

Illuminating GCSE PE: An experimental research project

Are student outcomes higher when taught through the Flipped Learning model compared to the traditional teacher-led method of delivery?

Alex More

Bath University Distance Learning MA Ed

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Abstract

The framework for this experimental research project was established as a small-scale study to investigate whether students who were taught GCSE PE through the flipped learning model performed better in their theory examination than students who were taught in the traditional teacher-led method. Experimental research in the field of flipped learning was conducted which could make a significant difference to understanding and practice in GCSE PE both locally and nationally. There is a plethora of research that investigates flipped learning as a pedagogical strategy to improve learning but a paucity of action research conducted within schools that examine its efficiency directly.

The purpose of the enquiry

Cohen et al (2011, p.106) emphasise that 'it is important for the research to be original, significant, non-trivial, relevant, topical, interesting to a wider-audience and to advance the field'. It is intended that the research collated will contribute to *Physical Education* specific research in the domain of flipped learning. To support the delivery of the flipped learning model, mypeexam which is an online learning platform will be used to deliver podcasts and quizzes which are consistent with delivery in other associated flipped pedagogy (Kahn, 2013, Bergman & Sams, 2014 and Wheeler, 2015).

Context

In stage 1, the secondary school was identified as the testing centre where the experimental research would take place. The participating school is a slightly larger than an average-sized secondary school with a sixth form and serves a local town in Dorset, and the surrounding area Ofsted, (2013). The focus and participant group for this research is the current GCSE PE Cohort which consists of 52 students from varying social, economic and academic backgrounds. Students involved in the research are 15 years of age.

Rationale for the enquiry

Stage 1 identified a research problem to be investigated. Students in the UK underperform in the theory related syllabus of GCSE PE in comparison with the practical based syllabus. The literature in stage 1 explored annual trends in data, reviewed policy documentation and reported on the changes associated with the new GCSE specifications. The new GCSE PE syllabus (First teaching Sept 2016) has a 30% increase of theory content. The problem to be investigated pertains to how teachers might manage the increased theory content to help students perform better in the theory examinations. Flipped learning emerged as one potential strategy to help students and teachers alike manage learning inside and outside of the classroom.

Methodology

To design the experimental research appropriately consideration had to be given to the research problem. The research aim was to investigate how two separate teaching groups performed when exposed to two different methods of teaching. The design had to allow for two levels of independent variable as two separate groups were being tested and compared. The between-participant pre and post-test design model were selected for this enquiry as it permits a comparison between two control groups. For the purpose of this enquiry, the teacher in control group 1 taught in a traditional teacher-led way, not using the flipped model of delivery. In group 2, the teacher utilised flipped learning pedagogy so this group was referred to as the intervention group.

Initially, the within-participant design was considered but this method can't be used when the effects of any of the interventions are irreversible. Once the control and interventions groups were established, research needed to flow and follow the six-week plan. A matched-pairs design where participants are case-matched was also considered but dismissed due to time constraints and the potential challenges of finding ample participants who were similar enough to be case matched.

The independent variable (IV) is the control and intervention groups which have been created to form a comparative measure. There are two levels of IV;

IV Level 1 - the control condition (traditional classroom practice)

IV Level 2 – the experimental / intervention condition (the flipped classroom model)

The dependant variable (DV) is the primary data measured through GCSE PE test scores collected quantitatively from an externally set GCSE theory exam paper that both control groups completed. This final examination will be the surrogate measure, the post-test and will be the final marker or measure of progress achieved between both groups. To ensure the validity of the DV, GCSE exam papers were cross-moderated and marked by PE specialists not involved with the control groups. Reliability of the DV was assured by allowing a six week testing period and having the final theory exam designed by a colleague not involved in the

teaching of either control group. The experimental hypothesis predicted that the IV (control group) would have an impact on the DV (quantitative data collated). It was predicted that all participants would make progress in-line with expected levels for their age and course regardless of whether they were in the control or intervention group.

Research hypothesis

Are student outcomes higher when the teacher practices flipped learning in comparison to traditional methods of teaching?

Research associated with flipped learning (Bergman and Sams, 2014 & Abeysekera and Dawson, 2015) highlighted the potential positive impact flipped learning can have on learning. The highlights of this research suggest that flipped learning promotes learner independence (Bergman & Sams, 2014), advanced research skills (Abeysekera & Dawson, 2015) and allows the teacher to spend more time teaching to the gaps in students' knowledge (Kahn, 2013 & Alfstrom et al, 2013). The experimental hypothesis for this enquiry proposes that participants in the control group will outperform those in the intervention group. This is an alternative hypothesis, contrary to the null hypothesis as the observations gathered from the data will be a result of a real effect. This hypothesis set up the parameters for an exciting experimental research enquiry which could have a significant impact on the way GCSE PE theory is delivered in the future.

The teacher of the intervention group was experimenting with a new method of pedagogical delivery which was defined by Alfstrom et al (2013) as being in its 'infancy'. A narrow field of PE related flipped learning resources and lack of teacher exposure to flipped learning could be limiting factors to the interventions groups' progress thus justifying the alternative hypothesis outlined above.

The purpose of pre-testing and post-testing

Cohen et al (2011) advise that devising a pre-test is considered best practice when implementing the experimental model of research in the educational setting. Churches and Dommett (2016) advocate that for pre and post testing to be valid and ethical specific guidelines such as group size, composition, time frame, test suitability and a consistent testing experience or protocol must be adhered to.

Pre-testing

The pre-test was designed to be the same between the control and the intervention groups, a 60 minute GCSE PE theory exam that consisted of 45 mixed-content questions covering identical parts of the syllabus. These 60-minute tests would take place anyway so this research is ethical in that it does not place any additional pressure on the participants.

Convergent validity is defined as 'the degree of association between two testes that you assume measure the same thing' (Churches & Dommett, 2016, p.18). The groups completed exactly the same tests, a 60 minute theory paper at the start and end of the six-week testing window. Pre-Public Examinations (PPE) are standard practice in secondary schools in the UK

so testing the participants twice within a six week period is ethically sound as the data collated is used as a performance measure to illustrate student progress in-line with school policy. The level of difficulty in both PPE's was identical and the papers selected were externally constructed by the exam board. Exam boards design PPE's to avoid ceiling and floor effects, so consequently fit for purpose for use in this enquiry as it's less likely to lead to researcher bias in comparison to a PPE that would have been designed by a teacher in the school or associated with the study.

Pre-testing had a dual purpose. Firstly, the initial PPE would identify weaknesses in student attainment that could be addressed by the teachers within the testing period. Both groups were then exposed to the same content safeguarding construct and convergent validity. Secondly, quantitative data from the pre-test PPE created a platform for comparison to measure progress over time when compared to the post-test PPE. Progress over time referred to as the Progress-8 measure (Gov UK, 2015), is the key performance indicator of secondary schools in the UK as outlined in stage 1 of this enquiry. Measuring progress over time assures construct validity as this measure reflects the concept that it is intended to be measured; GCSE test data which in turn illustrates progress over time.

Group composition

Both groups were constructed using random allocation as the participants were randomly allocated to the conditions they would experience. Potential existed for a matched pair design where participants could be grouped based on learning needs (SEN), Ethnicity (EAL), Pupil Premium (PP) or academic ability. It was decided that case matching participants based on characteristics they shared prior to the experiment could influence the research hypothesis so the random allocation method was adopted.

To ensure internal validity the sample size needed to be considered carefully so the decision was made to involve the whole GCSE PE cohort of 52 students. Ethics pertained that the whole cohort should be involved as the content being delivered was normal for the age of the participants and in-line with the normal syllabus delivered at this stage of the year. Once informed consent was gained, 48 out of the proposed 52 students consented to have their data shared as a result of this enquiry. The sample size remained at 52 as all students experienced the syllabus as normal but only the consenting 48 participants had their PPE data shared within the results section of this study. As a result, both the control and intervention group consisted of 26 randomly allocated participants.

A critical review of data gathering methods

Ethics

Informed consent was requested for all 52 of the subject participants who were involved in this enquiry. 'Informed consent is the cornerstone of ethical behaviour' (Howe & Moses 1999, cited by Cohen, 2009, p.77). In the first instance, the gatekeeper (the Head teacher) approved the rationale and confirmed that the enquiry could take place at the school selected.

The research proposal was outlined to the PE department and significant others involved. The purpose, contents, procedures, reporting and benefits that might derive from the research was discussed at length and it was agreed that the between-participant pre and post-test design model was fit for the purpose of the research question outlined. This model required two different teachers (co-actors) who are timetabled to teach GCSE PE to consent to be involved in the enquiry. Consent was given by two teachers and anonymity assured.

It was essential that mypeexam, the platform being used to promote online learning through the flipped model were consulted about using this software as part of the research. This represented an important aspect within the enquiry as the flipped model requires participants to access online learning outside of the classroom. Mypeexam were the only external organisation involved in the research and consent was given to use this tool for the purpose of the enquiry. Participant accounts were generated and subjects were allocated individual email and password access so learning was available to them 24 hours a day, a key feature of the flipped learning model (Gojak 2012 and Gorman 2012).

An ethics form was approved and processed which led to an informed consent being drafted, proof read by the gatekeeper and sent out to all 52 participants. Due to the participants being children (aged 15) the letter was sent to parents to seek consent. The purpose of the research was outlined clearly with the associated factors involved with ethics in educational research (Cohen, 2011 pg.80). Parents had the opportunity to decline or withdraw from the enquiry at any time and it was made clear that the results from the PPE exams would be shared confidentially and in-line with the school exam feedback policy. In total, 52 parents approved consent for their child to be involved in the enquiry, but 4 parents requested that results were not published for their child.

The role of mypeexam in the enquiry

As outlined in stage 1, mypeexam is a PE specific online tool which allows participants to access podcasts and quizzes to test knowledge. The GCSE PE syllabus is divided into 108 podcasts which last 10 to 12 minutes in duration. After completing a podcast, participants have the option to complete a quiz which is computer generated and marked online giving instant feedback. Technology has evolved to support learning outside of the classroom. All 52 participants were allocated mypeexam accounts and given individual log-ins. The control group used the podcasts as part of the PE homework schedule during the six-week test window and the intervention group had to view podcasts and make notes ahead of the theory lessons. Both groups received 2 x 60-minute theory lessons per week for six weeks.

The main difference in the research design was that the intervention group were required to embrace the flipped learning approach. The control group only watched the podcast and did not engage with noting taking or the quiz. The intervention group watched the podcast, were advised to take notes and completed a quiz. The work is completed outside of the classroom and forms the focus for discussion at the start of every lesson as a starter activity. The control group used mypeexam to develop knowledge and did not discuss podcasts within the taught lessons.

Validity and Reliability

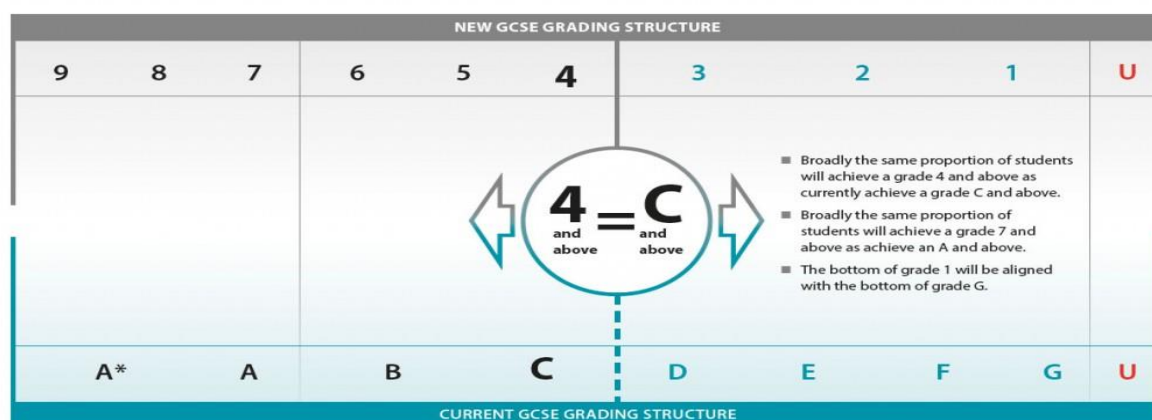
This experimental research will yield quantitative data. Cohen et al (2011) stress that being faithful to the assumptions underpinning the statistics used, the construct and content validity of the measures used will assist in avoidance of a range of threats to external and internal validity.

Construct validity is the extent to which the measure (GCSE test) reflects the concept it is intending to measure (progress). To ensure construct validity in this enquiry an appropriate timescale was agreed. The six-week window allows enough time for both the Independent Variable to be measured and the content to be covered. As advised by King et al (1987) the appropriate resources were made available to the participants. All 52 participants were given mypeexam accounts to access course content in addition to timetabled curriculum time. The sample selected was representative as was the entire GCSE PE cohort of a specific year group, therefore 'operationalizing' the constructs fairly. The Dependant Variable selected was an appropriate focus which in turn dictated the nature of the results. A pre and post-test model protects from invalidity as construct validity is assured through a standardised examination being used at the start and end of the testing window.

To ensure reliability the situational factors for the test were considered. All participants would sit the examination in examination conditions within an invigilated environment consistent with actual GCSE examinations. This eliminated the potential for participant collusion and avoided the 'Hawthorne effect', a theory that explains how individuals behave differently when they feel they are being observed. The temperature of the exam room, the content of the exam paper and the invigilated environment are all consistent variables which help safeguard from unreliability in the research. In addition, the instrument variable being the written theory examination was externally created by the exam board which avoids idiosyncrasies and subjectivity. The examinations were externally marked outside of the test centre to avoid 'marker bias (Wheeler, 2015) which confirms the realism of the results.

Analysis and discussion of findings

Inferential statistics from the pre and post-tests are represented as 9-1 scores in-line with the new Progress-8 measure for which student populations are now assessed through in the UK.



Ofqual, Gov UK (2016) <https://www.gov.uk/government/organisations/ofqual>

Data collated from the pre and post-test between-participant design is illustrated in a table form in appendix 3. Participant names have been shaded to assure anonymity. There were two levels of the independent variable so the data was recorded in a table format.

Results

The Mean Average (MA) as a starting measure for the Control pre-test was 68.04 and the post-test 69.04. The Intervention pre-test MA was 67.58 compared to the post-test 69.04. Whilst the post-test data for both control and intervention groups were identical, the intervention group's gain score was larger (1.46) compared to the Control (1.0) indicating that the intervention group made significantly more progress under the new Progress-8 measure.

Gain scores, defined by Churches and Dommett (2016, p.110) as 'the difference between post-test score and the pre-test scores' have been included in the data table as they represent true Progress-8 measures for each participant and will help measure progress over time.

T-tests are conducted to test the statistical significance of the differing mean gain scores. A 95% significance level is used ($\alpha=0.05$), this is compared to the p-value from the t-test which indicated the probability the mean gain score of the intervention group would occur in the control group. If $p < 0.05$ we reject the null hypothesis (there is no difference between the control and intervention group) in favour of the alternative.

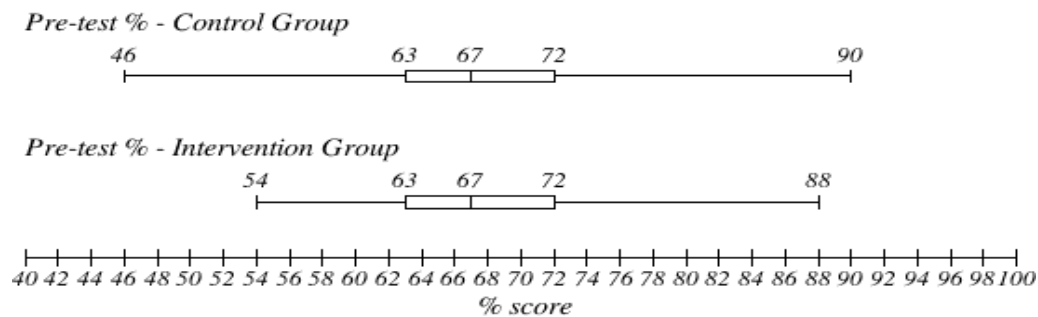
t-Test: Two-Sample Assuming Unequal Variances

	control	intervention
Mean	0.608696	1.043478261
Variance	68.70356	27.6798419

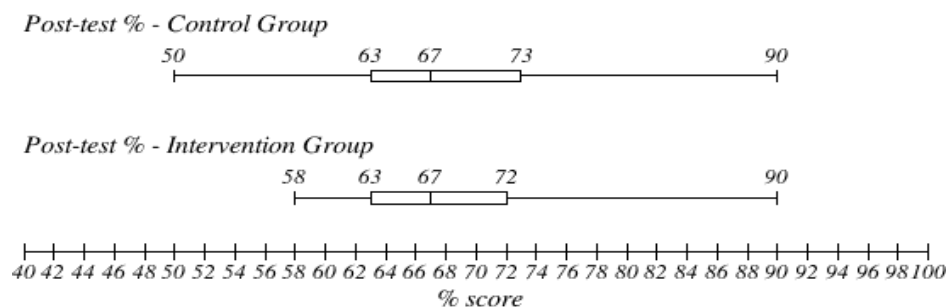
Observations	23	23
Hypothesized Mean Difference	0	
df	37	
t Stat	-0.21239	
P(T<=t) one-tail	0.416484	
t Critical one-tail	1.687094	
P(T<=t) two-tail	0.832968	
t Critical two-tail	2.026192	

The *p-value* result is 0.83 which is very high which indicates that there is no statistically significant difference between the control and intervention group data. The two-tailed test or non-directional hypothesis is the standard test of significance to determine if there is a relationship between variables in either direction.

Box Plot (with outliers) for the control and intervention **pre-tests**



Box Plot (with outliers) for the control and intervention **post-tests**



The box plots show the range over which the data is spread, shown by the vertical line in each graph. The interquartile range of each data plot (shown by the plot) is significant because it illustrates the vast range, particularly in the control group.

Critical evaluation and conclusion

The data collated from this study illustrates two interesting factors. Firstly, when a t-test was conducted the p-value (0.83) was very high suggesting that there was no statistically significant difference between the two groups. The box plot graphs exemplify the range in student scores and suggest a possible weakness in the design of the study. Student starting points before the pre-test were too varied as the spread of grades 9-1 was vast. It would be interesting to run the same study with a cohort of students who had identical or very similar starting data. For example, a cohort who were predicted 5's on the 9-1 scale prior to commencing the testing.

Secondly, the alternative hypothesis proved inaccurate. The control and intervention group both performed identically in the pre-test 68.04 Mean Average which suggests the group composition was valid and that random allocation worked to an extent. An interesting trend that was not predicted emerged when the intervention group outperformed the control group in the post-test. The intervention group's gain score was larger (1.46) compared to the Control (1.0). This clearly illustrates that the intervention group made more progress during the six-week testing period and in theory rejects the alternative hypothesis predicted in the methodology. This is a significant finding as it directly reflects progress, the dependant variable being tested.

A systematic approach to the planning and conduct of the research was adhered to. A six-week testing period worked well as all the participants were aware of the time-frame but this constraint did place additional pressures on the researcher. The data collection was simple to administer and placed no additional strain on the participants as they were due to take the tests anyway. However, the need to externally verify the results did place a time pressure on both the pre and post test as papers had to be sent offsite so marking could be authenticated. The strength of this method was safeguarding validity in the data and marker bias was avoided which could have influenced the outcomes of the study. Perhaps online standardised tests that are assessed and graded by a computer program would be more effective way to proceed. There is scope to explore this through technologies that automatically grade and assess such as Socrative, myppeexam and EduPuzzle all Apps and programs that would be fit for purpose in future enquiries.

Proximal factors such as learner's academic self-concept, teacher dialogues with participants and the level of parental engagement in the intervention group's work outside of school created external variables which proved hard to control. Interesting, these factors were more prevalent in the intervention group who were exposed to flipped learning. This is consistent with research associated with flipped learning (Bergman and Sams, 2014 & Abeysekera and Dawson, 2015).

There were some external variables which could be perceived as limitations of the experimental research method. These variables were mostly out of the control of the researcher and included; student and teacher absence from lessons, problems associated with mypeexam log-ins and unforeseen distractions to timetabled lessons. Student motivation in both the control and intervention groups seemed to affect the degree in which participants interacted with the tasks. Naturally, some students were more motivated than others to complete the quizzes, use the podcasts and complete home study. Self-Determination Theory (SDT) first introduced by Deci and Ryan (1985) is a theory of motivation which suggests key psychological needs are innate and universal. The SDT theory emerges consistently in flipped learning research (Abeysekera & Dawson, 2015 and Alfstrom et al, 2013) and could provide insight into why some learners have lower academic self-concept than others. Key features of SDT research highlight the need for competence, relatedness and autonomy. Exploring student motivation and self-concept in more depth would have been a worthy development if time permitted. The use of systematic observation could be viable to gather qualitative data if this study was to be repeated.

Reflections

This experimental research enquiry attempted to solve a real practitioner-identified problem. Are student outcomes higher when the teacher practises flipped learning in comparison to traditional methods of teaching?

In this enquiry, the intervention group did make more progress over time (Progress-8 measure). The flipped learning group did outperform the traditionally taught group which suggests there are scope and justification to explore flipped learning in more depth, potentially at dissertation level. Valuable insights into the realities of experimental based practitioner research provided an incentive to explore flipped learning, the self-determination theory and the between-participant pre and post-test design model further.

Experimental research design allows for reflective practice and professional development which could inform best practice. In this case, flipped learning has proved worthy of exploration and further research, particularly when linked to learner progress and motivation in GCSE PE.

Words: 3834

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Appendices

Appendices 1 – Letter requesting informed consent

Dear Parent / Carer,

I am writing to request informed consent for an exciting research project that I am proposing to implement within GCSE PE this year. I am currently studying an MA Ed (Teaching & Learning) through Bath University and plan to implement an experimental research project to investigate the impact flipped learning has on student progress.

Flipped classroom is an instructional strategy and a type of blended learning that reverses the traditional learning environment by delivering instructional content, often online, outside of the classroom. It moves activities, including those that may have traditionally been considered homework, into the classroom.

In the past few years GCSE PE students have struggled to achieve really good theory results in the final examination and Ofsted (2013) reported this as an area for improvement. I am keen to try out a new strategy known as 'flipped learning'. I propose to organise the cohort of 52 GCSE PE students into a control group (26 students) and an intervention group (26 students). The control group will be taught traditionally, as normal every-day practice pertains. The intervention group will be taught through the new flipped learning model. Students will be randomly allocated between the two groups. Both groups will complete a pre and post-test mock exam which they would be completing in-line with the schools assessment process anyway. This assures no extra pressure will be placed on the students involved in the study

I have spoken to the group about the proposed plan and had a very positive response. There are no risks associated with the research and individual student names and achievements will not be published in any of the data being reported or published. If successful, the findings may inform future groupings in other subjects within the school.

To complete this study I do require informed consent from a parent or carer as the young people involved in the study are under the age of 18. Please could you email _____ to confirm you are happy for your child to be involved in the study. I am happy to discuss any aspects of the study in person and need to emphasise that students have the right to withdraw from the study at any point.

Yours sincerely,



Head of PE

Appendices 2 – Timeline for enquiry

Date	Action	Documentation
01/11/16	Gatekeeper was approached to request permission to conduct the educational enquiry	Meeting with Head Teacher and Gate Keeper
03/11/16	Mypeexam was consulted about using product as part of the research tool used to measure progress	Email – copy enclosed
04/11/16	Proposal for enquiry outlined to other PE teachers within the department. Validity, Reliability and potential problems with the research discussed	PE Meeting Minutes 04/11/16
02/12/16	Ethics form completed and approved by Bath University	Copy of signed ethics form on Moodle. Paper copy enclosed in appendices 3.
02/12/16	Letter sent to parents requesting informed consent for students to be involved in the enquiry	Copy of letter in appendices 1
05/12/16	Deadline for informed consent letters to be returned and start of six-week testing window	

Testing window

05/12/16	12/12/16	09/01/17	16/01/17	23/01/17	30/01/17
Week 1	Week 2	Week 3	Week 4	Week 5	Week 6

The testing period spanned over the Christmas holiday 2016-2017.

Appendices 3a – Table of Results for Control Group

c	Control Group - Traditional				
	Pre-test %	9-1 score	Post-test %	9-1 score	Gain Score
Participant 1	54	4	63	5	9
Participant 2	67	5	63	5	-4
Participant 3	82	7	84	7	2
Participant 4	72	6	67	5	-5
Participant 5	67	5	72	6	5
Participant 6	46	3	58	4	12
Participant 7	67	5	Abs	Abs	N/a
Participant 8	90	8	88	7	-2
Participant 9	58	4	63	5	5
Participant 10	63	5	67	5	4
Participant 11	67	5	78	6	11
Participant 12	72	6	72	6	0
Participant 13	86	7	67	5	-19
Participant 14	67	5	80	7	13
Participant 15	67	5	72	6	5
Participant 16	63	5	67	5	4
Participant 17					
Participant 18	63	5	58	4	-19
Participant 19	54	4	50	4	-4
Participant 20	72	6	76	6	4
Participant 21	67	5	63	5	-4
Participant 22	88	7	90	8	2
Participant 23	63	5	58	4	-5
Participant 24	67	5	72	6	5
Participant 25					
Participant 26	72	6	67	5	-5
	MA (25) =		MA (24) =		
	68.04		69.4		
Exam % Boundaries (Edexcel Summer 2016 series)					



Data blanked out represents participants who did not consent to data being used

Appendices 3b – Table of Results for Intervention Group

Name	Intervention Group - Flipped				
	Pre-test	9-1 score	Post-test	9-1 score	Gain Score
Participant 27	67	5	72	6	5
Participant 28	80	7	82	7	2
Participant 29	58	4	63	5	5
Participant 30					
Participant 31	63	5	67	5	4
Participant 32	72	6	67	5	-5
Participant 33	67	5	72	6	5
Participant 34	54	4	58	4	4
Participant 35	63	5	67	5	4
Participant 36	72	6	67	5	-5
Participant 37	80	7	72	6	-8
Participant 38	63	5	67	5	4
Participant 39	67	5	67	5	0
Participant 40	63	5	Abs	Abs	N/a
Participant 41	58	4	63	5	5
Participant 42					
Participant 43	88	7	90	8	2
Participant 44	72	6	67	5	-5
Participant 45	58	4	63	5	5
Participant 46	67	5	72	6	5
Participant 47	63	5	72	6	9
Participant 48	82	7	76	6	-6
Participant 49	72	6	67	5	-5
Participant 50	67	5	63	5	-5
Participant 51	63	5	72	6	9
Participant 52	Abs	Abs	63	5	N/a
SPE01 Theory	MA (24)		MA (25)		
	67.58		69.4		



Data blanked out represents participants who did not consent to data being used

Grade	%	9-1 Equiv
A*	100	9
A*	90	8
A	80	7
B	70	6
C	60	5
D	50	4