and challenges when applying the four relevant studies to my own.

Author	Sample	Age, Setting	Method design	Summary of findings	Implications	Challenges on application
Bowman-Perrott, Greenwood and Tapia (2007)	N=19 (17M, 2F)	10 to 16, School for students with emotional and behavioural difficulties.	**Sub-study 1**: ABAB design: initial baseline stage (teacher-led) followed by intervention (CWPT), then repeated. **Sub-study 2:** alternating treatment design. Introduced self-management.	**Sub-study 1** - both baseline _and_ CWPT showed improvement. **Sub-study 2** - increased test score after both interventions. Both increased on-task behaviour.	Age group and subject area comparable. Targets students with complex needs.	Study 1 inconclusive: could be due to small sample size. Study 2 implemented behaviour strategies: could this explain attainment increase?
Allen and Chavkin (2004)	N=256 (156M, 100F) 202 FSM, 46EAL	11 to 14, Middle school: part of a dropout-prevention initiative	"Within-program control group" used: comparisons made between children receiving different levels of tutoring (13.25 hours vs. 13.25-61 hours). 'End grade' after tutoring compared to grade achieved before tutoring.	Tutoring increased likelihood of passing. Ethnicity and FSME had no effect. Females more likely to pass than males.	Age group and subject area partly comparable. FSM analysis used. Represents cross-age tutoring.	Tutors were adults not peers. Results not distinguished between subject. Control group technique is not comparable. No detail of how tutoring was done.
McKinstery and Topping (2003)	N=15 (6M, 9F)	12, High-school, mixed ability children (no further details)	Paired reading followed by paired thinking. Approx. 1 hour/week. Pre-/post-intervention reading age tested. Participant questionnaire and analysis of participation carried out.	Reading age significantly increased after tutoring. Tutees enjoyed sessions, found tutors friendly and tutors explained concepts.	Comparable age group of tutors. Uses cross-age design.	Age gap between tutor and tutee is larger than this study. Focus was skills not content i.e. science. Students were mixed ability.
Vogelwiesche, Grob, and Winkler (2006)	N=93 completed full course (51M, 42F)	11 to 20, Numerous schools of different types (detailed information not provided)	Two experimental groups compared. Tutees randomly assigned adult or same-age tutor. Post-intervention testing compared against pre-intervention self-report scale indicating initial computer skills. Self-esteem of participants assessed before and after.	Post-test pass rate shows progress. Self-esteem of tutees increased. Same-age tutoring more effective than adult-child pairing. No difference between gender, school type or SES.	Participants were DPs. Tutors given guidance. Cross-age tutors were adults; mine will be closer to peers.	Subject content was computer skills, not science. Authors suggest cross-age is not as effective as same-age tutoring.

METHODOLOGY

The purpose of this study was to investigate the positive effects of cross-age peer tutoring in GCSE biology within a comprehensive secondary school in the UK. Two sub-questions (SQs) have been developed to assist in answering the overarching research question:

Research question: *"How effective is cross-age peer-tutoring as a strategy to increase attainment for underachieving pupils in biology?"*

SQ1: *Does peer-tutoring raise academic attainment in biology?*
SQ2: *What reasons could explain improvement in attainment?*

Data Collection and Design

Overall, the study consisted of an initial testing, selection and pairing process; followed by a seven-week tutoring programme (one 30-minute session per week); then an analysis phase (testing and interviews). A quasi-experimental approach was taken as an experimental group (students who received tutoring) was compared to a control group (students who do not receive tutoring). These groups were not allocated randomly because they were chosen within the classes accessible for this study; with an attempt to keep other variables as similar as possible (Winterbottom, 2009). To invest more validity in the study, a randomised selection of students for each group would have been preferable (Shadish, Cook, & Campbell, 2002); however, it would also be unethical and potentially detrimental for the class teacher (and indeed the school) not to offer such opportunities to students who are underachieving. Although this does infringe upon validity; the methods of data collection and analysis still provide a sufficient degree of internal validity. As combinations of both quantitative and qualitative data were collected during this study, a mixed methods research approach was adopted. All quantitative data were subjected to statistical analysis, using IBM SPSS Statistics (V.23). Analysis firstly involved tests of normality (to determine further testing) and then (as data were normally distributed) either paired-samples t-tests

or independent-samples t-tests, depending on the comparisons made. The data collection techniques used, and the purpose of each method are outlined in table 2.1.

Title: A quasi-experimental study into the effects of cross-age peer tutoring on disadvantaged pupils				
Research question: How effective is cross-age peer-tutoring as a strategy to increase attainment for underachieving pupils in biology?				
Stage	Aim	Data source/method	Description	Data type
1	Select students for study participation Pre-intervention assessment measure	School-wide progress check (GCSE standardised end of term test)	Identify Y10 tutees by ranking class test scores and selecting the lowest ranking students. Identify suitable Y11 tutors by ranking the year group and selecting top ranking students.	Quantitative
2	Inform tutor-tutee pairings	SALES instrument	All identified students complete the SALES survey (Velayutham, Aldridge, & Fraser, 2011) and results analysed. Information on student attitudes used to formulate complementary tutor-tutee pairings.	Quantitative
Completion of the peer tutoring intervention programme.				
4	Monitor student progress Assess effectiveness of tutoring	Administration of assessment comparable to the pre-test	Assess Y10 attainment for any improvements by comparing the post-test with the pre-test conducted earlier. Statistical analysis for significance.	Quantitative
5	Gather rich qualitative data from the tutors to explain the benefits of tutoring	Student questionnaire/ survey via email using Surveymonkey©	Open and closed-option questions to explore opinions of the tutoring programme and any positive or negative outcomes.	Qualitative
6	Gather rich qualitative data from tutees to	Semi-structured group interviews with tutees	Focus group session with Y10 tutees to explore opinions of the tutoring programme and any positive or negative outcomes. Thematically	Qualitative

		coded.	
explain the benefits of tutoring			

Table 2.1: descriptions of the phases of data collection

Tutoring Session Structure

Sessions began with a concept-mapping activity, as concept maps are recognised as useful activities for (1) organising information, (2) motivating students to study a topic, (3) revising topics, (4) generating discussion around a topic, (5) ranking important ideas and (6) reinforcing ideas (Malone & Dekkers, 1984). Many of these ideas complement those which I hoped would be incorporated into tutoring sessions, and I felt providing tutors with a skeleton structure of the concept map would assist in generating discussion and providing direction for the session. Where possible, the concept maps used were taken from a book by Burggraf (1998), containing pre-drawn content-rich concept maps created using the "National Science Education Standards" as a guide (Burggraf, 1998). If the topics to be covered were not found in this book, I created them myself, bearing in mind the structure and layout of the concept map activities in this book. The concept-mapping activity was followed by a past examination question, giving students an opportunity to apply their knowledge in the format that they will ultimately be examined on, and for the tutor to give feedback and confirm/correct the tutee's answers.

A visual summary of the data sources used to answer the specific research sub-questions can be seen in table 2.2: adapted from Wilson and Stutchbury (2009) table 4.5 p.72.

Table 2.2: Summary of data collection methods used to answer the research question and sub-questions

Title	A quasi-experimental study into the effects of cross-age peer tutoring on underachieving pupils.			
Research Question	How effective is cross-age peer-tutoring as a strategy to increase attainment for underachieving pupils in biology?			
Sub-questions	Data source: Pre-intervention assessment	Data source: Post-intervention assessment	Data source: Student interviews	Data source: Student questionnaire
1. *Does peer-tutoring raise academic attainment in biology?*	✓	✓		
2. *What reasons could explain improvement in attainment?*			✓	✓

RESULTS

The data of 27 out of a possible 29 students were used, as data for two students were withdrawn due to parental request and non-attendance to sessions. Twelve students participated in the tuition programme. The ratio of males to females was equal (6M, 6F); a good representation of gender within the school. The ratio of disadvantaged pupils (DPs) to non-disadvantaged pupils was also equal (6 DPs, 6 non-DPs). Of the six DPs, half were male and half were female. The study therefore consisted of a broad representation of range of student backgrounds.

SQ1: Does Peer Tutoring Raise Academic Attainment in Biology?

Percentage scores on pre- and post-tests were used to provide a comparable scale, as the tests undertaken were not the same test, and were not out of the same marks. All students sat the same pre- and post- tests at the same time, were in the same teaching class, and were exposed to the same treatment throughout the study. No revision lessons were covered between pre- and post- tests and therefore students had not re-covered any topics in lessons after the pre-test that were then covered in the post-test. Both the pre- and post-tests were sat under the same conditions, in the same room.

Shapiro-Wilks tests confirmed normality of both pre- and post-test data (p=0.264, p=0.100 respectively). An independent samples t-test of results of the pre-test (completed prior to the intervention) revealed that the students which were subsequently selected for tutoring (M = 25.63, SD = 6.50) had scored significantly lower (t = 6.403, p = 0.000) than their peers who were therefore not selected for intervention (M = 51.00, SD = 13.65).

Post-test data show that attainment of tutored students increased from the pre-test to the post-test (M = 40.99, SD = 11.36). A paired samples t-test revealed that this increase was significant (t = 4.905, p = 0.000). A paired samples t-test was also carried out on the results of the non-tutored students, which demonstrated that on average, there was a slight

decrease in the results of students who did not receive tutoring (M = 43.90, SD = 12.06), but that this decrease was not significant (t = 1.828, p = 0.898).

An independent samples t-test on all students' post-test results indicated that in the test subsequent to the intervention programme, there was no significant difference (t = 0.64, p = 0.528) between the test scores of students who received tutoring (M = 40.99, SD = 11.36) and those who were not selected in the first place as they were already achieving higher scores (M = 43.90, SD = 12.06). This suggests that the intervention closed the existing attainment gap within the class.

Additionally, an independent samples t-test was carried out all students' results to confirm whether the percentage difference between pre- and post- tests results can be explained by peer tutoring as an independent variable. These results were highly statistically significant (t = 4.34, p = 0.000), suggesting that the intervention can account for the difference in attainment (tutored: M = 15.36, SD = 10.85; not tutored: M = -7.10, SD = 15.05). Collectively, these results show a highly significant increase in the attainment of students who received peer-tutoring, and no significant change in attainment by students who did not receive peer-tutoring.

SQ2: What Reasons Could Explain the Improvement in Attainment?

This question was answered with the use of the following qualitative data:

- Interviews with Y10 students who received tutoring
- Open and closed question survey completed by Y11 students who were the tutors for the intervention programme

Student Interviews

Six students (2M, 4F) were interviewed; one interview was held with two students, and the other with four. Two of the students were disadvantaged (1M, 1F); therefore interviews covered a broad spectrum of students. It was intentional to interview all tutored students, but due to absences and limited available opportunities to conduct the interviews; this was

not possible. This does compromise the validity of the study, however these problems were unavoidable and so results are a 'best interpretation'.

Interviews were semi-structured; consisting of three pre-planned open-ended questions, but during the interview additional questions were asked to extend or clarify answers. The over-arching questions were:

1. Did you find the tutoring useful, and why?
2. What have been the barriers to your learning prior to tutoring?
3. How has tutoring allowed you to overcome those barriers?

Interviews were transcribed using the coding system discussed by Evans (2009) which was adapted from Ellis and Barkhuizen (2005). Transcriptions were thematically coded using an inductive approach (Evans, 2009), whereby themes which emerged from the data were identified (see appendix for transcription and thematic analysis). A deductive approach was not used as this was an exploratory exercise and there were no predetermined themes. The identified themes were then tallied to count the number of associated responses per question.

Interview Question 1

"Did you find tutoring useful, and why?"

All students concluded that they had found the tutoring experience worthwhile. This question aimed to explore different pupils' opinions on exactly why they had felt the tutoring had benefitted their learning, leading to their increase in attainment. All of the responses given by students are echoed in some way within literary articles already quoted, and so data are confirmatory to studies already quoted. As shown in table 3.1 below, of all responses, the most popular were the ideas that tutors provide good explanation of concepts, and help aid understanding within the sessions.

Table 3.1: Summary of themes identified from student interviews

Theme	Number of responses (max:6)
Explanation	4
Aids understanding	4
One-to-one	2
Improves confidence	2
Discussion opportunity	2
Clarify uncertainty	2
Provides a focused environment	1
Opportunity for reflection/marking/feedback	1
Provides revision	1

Interview Question 2

"What difficulties have prevented you from learning so far?"

This question aimed to explore a little about the students views on their own learning barriers, and to also encourage them to consider them to reflect on their prior learning experiences. Table 3.2 demonstrates that the majority of students stated they found the classroom a distracting environment, or that they find it difficult to concentrate.

Table 3.2: Summary of themes identified from interview question 1

Theme	Student responses (max:6)
Distractions	4
Poor concentration	2
Lack of revision	2
Misheard/misread instructions	1
Lack of revision *technique*	1

Interview Question 3

"How has tutoring allowed you to overcome these barriers?"

The students had not been given their post-test data and therefore were unaware whether or not they had improved academically. Thus, the question was not "*how did tutoring help you improve",* as it was intended for students to be reflective upon their experience with their tutors, in relation to their own barriers to learning. The overriding theme, shown in table 3.3, appears to be that tutoring removes classroom distractions and provides opportunity to help students concentrate.

Table 3.3: Summary of themes identified from interview question 2

Theme	Number of responses (max:6)
No distractions	3
Concentration	2
Well explained	2
Broken down/simplified	1
Revision opportunity	1
Cover what was missed	1
Opportunity to reflect/marking	1
Clarify uncertainty	1
Learn revision techniques	1
Aids memory	1

Student Questionnaire

The questionnaire involved nine questions, compiled electronically on SurveyMonkey© and emailed to the tutors, due to time restrictions and ease of communication. Eight students completed the questionnaire. Each question consisted of two parts; a yes/no option and a comment box. Table 3.4 summarises the questions and responses.

Table 3.4: Summary of themes identified from the student questionnaire

	Question	Response	
		Yes	No
1	Did you enjoy tutoring?	8	0
2	Did you experience any problems whilst tutoring?	5	3
3	Do you feel that your tutee's subject knowledge improved as a result of tuition?	8	0
4	Do you feel that your tutee's motivation in biology improved throughout tutoring?	4	4
5	Did you find the resources provided for the session useful?	8	0
6	Would you prefer to have had unstructured tutoring sessions (no resources provided), or do you feel you needed guidance? *	1	7
7	Do you feel that tutoring has improved your own subject knowledge in biology?	8	0
8	Do you feel that tutoring has improved your confidence?	8	0
9	Would you tutor again?	7	1

* For simplicity of presenting the table – 'unstructured' answers have been categorised as 'yes' and 'structured' answers as 'no'

These findings suggest that the tutors found that peer-tutoring was a successful strategy, as they perceived that their tutees' knowledge improved throughout the designated sessions, in addition to securing their own knowledge of the subjects being tutored. Tutors also believed that in the process of tutoring, their confidence with the topic content had improved, though most tutors clearly felt that they needed support (in the form of resources) in order to manage the tutoring sessions.

Summary of Findings

Overall, it is evident that tutoring benefitted all students. Students who were interviewed felt that being tutored was useful for their learning for a number of reasons, with the largest proportion of positive comments being based around tuition providing an opportunity to discuss topic content with clear explanations from their tutor. This links very closely with the provision of an opportunity for clarification on particular areas which students were not sure about, and also for reflecting on/reviewing answers or previous ideas held by students, which were incorrect, and therefore misconceptions were addressed by the tutor. Student opinions on their barriers to learning most frequently involved comments relating to distractions within the classroom setting. This is not surprising, as disengagement within the classroom is widely reported to impact on academic attainment. The varied responses given from students for how tutoring allowed them to overcome learning barriers demonstrates that tutoring is an individualised process; different students will gain different experiences and different benefits.

Qualitative outcomes and inferences are supported by quantitative data analysis; confirming that tutoring has been successful in significantly ($p = 0.000$) raising the attainment of underachieving students, closing the attainment gap between underachievers and their peers.

DISCUSSION

This study explored the effect of cross-age peer tutoring on attainment in biology within a mixed comprehensive 11-18 school. The work involved in this study is highly significant as evidence for the effectiveness of peer-tutoring as a strategy to close any attainment gaps which may be identified. Through quantitative analysis of the data collected, cross-age peer-tutoring was found to significantly increase the attainment in GCSE biology of all pupils ($p = 0.000$). A multitude of research within the literature supports this, and also suggests explanations of the positive effects of peer-tutoring on attainment.

Table 4.1 represents a summary of the qualitative findings, simplifying the student interview and survey responses into a clear visual representation, linking together statements from both sources to offer explanations for the positive effect of peer-tutoring.

Table 4.1: Summary of qualitative findings

Barriers to learning	How has tutoring helped?	Benefits gained
Lack of concentration in class due to classroom distractions and/or poor behaviour	Tutoring provides a focused and fostering environment where students are able to concentrate on subject content.	Covers what may be missed in the classroom, allowing students to fully engage with material.
Lack of revision	When used to re-cover previous content (not new learning), peer-tutoring can act as a revision mechanism.	Students have the opportunity to revisit material with structured guidance (from the organiser) ensuring key concepts are covered in preparation for assessment.
Misheard/ misinterpreted instructions/concepts	Tutors re-explain information in a format that students, who may not have understood the teacher's explanations, can relate to.	Tutors are able to simplify concepts and information so that tutees understand better.
Lack of revision technique	Tutors impart their own revision experiences and techniques to tutees, who may not have had experience of learning revision strategies before.	Tutees learn new ways to revise, and discover whether these are successful to help them to learn/remember information.
Lack of understanding of previous lesson content	Tutoring provides a supportive opportunity for reflection and feedback, in which the tutor corrects any of the tutee's misconceptions.	Tutee's knowledge is improved through identification and correction of mistakes, or gaps in the tutee's knowledge.

Revisiting the Wang, Haertel and Walberg (1997) report which identified 28 categories which influence student learning; the benefits described by students within the present study share links with many of the top ranked influences on learning. Table 4.2 recaps on some of the categories identified by the authors, and the links that I have drawn from the qualitative data within this study to the applicable categories. The categories of influence on learning identified by Wang, Haertel and Walberg (1997) offer valuable explanations for the success of the tutoring programme explored within this study, and combined with my own evidence, supports the conclusions drawn within this research.

Table 4.2: Some of the influences on learning identified by (Wang, Haertel and Walberg 1997) together with how tutoring within this study links with the influences.

Category	How peer-tutoring impacted on this learning category
Classroom management	Tutoring sessions were held in a quiet, supervised area, providing a lack of classroom distractions. This, combined with the tutors' ability to provide conversation and questioning throughout session, maintains engagement of the tutee.
Metacognitive processes	Tutors and tutees are provided with specific activities to aid learning, which firstly aim to revise content before 'testing' via completion of an exam-style question, and then evaluating and/or correcting the answer.
Cognitive processes	The tutors selected to participate have a good knowledge of the subject (demonstrated by high attainment), and are briefed on how to use the resources to impart this upon tutees.
Social and behavioural attributes	Tutoring sessions remove the presence of disruptive class-mates; fostering a positive environment for learning
Peer group	The tutors selected are high-achievers, who strive to gain excellent results and are therefore a positive influence on the tutee.
Quantity of instruction	Tutoring sessions cover previously learned topics, allowing students to spend further dedicated time on a topic/concept. Sessions are shorter than lessons, therefore it is less likely for tutees to lose focus, and thus will remain actively engaged.

Responses gained from students during the qualitative phase of this study support many ideas within the literature. In correlation with Wang, Haertel and Walberg (1997) categories of influences on learning; tutees within this study identified that their lack of engagement during class time (due to being distracted) was the most common barrier to their learning, and that these distractions were not present during tutoring sessions (figure 4.2). Tutees

noted that they felt more confident during the sessions (figure 4.3), and it was expressed that students felt the benefit of having their tutor correct their mistakes (figure 4.4); suggesting they felt comfortable making mistakes in the presence of the tutor.

"Well in the tutoring there is no distractions [sic], it's easier to concentrate."

Figure 4.2: student quote relating to the engagement/classroom management concept

"It made me feel like [sic] more confident on questions I didn't understand" *"…it like [sic] made me more confident in that subject, having a one to one session."*

Figure 4.3: student quotes relating to confidence

"He like [sic] let me do the question first, and then he went over the answer."

Figure 4.4: student quote relating to tutor providing immediate feedback

In terms of providing effective learning models; tutees expressed that the tutor provided ideas on revision technique, or was able to draw diagrams if they did not understand something; representing one type of learning model (figure 4.5). Numerous students expressed that they found their tutor good at explaining concepts (figure 4.6); offering explanations to assist understanding. This supports one suggestion by Vogelwiesche, Grob and Winkler (2006) that peers are more likely to provide shorter explanations with demonstrations than adult instructors are, potentially making topic content more accessible to tutees. One tutee also expressed a benefit of her tutor simplifying material to a level she understood (figure 4.7); an example of the tutor directly responding to the tutee's needs.

"[the tutor] drew diagrams if I didn't understand things" *"[before tutoring] I didn't really know how to revise"*

Figure 4.5: student quotes relating to learning models

"They explain it really well, like in depth [sic]" *"I think they explain it clearly…"*

Figure 4.6: student quotes relating to tutor explanations

"I think they [the tutors] explain it clearly, and like if you don't understand something they do [explain] it step by step so that it makes it more simpler [sic]…"

Figure 4.7: student quote relating to how a tutor adapted to her needs

CONCLUSIONS AND IMPLICATIONS

Overall, the study revealed that peer-tutoring is an effective strategy to raise attainment for underachieving students. This has been evidenced through both statistical testing of student data in the pre- and post-testing phases, and also qualitatively through student responses during interviewing. Peer-tutoring provides a focused environment, away from classroom distractions, in which one capable student can share knowledge with another. This has been supported by descriptions that students felt there were no distractions during their tutoring sessions. With effective use of structure to guide sessions, steps can be made to aid the understanding of topic content by the tutee, whilst improving the tutor's confidence and knowledge security. This is reinforced by comments from students regarding tutors improving the tutees' confidence. A large benefit of peer-tuition, as supported by other literature, is that it provides tutees with the opportunity to ask questions without feeling peer-pressure or intimidation from classmates, and receive immediate feedback from their tutor; to confirm knowledge or correct misconceptions. Tutors are able to provide effective explanations for the tutee, potentially at a more understandable level than a classroom teacher, in order to reaffirm knowledge. Older and more experienced tutors are able to suggest mechanisms of revision, inspiring tutees to try new techniques when revising alone, potentially aiding their recall and application to examination questions. Tutoring sessions are tailored to the needs of the tutee, and can be completed at a pace comfortable for the tutee, without experiencing time pressures which may be experienced by teachers in order to complete teaching subject curriculum in the given time frame. Overall within this study, both tutors and tutees described tutoring as a positive experience, demonstrating an enjoyment and engagement with the subject through participation in the programme.

This study leaves some interesting doors open for a variety of audiences. On the whole, with correct implementation and organisation, I would suggest that peer-tutoring is successful for raising attainment of underachieving students in secondary science. League tables are continuously being reported where one school is compared with others nationally; the pressure for improvement in attainment is higher now than ever; evidenced by the recent introduction of performance-related pay increases which hold teachers accountable for

improving the results of their own classes. Peer-tutoring offers a cost-effective mechanism that schools could utilise, and I would promote consideration of this route.

Since the study identified a significant increase in attainment for tutored students, the methodology adopted within the study could provide recommendations for others. Students were paired based on scores from a self-regulation questionnaire, coupled with the teacher's personal knowledge, as one way to find the most complementary pairings. The structure of tutoring sessions involved a concept-mapping exercise guided by the tutor, followed by exam practice where the tutee independently applied knowledge, for which the tutor would provide feedback; which is widely regarded as one of many reasons for success of peer-tutoring. The study also sparks interest for potential research into whether structured or unstructured tuition would be more effective, and whether tutors should receive prior 'training'. The sample size and generalisability of this study, however, is fairly poor. This leaves the door open for extensive follow-up studies to ascertain both the short- and long-term outcomes of peer-tutoring on wider groups of students, and also within different types of schools.

REFERENCES

Allen, A., & Chavkin, N. F. (2004). New evidence that tutoring with community volunteers can help middle school students improve their academic achievement. *School Community Journal*, *14*(2), 7.

Bayne, G. U. (2013). Coteaching, peer tutoring and curriculum writing: lasting effects of involving students in talking about science. *Pedagogies: An International Journal*, *8*(4), 369–383.

Becker, B. E., & Luthar, S. S. (2002). Social-emotional factors affecting achievement outcomes among disadvantaged students: Closing the achievement gap. *Educational Psychologist*, *37*(4), 197–214.

Bishop, J. H. (1989). Why the apathy in American high schools? *Educational Researcher*, *18*(1), 6–42.

Boliver, V., Gorard, S., & Siddiqui, N. (2015). Will the Use of Contextual Indicators Make UK Higher Education Admissions Fairer? *Education Sciences*, *5*(4), 306–322.

Borkowski, J. G., & Peck, V. A. (1986). Causes and consequences of metamemory in gifted children. *Conceptions of Giftedness*, 182–200.

Bowman-Perrott, L., Davis, H., Vannest, K., Williams, L., Greenwood, C., & Parker, R. (2013). Academic benefits of peer tutoring: A meta-analytic review of single-case research. *School Psychology Review*, *42*(1), 39.

Bowman-Perrott, L. J., Greenwood, C. R., & Tapia, Y. (2007). The efficacy of CWPT used in secondary alternative school classrooms with small teacher/pupil ratios and students with emotional and behavioral disorders. *Education and Treatment of Children*, 65–87.

Bronfenbrenner, U. (1977). Toward an experimental ecology of human development. *American Psychologist*, *32*(7), 513.

Bronfenbrenner, U. (1986). Ecology of the family as a context for human development: Research perspectives. *Developmental Psychology*, *22*(6), 723.

Brophy, J. (2006). *Research review: Child care proceedings under the Children Act 1989*. Department for Constitutional Affairs.

Burggraf, F. (1998). *Thinking Connections: Concept Maps for Life Science. Book B.* ERIC.

Ceci, S. J., & Papierno, P. B. (2005). The rhetoric and reality of gap closing: when the' have-nots' gain but the' haves' gain even more. *American Psychologist*, *60*(2), 149.

Cicchetti, D., & Toth, S. L. (1997). 14 Transactional ecological systems in developmental psychopathology. *Developmental Psychopathology: Perspectives on Adjustment, Risk, and Disorder*, 317.

Cohen, P. A., Kulik, J. A., & Kulik, C.-L. C. (1982). Educational outcomes of tutoring: A meta-analysis of findings. *American Educational Research Journal*, *19*(2), 237–248.

Coman, W., & Devaney, J. (2011). Reflecting on outcomes for looked-after children: An ecological perspective. *Child Care in Practice*, *17*(1), 37–53.

Cook, S. B., Scruggs, T. E., Mastropieri, M. A., & Casto, G. C. (1985). Handicapped students as tutors. *The Journal of Special Education*, *19*(4), 483–492.

Damon, W., & Phelps, E. (1989). Critical distinctions among three approaches to peer education. *International Journal of Educational Research*, *13*(1), 9–19.

Ellis, R., & Barkhuizen, G. P. (2005). *Analysing learner language*. Oxford University Press, USA.

English Baccalaureate (EBacc) - GOV.UK. (n.d.). Retrieved 30 December 2015, from
https://www.gov.uk/government/publications/english-baccalaureate-ebacc/english-
baccalaureate-ebacc#ebacc-subjects

Evans, M. (2009). Analysing Qualitative Data. In *School-Based Research: A Guide for
Education Students* (1st ed., pp. 125–136). London: SAGE Publications Ltd.

Ginsburg-Block, M. D., Rohrbeck, C. A., & Fantuzzo, J. W. (2006). A meta-analytic review of
social, self-concept, and behavioral outcomes of peer-assisted learning. *Journal of
Educational Psychology*, *98*(4), 732.

Gorard, S. (2012). Who is eligible for free school meals? Characterising free school meals as
a measure of disadvantage in England. *British Educational Research Journal*, *38*(6),
1003–1017. https://doi.org/10.1080/01411926.2011.608118

GOV.UK (2010-2015). (n.d.). Retrieved 22 December 2015, from
https://www.gov.uk/government/publications/2010-to-2015-government-policy-
education-of-disadvantaged-children/2010-to-2015-government-policy-education-
of-disadvantaged-children

Harwell, M., & LeBeau, B. (2010). Student eligibility for a free lunch as an SES measure in
education research. *Educational Researcher*, *39*(2), 120–131.

Horwath, J., & Basarab-Horwath, J. A. (2010). *The child's world: The comprehensive guide to
assessing children in need*. Jessica Kingsley Publishers.

Jacobson, J., Thrope, L., Fisher, D., Lapp, D., Frey, N., & Flood, J. (2001). Cross-age tutoring: A
literacy improvement approach for struggling adolescent readers. *Journal of
Adolescent & Adult Literacy*, *44*(6), 528–536.

Jun, S. W., Ramirez, G., & Cumming, A. (2010). Tutoring adolescents in literacy: A meta-
analysis. *McGill Journal of Education/Revue Des Sciences de L'éducation de McGill*,
45(2).

Kounali, D., Robinson, T., Goldstein, H., & Lauder, H. (2008). The probity of free school meals
as a proxy measure for disadvantage. *University of Bath, Maths/Education*.

Leung, K. C. (2015). Preliminary empirical model of crucial determinants of best practice for
peer tutoring on academic achievement. *Journal of Educational Psychology*, *107*(2),
558.

Madden, N. A., & Slavin, R. E. (1987). Effective Pull-out Programs for Students at Risk.

Malone, J., & Dekkers, J. (1984). The concept map as an aid to instruction in science and mathematics. *School Science and Mathematics*, *84*(3), 220–231.

Marsh, A. J. (1995). The effect on school budgets of different non-statemented special educational needs indicators within a common funding formula. *British Educational Research Journal*, *21*(1), 99–105.

McKinstery, J., & Topping, K. J. (2003). Cross-age peer tutoring of thinking skills in the high school. *Educational Psychology in Practice*, *19*(3), 199–217.

RAISEonline - FAQ. (n.d.). Retrieved 22 December 2015, from https://www.raiseonline.org/contact/faqData.aspx?faqId=43

Robinson, D. R., Schofield, J. W., & Steers-Wentzell, K. L. (2005). Peer and cross-age tutoring in math: Outcomes and their design implications. *Educational Psychology Review*, *17*(4), 327–362.

Rohrbeck, C. A., Ginsburg-Block, M. D., Fantuzzo, J. W., & Miller, T. R. (2003). Peer-assisted learning interventions with elementary school students: A meta-analytic review. *Journal of Educational Psychology*, *95*(2), 240.

Ruiz, C. J. (1985). Cognitive modifiability and irreversibility (Pub. No. 4). *Guayana, Venezuela: University of Guayana*.

Sahota, P., Woodward, J., Molinari, R., & Pike, J. (2014). Factors influencing take-up of free school meals in primary-and secondary-school children in England. *Public Health Nutrition*, *17*(06), 1271–1279.

SFR 40/2014. (n.d.). Retrieved from https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/398657/SFR_40_2014_Measuring_disadvantaged_pupils_attainment_gaps_over_time__updated_.pdf

Shadish, W. R., Cook, T. D., & Campbell, D. T. (2002). *Experimental and quasi-experimental designs for generalized causal inference.* Houghton, Mifflin and Company.

Strand, S. (1999). Ethnic Group, Sex and Economic Disadvantage: Associations with Pupils' Educational Progress from Baseline to the End of Key Stage 1. *British Educational Research Journal*, *25*(2), 179–202.

Strand, S. (2011). The limits of social class in explaining ethnic gaps in educational attainment. *British Educational Research Journal*, *37*(2), 197–229.

Styles, B. (2008). Moving on from free school meals: national census data can describe the socio-economic background of the intake of each school in England. *Educational Research*, *50*(1), 41–53.

Topping, K. J., Miller, D., Murray, P., Henderson, S., Fortuna, C., & Conlin, N. (2011). Outcomes in a randomised controlled trial of mathematics tutoring. *Educational Research*, *53*(1), 51–63.

Velayutham, S., Aldridge, J., & Fraser, B. (2011). Development and validation of an instrument to measure Students' Motivation and Self-Regulation in Science Learning. *International Journal of Science Education*, *33*(15), 2159–2179.

Vogelwiesche, U., Grob, A., & Winkler, B. (2006). Improving computer skills of socially disadvantaged adolescents: Same-age versus cross-age tutoring. *Learning and Instruction*, *16*(3), 241–255.

Walberg, H. J., & Tsai, S.-L. (1983). Matthew effects in education. *American Educational Research Journal*, *20*(3), 359–373.

Wang, M. C., Haertel, G. D., & Walberg, H. J. (1997). What Helps Students Learn? Spotlight on Student Success.

Wilson, E., & Stutchbury, K. (2009). Research Design and Ethics. In *School-Based Research: A Guide for Education Students* (1st ed., pp. 57–72). SAGE Publications Ltd.

Winterbottom, M. (2009). Taking a Quantitative Approach. In *School-Based Research: A Guide for Education Students* (1st ed., pp. 137–153). London: SAGE Publications Ltd.