Enhancing Independent Learning in Physics by Developing Study Skills

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A Research & Development Project

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Abstract

In this piece of practitioner action research I aimed to help students of Advanced Level Physics to become better at learning independently through teaching study skills in prescriptive homework assignments. This focus is of personal importance, having taught A level Physics for four years my in lesson or face to face teaching has improved, I've come to realise that a major limiting factor in my students success is their activities outside of classrooms, either entirely independently or as students working together without the presence and guidance of their teacher. This is relevant to the wider school context as there is drive to improve students metacognition, their thinking about thinking, learning about learning, to maximise students' success in their A-level studies and in learning later in life. Teachers are dedicated to encouraging our students to become lifelong learners, helping them to develop as independent learners while studying is key to achieving this.

As practitioner action research the approach taken was to investigate the specific focus, 'how to encourage students to learn independently' through cycles of intervention, observation, reflection and conclusion. During these research cycles the environment in which the research took place changed significantly, the school was partially closed down due to the coronavirus pandemic, and students were asked to work independently from home, communicating with their teacher and other students digitally. This gave unique opportunity for students to be observed working independently, but did mean that the intervention was put on hiatus. The intervention continues into the next academic year, and this document outlines how the research to date has influenced myself and my school's thinking on independent learning, and how the research will continue with two new classes of year 12 Advanced level Physics students.

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Chapter 1: Introduction

1.1 Background

As a teacher of Physics in a comprehensive secondary school it is my duty to afford my students the best start in life, giving them the best quality of education that I am capable of. The UK Teacher's Standards (DfE 2013) requires that teachers "encourage pupils to take a responsible and conscientious attitude to their own work and study" (p.10), in helping students to examine and improve study habits I believe that they can become more resilient, able lifelong learners. Post 16 education is pivotal for students making choices influencing their future paths, whether studying in an 'academic' educational setting such as undergraduate courses or more 'technical' settings such as apprenticeships. In the UK government's 'Post-16 Skills Plan' Nick Boyles, Minister of State for Skills gives his opinion that:

"Sustained and skilled employment leads to prosperity for individuals, but for too long it has been those from the most disadvantaged backgrounds who have been denied this opportunity by poor-quality and irrelevant education. Too often they have been taken down paths which have led nowhere." (DfE, DfBI&S 2016, p.5)

I disagree that any education is irrelevant, the thrust of the argument that education should prepare students for life by giving them the best opportunities for sustained career paths resonates with me. I cannot alter the curriculum to make it more relevant to students' future careers, as many do not know what this career will be until later in life, but I can maximise their opportunities by fostering in them the skill of learning. Through teaching my students new effective study skills, I hope to encourage them to become lifelong learners who will be empowered to achieve whatever goals in life it is that they set their hearts on. I believe that

secondary education should primarily prepare students for broad ranges of possible careers and life choices, it should give them the essential knowledge, skills required to take their next steps in life. For me the intrinsic motivation of having careers that enables one to interact with the world in fulfilling ways is its own reward, while government documents typically focus more on the economic prosperity of the country as "economic security will not come from having a job for life but from having the ability to maintain and renew the right skills through lifelong learning." (Government Office for Science 2017, p.6) Whatever our motivations, we can agree that encouraging students to become lifelong learners will be of benefit to them and to society.

Having taught Physics at A-level for four years I feel I am a passable teacher in lessons, making effective use of the few hours of face to face teaching time available. In class teaching can be improved by having good subject knowledge, clear explanations, and well-planned lessons with appropriate tasks. Specific planning and differentiation can be achieved by getting to know students through conversation, observation, questioning, assessments and marking pieces of work. Where my teaching practice could now be most immediately improved is in 'independent learning', what my students do to learn when they are out of the lesson, either on their own or working together independently of their teachers.

During initial teacher training many new teachers will come across the concepts of independent learning, study skills, and growth mindsets. Teachers are facilitators of learning, interacting with students so that they become more familiar with various concepts and facts, develop their skills and abilities, becoming adept at performing under practical and exam conditions. That primary goal is that the students should learn and become better learners. Students should come to understand that their minds are not fixed, that they can improve, become 'more intelligent'. If

they've not excelled academically in the past, or even feel that they've failed, they can learn how to learn effectively, opening the door to wider worlds of knowledge, skills, and abilities.

This research took place in England during the academic year 2019-20, when the coronavirus pandemic caused the partial closure of schools between March and September, and drastically changed the format of typical teaching beyond that. The comprehensive, non-selective secondary school in which this research took place continued teaching predominately through digital online means such as Google Classrooms so that teachers were able to guide their students in learning independently. This did mean that the intervention could not continue as planned, but informed the development of new interventions to be carried out in the academic year 2020-21. More than ever before students have needed to seek success in learning independently, with better developed study skills, belief in growth mindsets, and an intrinsic motivation to learn enabling some students to continue learning effectively during this time. To succeed in learning those with less well-developed study skills needed more support, and those with less intrinsic motivation to learn needed more extrinsic motivation from their schools, families and friends. During the school closures most families went through periods of extreme isolation, so students whose families had little educational capital, who placed little importance on learning, struggled to learn without the classroom environment and the support of their teachers and schools.

It has become a focus for many schools and teachers that they should improve their students' ability to learn independently, helping them to study effectively through the teaching of study skills, and that this can be achieved through fostering growth mindsets in students and an inherent desire to continue to learn.

1.2 The Problem

Some A-level Physics students do not have good study skills, do not actively seek to improve their study skills, and so are not robust independent learners. Some teachers do not actively seek to improve their students' study skills, and yet will expect them to develop throughout their schooling. This severely disadvantages students in the A-level Physics course, and in their future as lifelong learners. This is my opinion based on my experiences teaching in an English secondary school, my discussions with teachers from a range of different schools, and my reading of the literature.

I will focus on ways that teachers can facilitate their students' learning through teaching of study skills alongside and integrated with curriculum teaching. Specific work set for students to complete out of lessons, or homework assignments, are an already established means through which teachers can interact with ways their students learn when away from their teacher. If independent work is not currently carried out to good effect, this can be more difficult to identify than inadequate work in lessons. Teachers can manage behaviour and engagement in lessons, and observations of taught lessons are typically used by schools to ensure that teaching is carried out to the required standard. Examples of homework are used by teachers to judge students' progress, or by departments to assess the effectiveness of teachers, and students are encouraged to engage with independent learning or homework assignments with extrinsic motivation such as positive reinforcement for good work completed or detention sanctions for a lack of said work. It is common for students to avoid true engagement with the independent assignments through avoidance strategies such as copying the answers from their peers, absent when the assignment is due, doing the minimum required, or in some cases openly accepting

that they do not and will not carry out learning outside the lesson and accepting what disciplinary actions result.

I focussed on Year 12 students studying A-level Physics, many of whom go on to study Physics, Mathematics or Engineering at the undergraduate level, while significant numbers will not continue with 'academic' studies but will instead enter the workplace or some other form of education such as an apprenticeship. Students starting university courses commonly find wide 'gaps' between their A-level and university studies with great deals of prior knowledge assumed of them, and an extensive amount of independent learning required of them. This is quite similar to the evolution from GCSEs to A-level, when again there is quite a leap in the cognitive requirements of the material, lots of assumed knowledge from their GCSE course in the same subject, and an extensive amount of work set with the assumption that during their studies they've already developed good study skills. Common styles of homework assignment can be observed given to A-level students at the start of their course: "Complete Chapter 2.2 before next Tuesday's lesson". This results in wide, even wild, varieties of interpretations including reading the chapter, making notes on it, answering the questions posed, watching additional materials to support their knowledge of the chapter, answering past paper questions relevant to the chapter, making revision cards concerning the key points, and other study strategies that students use to learn the material. Such simplistic instruction disadvantages those who have less well-developed study skills and less motivation to learn as they are likely to carry out the minimum required. By the end of the two-year course students are expected to engage in a great deal of independent learning, identifying for themselves areas for focus and taking action to improve in these areas. Teacher can mark out areas for improving, having noticed particular misconceptions in something they've said or written in an exam paper or drawing overall

conclusions from their learning, but it is ultimately the student who is best placed to identify what it is they know well and are confident in and what is worth spending hours of their precious study and revision time in improving. At GCSE students can succeed without having developed good study skills by carefully following the instructions of their teacher and through effective use of prescriptive revision materials such as their textbook, revision guides, or videos online specifically targeted to their subject and course. MEANINGFUL VS ROTE LEARNING, CITE AUSUBEL This is still true at A-level, to an extent, but the increase in the cognitive demand, the sheer volume of material that students need to be familiar with, the precise use of language, the well developed mathematical skills, and the need to 'stack' one idea upon another, mean that to excel or even to pass the course students need to engage in extensive independent learning. Some students succeed in A-level not through independent learning *per se*, but through the use of paid tutoring, which many students rely upon but is not available to all and further disadvantages those who cannot afford it. For those who do manage to 'make it through' their A-levels without having developed as independent learners, a daunting experience in the work place or in undergraduate study beckons, where they are faced with weighty tomes to read and understand, be they university textbooks or technical instruction manuals, and though they can take advantage of tutors they will find it yet more challenging to succeed without knowing how to learn on their own. It is important that I help by guiding students toward becoming more independent learners, giving them the study skills that will help them to succeed in life and be less dependent on others for their success.

1.3 Research Questions

Having identified a problem, students and teachers could more proactively engage in improving study skills and independent learning, I formed four research questions that this study aims to answer:

To what extent can teaching study skills encourage advanced level Physics students to become more independent learners?

How can teachers encourage students to develop their study skills?

What effect does the teaching of study skills have on students' performance in assessments?

What effect does the teaching of study skills have on students' confidence as learners?

I aimed to answer these questions through reviewing the current literature on the matter, an in school investigation involving observations of lessons, discussions with teachers and interviews with students, followed by an intervention with a class of Year 12 A-level Physics students that intends to improve their study skills, followed by a further round of interviews with those students and an analysis of their performance in assessments. This was partially completed with one Year 12 class before and during the school lockdown, and is to be continued with two further Year 12 classes in the coming academic Year.

2 Literature Review

2.1 What is ‘Learning’?

The Oxford English Dictionary (2020) defines learning as “to acquire knowledge of (a subject) or skill in (an art, etc.) as a result of study, experience, or teaching” where knowledge can be further defined as “the fact of knowing or being acquainted with a thing, person, etc.; acquaintance; familiarity gained by experience.” These rather simplistic definitions of learning and knowledge are important to remind ourselves of: learning is the process of becoming familiar with something. It does not necessarily require ‘correct’ thoughts or responses, only that an individual’s thoughts and responses have been modified, changed by some number of interactions with the subject.

In their 1932 article ‘What is Learning’ (Hollingworth 1932, p.64) describes learning as the modification of responses to stimuli, specifically that learning can be described as “the tendency of living protoplasm to respond to reduced cues”; educators will aim to enable students to respond to reduced cues with the correct or desired behaviour. As a rudimentary definition this is still quite useful for secondary school teachers: we are tasked with enabling students to respond to stimulus such as an exam question with ‘correct’ responses or answers that will score the most marks. Students are given ‘cues’ in the form of the exam question, including bullet points to address, diagrams, data tables etc., and are expected to give an appropriate response. The number of cues given by teachers during the course will be much more than those given in the final examination, such as using ‘fill in the gaps’ exercises or providing writing frames for answers. Successful learners should become adept at providing the ‘correct’ response with the minimal number of ‘cues’ or guidance.

The essence of this now 88 year old understanding and definition of learning can be seen throughout research in the 20th century and more recent research into cognitive psychology and teaching practice. In the article "What is learning? On the nature and merits of a functional definition of learning" (De Houwer, Barnes-Holmes & Moors 2013) discussed problems with definitions of learning from the last century and formed their own functional definition of learning as "ontogenetic adaptation—that is, as changes in the behaviour of an organism that result from regularities in the environment of the organism" (p640). In the context of teaching students in school, the change in the behaviour sought would be the adept answering of exam questions, and the regularities in the environment would be the instruction of the course material, homework assignments, and the posing of similar such exam questions as practice or training. (De Houwer, Barnes-Holmes & Moors 2013) highlight the concept of 'latent learning', learning may have taken place without an observable change in behaviour, but that behaviour could change due to this learning at some later time. Students might find themselves unable to answer questions, yet are better able to think about it due to learning that has taken place previously, it is not until subsequent learning leads to a modification of behaviour that we observe that learning has occurred. Students might be able to sense this latent learning within themselves, an increased familiarity with the material and an increased ability to form ideas about questions, but this is difficult for an external agent such as teachers or examiners to monitor. We might see students pondering, perhaps writing the start of sentences, writing some key words or equations that they intend to use, but retreating from half-finished thoughts, perhaps because they are not confident that the answer is correct, or literally because they cannot put their partial thoughts together to form coherent statements. Latent learning may not be a quantity that can be usefully measured by teachers, but is a valuable concept to discuss with students, letting them know that they may

be learning without significant change to their output, but that such change could eventually result with their persistent engagement and attempts to learn.

The concept of learning in education, particularly in the United Kingdom (UK) throughout the 20th century, has been heavily influenced by the works of Vygotsky, Piaget and Bruner. Their theories have influenced my understanding of learning to help me develop a 'constructivist' lens with which to view the learning process. Vygotsky's work in psychology took place in Russia between approximately 1924 and his death in 1934, and although his ideas may have influenced some psychologists earlier, his work was 'rediscovered' when translated from Russian to other languages including English and publicised in the 1970's. The 1978 publication 'Mind in Society : Development of Higher Psychological Processes' (Vygotsky 1978) is a useful collection of his ideas. Children or student's "actual developmental level" (p. 85) measures of their ability to complete tasks independently. If students complete tasks collaboratively with other students, or is prompted or guided toward the correct answer by the teacher; completion of the task is not a true indication of their actual developmental level. If "the child barely misses an independent solution of the problem-the solution is not regarded as indicative of his mental development." (p. 85) However, this does not mean that tasks students can only successfully complete with some additional help are not an indication of their level of development. Two students may be able to complete the same tasks with the same level of difficulty independently, and we may find that only one of them is able to complete more difficult tasks when given some help such as demonstrating the correct solution, while the other does not find that this additional help aids them in completing the task. Student's ability to take advantage of help is an indicator of their level of educational development. Vygotsky defines the "zone of proximal development [as] the distance between the actual developmental level as determined by independent problem solving

and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers." (p. 86) We could model the role of the teacher as the agent that bolsters students learning, allowing them to enter the zone of proximal development and complete tasks that would otherwise not be possible. By completing tasks in this way, students can develop until those same tasks are part of their actual developmental level, and new sets of problems are within reach in a new zone of proximal development. As Vygotsky puts it "what is in the zone of proximal development today will be the actual developmental level tomorrow-that is, what a child can do with assistance today she will be able to do by herself tomorrow" (p. 87), and so teachers should be able to make that which is unachievable now achievable with help, so that it will become independently achievable in the future.

Jean Piaget is attributed with developing the theory of 'constructivist learning', which views learning as processes where individuals 'construct' their understanding of the world by fitting information into their existing 'schema', their existing patterns of thought and behaviour. In part of their definition of 'constructivist learning' the Encyclopaedia of the Science of Learning describe the theory as stating "that learning happens when learners construct meaning by interpreting information in the context of their own experiences" (EotSoL 2012). Piaget is quoted as saying "Children should be able to do their own experimenting and their own research. Teachers, of course, can guide them by providing appropriate materials, but the essential thing is that in order for children to understand something, he must construct it himself, he must re-invent it. Every time we teach children something, we keep him from inventing it himself. On the other hand that which we allow him to discover by himself will remain with him" (Piers & Piaget 1972, p. 27). If we teach without allowing student the opportunity to learn for themselves, we are robbing them of an opportunity to become better independent learners. In my opinion it is important that teachers

should facilitate learning by giving students the opportunity to learn by providing the support for them to enter the proximal zone of development, but leaving still some way for the learner to conclude the learning in their own way. It is tempting to instruct students on an exact way to achieve success, but it is important that they have some choice and some agency in the learning process, so that their cognitive development happens by them incorporating new knowledge and skills into their existing learning schema. Independent learning and the development of students' ability to learn depends on them developing and changing this schema by assimilating new knowledge and skills. In 'Piaget's theory of cognitive and affective development', a book by Barry Wadsworth (1984), intellectual development is described as "the process of growth of intellectual structures…a process of construction of schemata" (p. 156) while learning can either be used synonymously with development, or can refer to "the acquisition of specific information from the environment, learning that is assimilated into an existing schema" (p. 156). The distinction here is useful, so that the term 'learning' can be used for the interaction with and assimilation of new knowledge, while 'intellectual development' can be used for activities in which the schemata are reordered and developed. Learning about learning, metacognition, and striving to improve ones own skill at learning, can be considered as intellectual development.

Jerome Bruner was instrumental in the formation of constructivist thinking in education, building on the ideas of Vygotsky and Piaget. In 'The Culture of Education' he stresses that metacognition or 'thinking about thinking' has to be "a principal ingredient of any empowering practice of education." (p. 19). Similar to Piaget, Bruner describes learning as constructive processes in which the learner takes an active role in assimilating new knowledge into their intellectual schemata, to construct new realities into which new knowledge can be successfully stored, allowing the mind to return to a comfortable equilibrium. For Bruner "education must be conceived as aiding young

humans in learning to use the tools of meaning making and reality construction, to better adapt to the world in which they find themselves and to help in the process of changing it as required." (p. 19-20) Education is not simply the passing on of knowledge, but the development of the students mind, their existing understanding of the world, the schemata into which they can attempt to fit new knowledge. The conception of the world developed by the mind is neither right nor wrong, but can be better developed to aid the mind in responding in the correct way to stimuli. There is arguably no 'correct' conception of the existence of the electron, for instance, and different students and teachers might have vastly different 'pictures' in their minds of the position, mass, charge and velocity of an electron when travelling along a wire in an electric current. Teachers might share their own model, their own conception of the reality, along with a range of other interpretations, but it is ultimately in the mind of the student that their own, perhaps unique, model of 'what is' is to be formed. It is difficult to understand what another's conception of such matters truly is, but through developing our ability to communicate, such as through verbal and written communication, drawing, physically moving the body, and building physical or digital models can help students and teachers to share what ideas they've constructed within their mind. Sharing the constructive journey with others can help us to consider the way that we construct, helping us to develop our internal schemata.

Driver *et al* (1994) explain that knowledge cannot be transmitted, must be "constructed by the mental activity of the learner" (p.1). They argue that "it is important in science education to

appreciate that scientific knowledge is both symbolic in nature and socially negotiated. The object of science are not the phenomena of nature but constructs that are advanced by the scientific community to interpret nature" (p.1) and that "individuals have to make personal sense of newly introduced ways of viewing the world" (p.11). Science teaching introduces students to a variety of

new metaphors and models to make sense of the world, and these can only be effectively taken on board by the student if they are able to reconstruct their world view, and their intellectual schema, to accommodate them.

Wellington and Ireson (2012) describe constructivism as the idea that "people do not acquire knowledge about an independent reality; rather they *construct* knowledge to fit what they experience" (p.68). They draw an important parallel between this constructivist view of education, and constructivist views of scientific discovery, as the development of relativity and quantum mechanics in the early 20th century required physicists to think more in metaphor and model than in "absolute physical properties" (Wellington & Ireson 2012, p.68). In A-level Physics teaching there are many concepts such as quantisation that students can become familiar with through rote learning, yet can only come to understand them through building their own models. (Wellington & Ireson 2012) summarise David Ausubel (1963) on the topic of rote learning, contrasting it with meaningful learning which "results in knowledge that is not superficial or arbitrary but is well connected with other knowledge" (p.72). Direct transmission of 'facts' or 'knowledge' through familiarisation and memorisation is less effective than students learning by reorganising information and incorporating it into their existing understanding. We should consider here whether knowledge is or can be an absolute and definite entity, as Karl Popper (1972) would call such knowledge "*qualified* belief- belief so qualified that it is certainly true" (p.76), and whether it can exist as "conjectural knowledge" (p.76), knowledge drawn together through an internal debate with oneself and one's exist world view, or through debate with others.

(Jenkins 2000) takes a balanced view of constructivism and warns against the pitfall of conflating constructivist thinking of scientific 'theories' in the scientific community and students "ideas about natural phenomena" (p.607). The ideas students, and I would argue that this applies to teachers

as lifelong learners, construct to help them understand new knowledge are not deconstructed and tested in the same way that scientific theories about natural phenomena are. Scientific theories imitate the phenomena at their heart.

I shall use a simple definition of learning relevant to secondary school students: learning is the beneficial adaptation of students' behaviour due to their experiences. The beneficial adaptation is that they are better able to answer exam style questions, and their experiences include everything that they do in and outside of the classroom while taking their course in Physics. This learning takes place within students' existing schemata, the structures within their mind into which they must assimilate new knowledge. This knowledge itself is not judged to be correct or incorrect, it is not an absolute quantity but is conjectural, formed from within the student as an attempt to incorporate it into their world view. The development of these schemata to make students better able to learn independently, more easily finding ways to move into the proximal zone of development, will be the focus of this research.

2.2 What is 'Independent Learning'?

The Oxford English Dictionary of Education (Wallace 2015) defines independent learning as an "approach to learning in which pupils are encouraged to be self-regulating"**;** that not only is the learning engaged with by students on their own, such as prescribed homework assignments to be completed independently, but that it is the student who regulates the learning, influencing the scope, content, and time spent on the exercise.

In 'Fostering Independent Learning: Practical Strategies to Promote Student Success' (Harvey & Chickie-Wolfe 2007) describe studying as "deliberate and purposeful learning that is pursued autonomously" (p. 1). Independent learning is when students take control of their own learning and "deliberately use self-regulatory strategies in reading, writing, task engagement, time planning and management, text summarization, test preparation and self-appraisal" (p. 53), which can be encouraged in students by sharing with them and demonstrating various study strategies. Teaching students to become independent learners is teaching them how to learn, a lifelong skill that will serve them well in a variety of contexts. The term 'independent learning' can be used interchangeably with 'self-directed study'; any studying or learning where the student has full control over what is taking place. In the context of secondary schools there is little expectation for truly independent or student directed learning; the teacher will ultimately be in control of the work set. However, tasks can be made more independent and students can be given more agency; control over the way that they learn. Independent learning does not even need to happen with students working on their own: teachers setting work for a group of students who go on to decide how they will work or how they will complete a task can be considered as self-directed tasks. In their article 'Toward self-directed learning in secondary schools: what do teachers do?' (Bolhuis &

Voiten 2001) observed lessons in Dutch secondary schools to see how teachers currently encourage students to develop self-directed learning through what they termed 'process oriented teaching'; teaching students how to learn, describing such activities as 'activating' students to become independent learners. These activities are distinguished from 'traditional teaching' which they describe as "knowledge transmission…when the teacher spends much time explaining the subject matter. The main activity expected from students is listening." (p. 840) Reflecting on my own practice, I've been guilty of 'lecturing from the front of the class' for the majority of a lesson and not giving enough opportunities for students to engage with the process of learning. Bolhuis & Voeten (2001, p. 842) described seven major categories of teacher-student interactions that I would later find useful when observing lessons by other teachers at my school, allowing patterns of behaviour to be easily identified. These include: Explaining, the teacher talking and the students listening; Questioning: the teacher expects students to answer questions in some form, out loud, in books, or rhetorically; Students' Turn: the teacher makes it clear that it is the students' 'turn' to act; Feedback: the teachers give some form of feedback to one or more students; Supervising: the teacher takes a non-invasive approach to facilitating the student's learning; Procedural: the teacher or students must do something not directly concerned with learning; Instruction: the teacher gives instruction for tasks such as classwork or homework. These categories were used to categorise behaviours in some preliminary observations of students in lessons before specific sub-categories were written for further use in observations, as will be outlined in further detail in my methodology.

In their report 'Effective practice in the design of directed independent learning opportunities' for the Higher Education Academy, Thomas, Jones & Ottaway (2015) described 'Directed Independent Learning', processes much more likely to occur in secondary schools than completely self-directed

independent learning, as “learning in which students are guided by curriculum content, pedagogy and assessment, and supported by staff and the learning environment, and in which students play an active role in their learning experience – either on their own, or in collaboration with peers” (p. 4). It is through directed independent learning opportunities that secondary school teachers can encourage students to build their independent learning skills.

2.3 Why is ‘Independent Learning’ important?

The Higher Education Statistics Agency collected data relating to the percentage of UK domiciled students who took up full time undergraduate studies in the UK in the academic year 2017 to 2018, remained on the course for 50 days, but left their higher education course. Of note are the courses that students of Physics at the advanced level typically apply for: in ‘Medicine, Dentistry and Veterinary Science’ only 1.6% left the course; In ‘Physical Sciences’ 4.6% left; in ‘Mathematical Sciences’ 5.1% left; in ‘Computer Sciences’ 9.8% left; and in ‘Engineering and Technology’ 7.3% left. The HESA did not collect data regarding the reasons for students leaving these courses. This data shows that significant numbers of students who take up these undergraduate courses do not continue until they are complete. Possibly due to the rigour of the course, the difference between the expectations and style of learning between their advanced level and undergraduate studies, the expectation that students should exhibit good independent study skills, the difference between what students thought learning at the undergraduate level would be like and the reality, and of course a host of other reasons individual to each student. There is a remarkable difference between the drop-out rate for different courses with only 1.6% of ‘Medicine, Dentistry and Veterinary Science’ students not continuing, while 9.8% of ‘Computer Sciences’ students did not continue. Perhaps due to the vocational nature of some courses, with students whose life dream

is to be a doctor or a veterinarian having a greater resilience and determination to complete their studies.

The Higher Education Academy in their review of existing literature 'Enhancing access, retention, attainment and progression in higher education' (Webb, Wyness & Cotton 2017) identified that the first year of undergraduate study is a "'crunch point' for student dropout" as students are "often unprepared for the level of study, independent learning, and lack of contact time" (p. 37). We should note that much of the research analysed was based in the US and not the UK, though it is reasonable to assert that the conclusions have relevance in the context of schools and universities in the UK. Universities in both the UK and US have been considering this when constructing the first year of their courses, but clearly secondary schools have a role to play in preparing students and helping them to develop their independent learning skills, ready for success in undergraduate studies. Specifically a "lack of 'readiness' for engaging with online tools; a pervading lack of technological and digital skills" (p. 44) were identified as barriers to students' learning at university, which can be alleviated through online introductory courses, but in the secondary school context this could be pre-empted by the use of online digital teaching. Charlton, Barrow & Hornby-Atkinson (2006) in their article 'Attempting to predict withdrawal from higher education using demographic, psychological and educational measures' identified that students' expectations of the level of 'independent study' required for their course in higher education could be unrealistic so that "such students may feel aggrieved because of the institution's failure to fulfil their side of an implicit psychological contract" (p. 34). Since their previous educational institutions expected little independent study and typically provided them with all the necessary information and materials for success, they naturally assumed that their university would do the same. In the sample of UK students that they scrutinised they found there

"were reliable differences between continuing and withdrawing students with respect to independent study expectations and intrinsic motivation, with withdrawing students having lower independent study expectations and lower intrinsic motivation" (p.42). 'Intrinsic motivation' is students' desire to learn that comes from within, such as having a passion for studying medicine and a desire to become a doctor, while 'extrinsic motivation' is a desire to learn that comes from without, such as the desire to avoid detentions or the disappointment of parents and teachers. It seems that high levels of intrinsic motivation can be linked to students' desire to engage in independent learning, partly to achieve long term success in the subject, while low levels of intrinsic motivation are linked to a lack of independent learning; extrinsic motivation and explicitly directed tasks that require little truly independent learning are the bread and butter of secondary school education. In their study of 143 students 31 did not continue with their course and it was found that "withdrawing students were older, exhibited lower average GCSE performance, lower independent study expectations, greater depression, and lower intrinsic and extrinsic motivation" (p. 39). It seems clear that experiences in secondary school impact the resilience of students and though there are many factors that affect success at university, the expectations for independent learning and students' previously acquired independent study skills have commonly been identified as important factors.

2.4 How can teachers encourage students to become more 'Independent Learners'?

In their article 'Nurturing learning or encouraging dependency? Teacher constructions of students in lower attainment groups in English secondary schools' (Mazenod *et al* 2018) focussed on English and Mathematics teachers' interactions with 'low attainment' or 'low ability' groups and identified that "the adoption of different pedagogical approaches for groups of low-attaining learners in order to nurture them may in some cases be fostering dependency on teachers and cap opportunities for more independent learning" (p. 54). Since students with lower prior attainment were commonly identified as having a lower ability to learn, the approach to teaching was to provide extensive support and explicit direction to students with little opportunity for them to learn independently, and such students would not develop the skill of learning independently to the extent that students who had higher prior attainment would. However, they believe it possible to find "a balance between nurturing learning and creating or fostering teacher dependency" (p. 54). In their interviews of 34 teachers in England they found that it was a commonly held view that strong relationships between the teacher and student were important or even essential for successful teaching of lower attainment groups, that they required more one to one time with the teacher in lessons, and that they were more likely to set more structured work. Seven of the teachers went as far as to view "students in the lower attainment sets as 'dependent learners' in contrast with students in the higher attainment sets who were viewed as 'independent learners'" (page 60).

Tofel-Grehl and Carolyn M. Callahan (2014) found through interviews with students and teachers in six STEM (Science, Technology, Engineering & Mathematics) specialist schools that staff "stated

beliefs about the relationship between student independence and success" and that students "noted substantial time spent learning independent of their classroom teachers" (p261). Successful students would engage with their learning without necessarily being directed toward particular tasks by their teachers, and this habit was linked to a desire to learn skills and knowledge in order to succeed in summative testing. These schools, as STEM specialists, highlighted to new students the importance of hard work and emphasised the requirement that students engage in independent learning to succeed. When students engage with independent learning to familiarise themselves with the core material of the course, more lesson time can be dedicated to more advanced material. For students who do not find the standardised tests challenging, additional work can be provided by teachers to help stretch their students' ability. Teachers remarked that "students reported that their ability to learn for themselves was one of the most important features of their growth as students while at their STEM schools" (Tofel-Grehl & Callahan 2014, p.262), indicating that an environment where students were not only expected to complete set work independently, but to find additional work for themselves, had helped students to develop their self-determination as learners. Students "did note that independent learning was a new concept to them upon enrolment in their specialized STEM school" (p262) so the reinforcement of the value of independent learning had made it seem like a new learning skill, something that they had not been expected to engage in in other environments. They valued this new skill, and they "felt a great deal of their growth and learning as students stemmed from the requirement that they learn to think for themselves" (p262), coming to accept that some basic concepts could not take up valuable lesson time when the students should be able to master or at least familiarise themselves with them on their own. Commonly students reported that independent learning consisted of watching YouTube videos on the subject, which commonly helped them to obtain

“additional problem-solving strategies or different ways of thinking about a topic” (Tofel-Grehl & Callahan 2014, p.262). The six schools involved “presented an inclusive, intellectually focused community” where “students felt safe being themselves and where being intellectually focused was accepted.” (P.262) Their success in encouraging independent learning was dependent on the school culture, with five of the six schools were selective, on admission of pupils based on their prior attainment.

Perez-Adamson & Mercer (2016) in their article ‘How do different types of schools prepare students for life at Cambridge?’ interviewed 20 students at Cambridge colleges regarding how their previous education had prepared them for life at the university. As students who had achieved the grades necessary and succeeded at the interview process, they were clearly able learners who had excelled at their advanced level studies in order to be admitted. Coming from a range of different backgrounds including ‘elite’ public schools, fee paying private schools, and non-fee paying state funded schools, their opinions on and experiences of the demands of Cambridge with respect to independent learning, and how their previous environment had fostered the skills required for independent learning, give valuable perspectives on the role of secondary schools in preparing students for even the most demanding of courses. Much of their discussions concerned the familiarity that public school students had with the style of academic and social life at Cambridge, the style of organisation, how to access support from the university, and the workload in the first year of study. These public-school students were typically quite adept at independent learning, having become accustomed to it as an expectation in their education. Some private school students felt less well prepared for independent learning, one student describing her education as being “spoon fed and then you regurgitate” (p. 27) so there was quite a leap when moving on to university level study at Cambridge. Private school students

“reported narrower, examination-focused, intensive teaching, which did not seem to encourage independent, critical or original thinking” (p. 26). State school students had not experienced encouragement for critical thinking, yet had not experienced the intense teaching or exam training of those in private schools. It seems that public school students had been better taught to learn independently, private school students had been coached into passing exams with less independent learning, and state school students had learned to learn independently on their own.

State school students, though struggling in many social respects in their first year, seemed more resilient and able to learn independently. These students had evidently learned to excel in academic studies at their state schools though the workload for them at Cambridge could be overwhelming. State school students reported “feeling that they lacked the work habits and strategies for dealing with the volume of work displayed” (p.28) by their public school peers. The researchers conclude that “state school students who do succeed at Cambridge are likely to be independent learners with a strong sense of self-efficacy” (p32). Encouraging students to learn independently while at state funded secondary school and emphasising the success of independent learners in such demanding environments as Cambridge could help them develop into more resilient and self-effective learners.

In their doctoral dissertation ‘An interview study analysis of the study skills and independent learning strategies of selected secondary homebound students in a county school system in east Tennessee’ Suellen (1991) interviewed teachers, students between grades 9 and 12, and parents who had been involved in a ‘homebound’ education system. Students who could not attend lessons in school for some reason such as medical conditions, pregnancy, or as an alternative to expulsion, were set work to complete at home. This work was supported by visits from

‘homebound teachers’ for three hours each week. Their extensive review of the literature up to that point identifies a number of ‘study skills’ that can be taught to or shared with students to help them become more independent learners, and their analysis of the opinions of students, parents and teachers involved sheds light on a range of typical obstacles that students face, and advantages to working independently of the classroom. The assumption in most cases was that the homebound system was to support students in their learning during temporary absence from the typical classroom, with students eventually returning to more traditional educational environments. It transpires that in the study 40% of students returned to the classroom that year, 30% graduated while on the homebound program, and 30% returned to the “regular school program” in the fall, the start of the next academic year. (Suellen 1991, p.133) This study has valuable parallels to the current situation in the UK with many students having been set work to be completed at home to continue their education during school closures, with the assumption that most if not all students will be returning to the classroom in the next academic year. The major difference is that advances in technology over the last three decades have allowed a much greater deal of support to be provided to students working at home by schools via digital means such as online classrooms. Aside from this the issues faced by students working at home are still very similar, requiring them to organise their working day, set their own timetable, interpret the depth and scope of tasks, and do all of this with little interaction with their peers or teachers. In summarising their discussions with students Suellen (1991) identified that students “used those skills to accomplish the purposes of understanding the material, meeting teachers' expectations, doing well on tests, and ultimately finishing high school” (Suellen 1991, p.133). The most frequently mentioned were “(1) previewing, (2) predicting; (3) answering adjunct, chapter, teacher-made and self-questions; (4) notetaking which consisted

primarily of summarizing paraphrasing, and outlining; (5) vocabulary study." (Suellen 1991, p.133). Previewing involves activities such as looking at the chapter headings, skim reading to identify key words, and reading relevant questions before reading chapters in full. Predicting could be attempting to predict what it was the teacher expected from pieces of work, what skills would be required for practice, and what future assessments would entail. Adjunct questions are those scattered throughout texts, such as short questions at the end of paragraphs that can help students to consider that section of text before continuing, and 'self-questions' are those that students set for themselves, which are often a prediction of what they thought teachers would ask.

Suellen (1991) concluded that study skills were used by both the homebound teachers and students to greater degrees than the previous literature indicated was likely. Students were sometimes explicitly taught these study skills by their teachers, had devised them for themselves, or had learned them from their text-book materials. With regards to students' motivation, "students used the study skills because they found them effective ways to accomplish their purposes of understanding the material, doing well on tests, and ultimately finishing high school" (p. 156). Suellen (1991) confidently concludes that students "will apply study skills that are taught to them, especially if they expect to be tested over the material they are asked to study" (p. 156).

The study skills described by Suellen (1991) are of course still in use by students today, and as this study specifically analyses their commonality and effectiveness with students having to work independently, the types of skill analysed and their conclusions have great relevance to my current attempts to encourage independent learning among my students. However, more recent literature on independent study skills should be analysed to provide more appropriate context

to my study, particularly considering advancements in technology and their influence on independent learning over the past three decades.

3. Methodology and Methods of Research

3.1 Practitioner Action Research

This piece of research is 'practitioner action research', often shortened to 'action research', and alongside a plethora of similar terms there are a great variety of interpretations of the same term and of formats that the research can take. The term 'action research' is commonly associated with Kurt Lewin who in 'Action Research and Minority Problems' described it as "research that will help the practitioner" (Lewin 1946, p. 34) and as "comparative research on the conditions and effects of various forms of social action" (p. 35). Lewin (1946), when considering social action for the improvement of inter group relations was convinced that "we should consider action, research and training as a triangle that should be kept together for the sake of any of its corners." (p. 42) Lewin's foundational work (Lewin 1946) in action research has been used and modified by researchers in various fields but his conception of action research as necessitating "group decision and commitment to improvement" (Dickens & Watkins 1999, p. 128) seems a common thread throughout the decades. From Lewin's original work in factories and towns of the USA in the 1930's and 1940's, and his proposals for improving inter group relations in Palestine in the 1940's, to educators in the 1990's using Lewin's "methods and principles to enable the school to act as the agency of democratic change within its community" (Adelman 1993, p. 11) through to modern day business leaders involving their employees in organisational change (Hussain et al 2016), the practitioner action research model has been shown to be popular, effective and diversifiable.

John Elliot (2002) feels strongly that action research can be both qualitative and quantitative, and the "methodology always emerges in a practical context" (p.170), it is a consequence of

educational professionals attempting to improve or change their craft, reflecting, and continuing to strive for improvement.

Carr & Kemis (1996) describe action research "as a methodology of social inquiry" (p.1) that began in the USA in the 1940's with Lewin, developed in Japan, and returned to the USA and to Europe in the 1970's having become ideas such as "total quality management" (p.1). Action research is "cyclical, problem centred, action oriented, non positivist and dialectical" (Carr & Kemis 1996, p.1) and thus is more appropriate for use in educational studies were more linear methods are inappropriate. Social systems and research that intends to improve them, such as education, must be able to and should seek to respond to the environment as it develops. Carr & Kemis (1986) in 'Becoming critical : education, knowledge, and action research' explain that action research takes place most effectively in education when the practitioners themselves work to develop the new theories "in his or her own self reflection" (p.199). New conclusions are most compelling when they come from within the researchers own self reflection and critical evaluation of the problem. This development in the thoughts and intellectual schemata in the researcher parallels a similar development that I aim to engender in my students.

(Coghlan & Brannick 2001) describe action research as "research that is based on a collaborative problem-solving relationship between researcher and client which aims at both problem solving and generating new knowledge"; it is scientific in that it emphases the importance of "careful observation and study of the effects of behaviour on human systems as their members manage change" (p. 15). In my research I and the other teachers who collaborated with me are simultaneously the researchers, the agents of change, and the clients, as the new knowledge garnered from our observations influences our future practice and our ability to influence students to become independent learners. My students could be considered as clients, as they

form the base of the human system within which we aim to engender a change in behaviour but they will have little to no knowledge of the research cycle as it takes place, and will have minimal agency in altering the mode in which the research occurs.

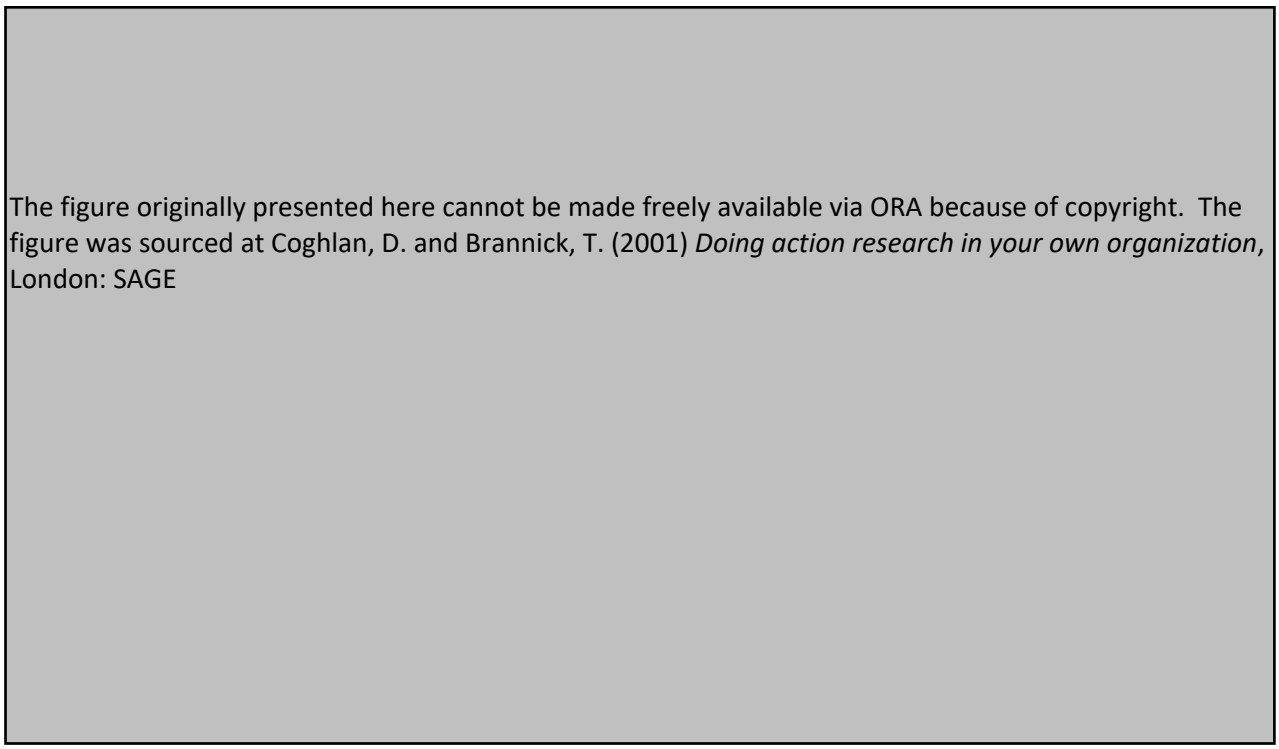
Herr & Anderson (2012) define action research as “inquiry that is done by or with insiders to an organization or community, but never to or on them.”(Introduction, p. 4) As a secondary school teacher I am an insider within an educational community with an opportunity to perform research on or with my students but not upon myself, though the ultimate aim is to influence changes in my practice. I am ultimately the agent of change and not the subject. The subjects of the research need not be excluded completely as Dickens & Watkins (1999) claim that “some social scientists who undertake action research projects define ‘involvement’ so broadly that participants actually engage minimally in the project”, and broadening the definition in such a way would allow me to consider myself as part of the subject for research, and my students not only as subjects but as collaborators in the research with some agency to initiate change.

‘Practitioner research’ is when “insiders to the setting are the researchers, whereas in other traditions of action research, the researcher is an outsider who collaborates to varying degrees with insider practitioners or community members.” (Herr & Anderson 2012, Introduction, p. 3). In ‘Studying Your Own School: An Educator's Guide to Practitioner Action Research’, Anderson, Herr & Nihlen (2007) explain that action research “connotes “insider” research done by practitioners using their own site (classroom, institution, school district, community) as the focus of their study.” (Chapter 1, p. 2) As a practitioner who wishes to take action directly to improve my practice and my ability to aid other practitioners in the development of their practice with regards to encouraging independent learning in students, as I intend to take a more rigorous systematic

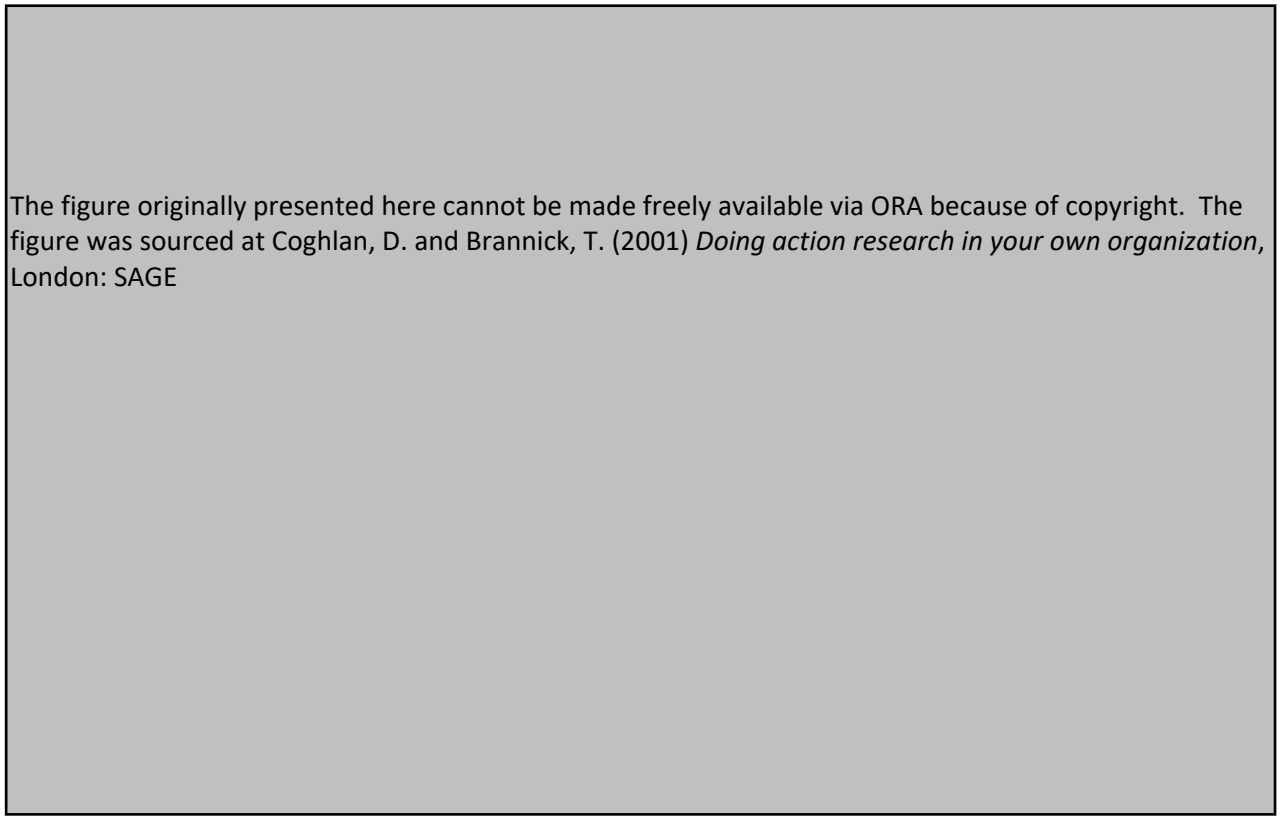
research approach than simply regularly reflecting upon my practice, ‘practitioner action research’ seems an appropriate format to achieve my goals, answer my research questions.

3.2 Research Cycles

Practitioner action research in education typically involves a repeating set of relatively short cycles, with several cycles occurring within one academic year, as opposed to more formal research cycles where research is formally concluded between cycles. Herr & Anderson (2012) describe these cycles as “an action research spiral in which each cycle increases the researchers' knowledge of the original question, puzzle, or problem and, it is hoped, leads to its solution.” (p. 5) Many researchers have described action research cycles in varying levels of complexity. Popplewell (2012) outlines a simple three step cycle as “planning action, taking action and evaluating action, which is repeated throughout the research process” (p. 2). Coghland & Brannick include an additional step which is to “first establish the context and purpose of the research and form collaborative working relationships” (Popplewell 2012, p. 2), which can be found described in the 2001 edition of their regularly updated book ‘Doing action research in your own organisation’ which emphasises that “collaborative relationships with individuals, teams, across teams, across organizations are critical to the success of the project” (Coghland & Brannick 2001 p. 107).



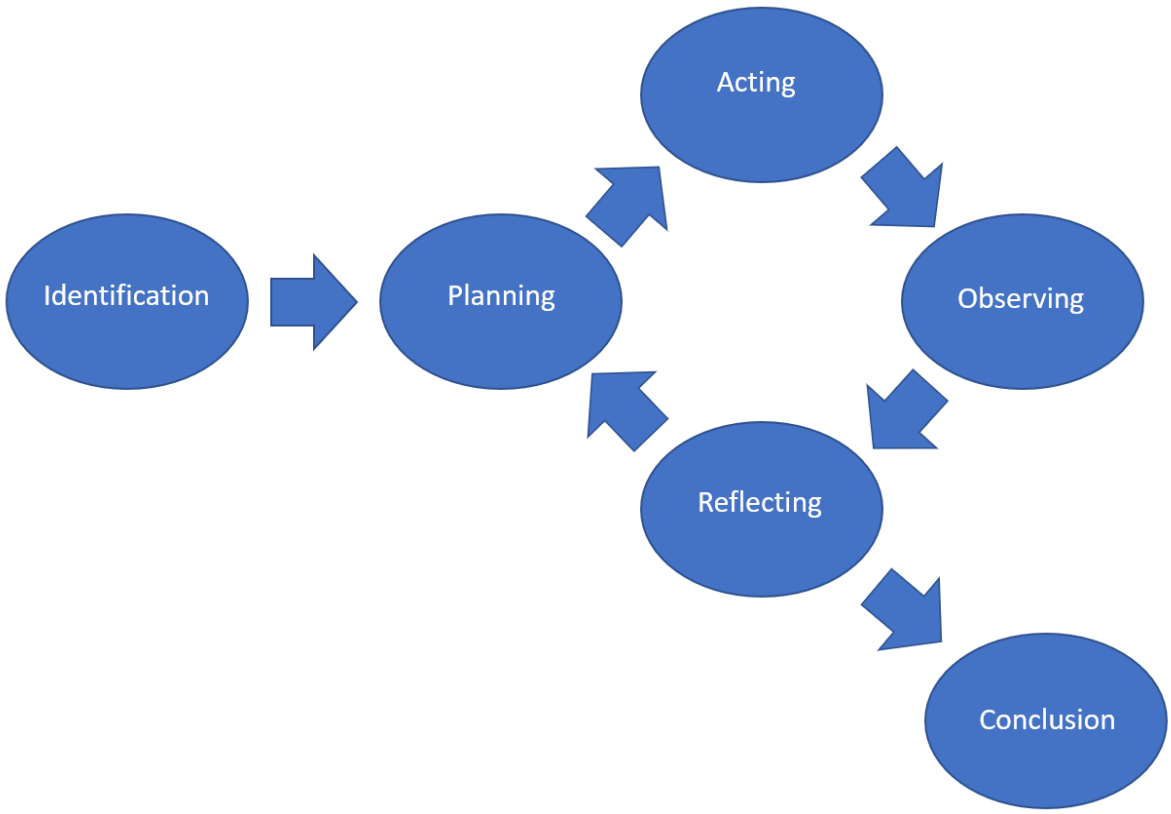
Coghland & Brannick (2001 p. 17) depict action research cycles using the diagram above where we can see that establishing context and purpose of research is the first step. Key to the context and purpose step is the "definition of a desired future state" (p. 17);, forming a clear idea of exactly what change the researchers desire to enact in the system. This precedes a diagnosis of specific problems, followed by planning action, taking the action, evaluating the effects of the action before returning to a re-diagnosis of the specific problem, and so the cycle continues.



Coghland & Brannick (2001 p. 19) depict a spiral of action research cycles, as shown above, to show that there should be "two action research cycles operating in parallel" (p. 19); one cycle to represent the actual research taking place, and another reflective cycle which represents a continual self-evaluation of the research to diagnose, plan, act and evaluate the research itself as it takes place. For this piece of research major changes to the structure of the research are not advisable. However, an unforeseen circumstances, closure of schools, did require a re-evaluation of the methods of research, although the ultimate aims and objectives remained the same.

This piece of practitioner research uses a series of research cycles involving Identification, Planning, Acting, Observing and Reflecting before planning and beginning the cycle again, until eventually the cycle is exited with a Conclusion phase. Identification is the selection of the problem to be addressed along with the formation of the aims, objectives and research

questions to be answered. This foundational step is not returned to, so is not a part of the 'cycle', as if this step is returned to in the research cycles an almost never-ending web of additional problems to be solved could be identified, preventing the research from coming to a satisfactory conclusion. Once the specific problem to address has been identified the researchers should design a possible intervention intended to address the problem and improve the situation (planning). The researchers should carry out this planned invention (acting) and collect data as to the effectiveness of the intervention (observing). Observations need to take place before, during and after the intervention itself so that the full context of its implementation can be understood. Observations should be analysed (reflecting) with a view to designing new interventions, improving the existing intervention, or possibly running the same exact intervention again in a new context. Researchers should reflect on the overall research structure, allowing for the adjustment of the overall research methods if this is deemed necessary. The researchers can plan the next intervention and begin the research cycle again. The cycle of Planning->Acting->Observing->Reflecting->Planning continues until the researchers feel that useful conclusions can be made from the research, or if the research must come to an end. Final observations are made before reflecting on all of the research cycles in order to draw conclusions about the effectiveness of the interventions at solving the problem and improving the situation. The figure below outlines this interpretation of the research cycle graphically.



3.3 Collaboration

There are two main types of collaboration that are important for this study: collaboration with teachers and collaboration with students. Teachers who collaborated did so on an entirely optional basis and were asked to fill in and sign the participant consent form (Appendix 1). Students who collaborated in formal interviews or separate discussion groups were asked to fill in and sign the student version of the participant consent form (Appendix 2), while those who were involved by being observed, taught in lessons, or by having the intervention work set for them in lessons and as homework did so without specifically knowing that research was done.

Any research that takes place within a secondary school must consider the political atmosphere of the school. No teacher is independent; they must work within the structures and rules as set

by the school and any change to practice or intervention must be agreed as appropriate before it can take place. Collaboration with fellow staff members helps to allow the research to take place in a manner acceptable to managers of the learning environment, especially those responsible for monitoring teacher practice through regular lesson observations and work sampling to ensure an acceptable quality of teaching is taking place. Reason & Marshall (1993, p.119) stress the importance "of recognising that research is a personal, political and social process"; relationships with students and other researchers or teaching professionals who interact with those students should be considered when planning research or interventions. Coghlan & Brannick (2001, p.36) divide action research into "three domains of (a) the individual researcher, (b) collaborative and political involvement with others, and (c) the generation of usable knowledge". If a teacher were to attempt to carry out research entirely independently of their department this would greatly limit the scope of their investigation and risk that their teaching is found to be unsatisfactory, unless the research is of a purely observational nature, enacting little or no change in the classroom. Collaboration with staff members is essential for a piece of practitioner action research that aims significantly to influence and change teaching practice so that outcomes can be observed: the expected outcomes should be considered positively by those concerned. For this reason, positive working relationships must be built within the teaching department so that the research is considered in a favourable light and so that collaborative staff are likely to engage with the research. Any form of engagement typically involves some sacrifice on behalf of the collaborator, such as precious time spent in reflective discussions or learning about new methods to influence planned actions, or the additional stress of teaching with an additional observer in the room. This study was designed so that at least one class could be observed in their interactions with their Physics and Mathematics courses, so a class was selected with whose Mathematics and

Physics teachers I had previously built good professional relationships. This resulted in a minimal negative impact on the collaborators; either when observations of their practice were made, as they were quite comfortable having me in the room and understood that observations were made and opinions drawn in a positive, constructive vein and not in a judgemental supervisory context; or when discussing methods and reflecting on interventions, as similar such conversations already happened on a regular basis, though in a more informal context in passing in the break room as opposed to the somewhat more formal interviews that occurred during this research. Regular informal conversations about specific and wider aspects of teaching practice between the collaborating teachers were still important and continued so that positive relations were maintained and those involved did not tire of the research. de Jong, Meirink & Admiraal's findings implied that "in schools where a collaborative culture already exists, collegial observations may serve as a window into colleagues' implementation of a collectively developed curriculum" (2019, p.11). My school having an existing culture that puts stock in collaboration, research and observations, such observations and interactions with teachers' lessons could take place without affecting the smooth running of curriculum teaching or the positive working relationships that had been developed.

Collaboration took place between teachers and students, since students were regularly spoken to or formally interviewed about their progress and how they felt that the assignments were helping them to develop independent study skills. Teaching is built upon positive relations between the teacher and students and so it is important for these positive relations to be maintained throughout any research. For one thing, students who dislike their teachers are not likely to want to sit and be interviewed by them for any additional length of time outside of lessons. However, teachers should not shy away from disciplinary action with any students as to do so would

introduce another variable into the dynamic of the intervention. Teachers were selected whose ‘soft skills’ in pupil management were already quite well developed; classes and individual students were selected such that disciplinary issues were not predicted to be a major concern and with whom engagement with teaching was previously deemed to be at an acceptable level. Breen & Lindsay (1999 p. 90) found that in university settings “'Intrinsic Motivation' and 'Course Competence' seem to be the main dimensions which are associated with positive student perceptions of faculty research activity” and associated negative perceptions of research were those “focused upon achieving good grades and who see research activity as an intrusive distraction”. Students who had volunteered to take part had some idea about the format of the research taking place and may have discussed this with other students, while those who had not volunteered but who received the intervention assignments were not specifically told that these assignments were part of some academic research; for them they were the normal ‘homework assignments’ that a teacher was setting. In my school teachers are allowed a good deal of freedom when planning their lessons and setting their assignments, so students from different classes under different Physics teachers will be quite used to sometimes having the same assignment, as they are shared on the same database, while at other times having something completely different.

In the academic year 2019-20, a Year 12 A-level Physics class was selected for the study. We shall call them ‘12X’, a pseudonym for their class code. I taught this class half of the Physics course, that concerned with Newtonian Physics and motion, while another teacher whom we shall call Fred (a pseudonym) taught the same class the other half of the Physics course, that concerned with electricity and waves. Fred no longer works in this school, having gained employment elsewhere, so cannot continue with the future research. Many students within 12X were in the same group

for their Mathematics A-level where they had three separate teachers. One of these teachers, whom we shall call Joe (a pseudonym) was quite willing to allow me to observe their teaching throughout the autumn and spring terms, and we had previously built up a positive relationship where we would regularly discuss teaching practice, so Joe was selected to take part. The class's other maths teachers were willing to be observed at first but without the previously developed relations, or for other reasons unknown to me and beyond the scope of this work, were not willing to take part in parts of the research that required much use of their time outside of their scheduled lessons, so they did not take part beyond allowing a few observations of them teaching 12X.

The class, 12X were selected for study as, including myself, three of their teachers were willing to be observed and take part in discussions, an initial round of voluntary discussions revealed that several were motivated to take part in additional research work such as interviews and group discussions outside of lesson time. 12X's lesson schedule was such that I was free to observe many of the Mathematics and Physics lessons, and the class contained several interesting individuals. This comprehensive, non-selective, mixed gender secondary school in an urban area, has well developed support departments for students with English as an additional language, hearing and visual impairment, and autistic spectrum disorder (ASD), caters to a diverse range of students with a smorgasbord of disparate needs. 12X were no exception, containing several students with ASD, one with hearing impairment, one with EAL, several who identified as female and several who identified as male, and their abilities ranged from those who did not quite achieve the level 6 in GCSE Mathematics, Physics and Chemistry examinations usually required before studying A-level Physics to those who achieved above A-level 7 in all of their GCSE examinations. In one class, then, I had the opportunity to discover how they learn independently, intervene to improve this, and analyse how their myriad of various background circumstances could affect outcomes.

I collaborated with other teaching professionals in and out of the school. This included: the head of the school, who approved the research proposal so that the observations and intervention could take place; the head of the Physics department, who took a closer view of the interventions, ensured that the planned intervention would not affect the practice of curriculum teaching, and gave advice as to the selection of appropriate students and the designing of effective interventions; a teacher of English at the same school who was conducting their own research in learning and teaching, who was able to advise on the structure of the research and give suggestions for relevant literature to be reviewed; a retired head of science who continues to be involved in the marking and assessment development process, who gave context and opinions from a previous generation of teachers; and my university tutor who gave advice at various points throughout the research concerning shifts in the focus of the research, possible methods for the study to use, ethical considerations, specific research questions and the rewriting of this project's title from its original form as 'Self Study and Homework- Supporting Students in A-level Physics' to 'Promoting Independent Learning in Physics Students through Developing Study Skills'. This was a collaborative effort of a host of teaching professionals with the overall aim of improving one individual teacher's practice.

3.4 Ethical Considerations

Norman Denzin is often quoted on the matter of relationship between the researcher and the researched, writing in the context of researching biographical studies that the "lives and stories that we hear and study are given to us under a promise, that promise being that we protect those who have shared with us" (Denzin, 1989, p. 3 of 'Conclusion'). According to the 1989 Convention on the Rights of the Child (United Nations, 1989) any person under the age of 18 can be considered as a child and is afforded certain essential rights, such as the freedom of expression, and the ability to make their views and opinions known. Blackburn (2015 paragraph 2) in her blog post for the British Educational Research Association (BERA) identifies that the "dilemma for researchers is that the perceived ability of a child to give consent will depend not just on an individual child's chronological age, also on their level of understanding, particularly if they are experiencing a developmental delay". We start to consider those in post-16 education as young adults, they may prefer to be treated and respected as such, we must still observe them with an ethical and moral lens that views them as a child, however well-developed they are. As teachers we are *in loco parentis*, "in the place of the parent" (Fellmeth & Horwitz 2009) in legal terms, having the responsibility to care for our students as if they were our own children while they are in our classroom or school. In conducting research we must consider the wellbeing of the student and although parental permission did not need to be sought if the students engaged in the research voluntarily, we should be confident that our methods would not be deemed unacceptable should other responsible adults such as parents, relatives and other members of staff were to discover the details of the investigation.

This research was conducted in line with the strict ethical guidelines as set out by BERA in the fourth edition of their 'Ethical Guidelines for Educational Research' who stress that researchers should apply their guidelines "with integrity in their research activities so that their actions can be seen to be ethical, justifiable and sound". (BERA 2018, p. 1)

This research took place under the remit of the University of Oxford who require that any research taking place should be approved by the 'Central University Research Ethics Committee' (CUREC) and 'Departmental Research Ethics Committee' (DREC) who provided a checklist of ethical questions to be considered and required that I produce samples of typical interview questions for their scrutiny (Appendices 3 & 4). DREC judged the material as meeting the appropriate ethical standards and granted approval for the continuation of the research in December of 2019. Before this time any research had taken place in a purely observational, non-invasive manner, and any form of student interview or class intervention could not take place before this.

Any students in a Year 12 class will be over the age of 16 but under 18, so although they can be considered to be young adults rather than children, they are still 'vulnerable'. Their vulnerability can be exacerbated by the power dynamic between student and teacher, the teacher having a great deal of influence, able to affect the student's life through detention sanctions, termly reports, parent's evenings, predicted grades and references for future employers or educational institutions. With such power comes great responsibility and this was considered whenever seeking volunteers for the research. Requests for volunteers were made once in each half term and attempts were not made to 'sell' the idea of participation to them. As I previously had a career in insurance sales, had I aimed to involve as many volunteers as possible I easily could have employed some soft selling, hard selling, positive or negative incentive selling techniques, such as implying that participation would lead to a positive relationship with me, with an unspoken

implication that this could influence predictions or references for university applications. Such sales tactics would have been unethical; as a teacher I would not allow participation to give an unfair advantage to students and I would not want to present the option as such. For these reasons I chose to make a simple statement such as “I’m conducting some research and would like some volunteers to join me for a discussion at some point next week. While you complete this task I will come around and ask if you would like to take part, and if so when we both might be available next week. I must stress that this is entirely optional, feel free to say no for any reason.” In the next half term I would make a similar statement during a lesson and would typically get the same volunteers involved, but those willing did vary between sessions. When students attended a voluntary session I would reiterate that participation was entirely optional and that they could withdraw at any time, before I would explain the purpose of the study “To investigate and establish best practices to support students in learning about Physics” as can be seen in the participant consent form (Appendix 1). Participating students needed to read, and add their initials and signature to, the simplified student version of the consent form, and I gave a chance for any questions to be asked before continuing. Discussions were not recorded, as this would have required further consent to be sought from their parents or guardians, and the recording of interviews can make those involved nervous and less likely to open up. Discussions were carried out with groups of students in communal areas of the school so that students felt at their ease. Although other students were part of the discussion and the possibility of teachers and students passing by overhearing the conversation could limit the frankness of the discussion, it did work towards building an environment where students did not feel ‘trapped in the headlights’, and under intense personal scrutiny.

As this research could not continue in its original format due to the partial closure of the school, the intention is that the research will continue by using the research data collected from class 12X and the teachers Fred and Joe, to influence the intervention that will be carried out with two more Year 12 classes, 12Y and 12Z, in the academic year 2020-21. The same standards of ethical rigour as described above will continue to apply with these two classes.

3.5 Data Collection

Data was collected throughout several research cycles in the academic year 2019-20 with one class of Year 12 A-level Physics students, 12X. A new research cycle will be carried out with two new classes 12Y and 12Z in the academic year 2020-21. I shall here outline the methods with which data was collected with 12X, and how data is intended to be collected with 12Y and 12Z.

3.5.1 Note-booking and Effective Inter-staff Communication

During the first Identification Phase of this research I reflected on my practice as an A-level Physics teacher with a specific focus on 'homework' that I set for my students and the 'self-study' that they engaged in. I kept a diary of notes in a small pocket notebook that I always had with me while in school so that I could jot down *ad hoc* thoughts and questions that occurred. This simple method, which I termed 'note-booking', allowed the many short discussions that took place with other teachers in shared spaces such as the staff break room, science prep rooms and classrooms, to be usefully noted down rather than easily forgotten. At the end of each week I would examine these notes and reflect on the discussions that had occurred. This was most usefully done on a Friday afternoon in the staff room. It was commonplace for staff in the Science and Mathematics departments to sit and discuss matters over coffee or tea, often accompanied with chocolates that I keep above my pigeon-hole. Teachers are often busy, rushing from lesson to lesson to other

obligations out of school, and the respite at the end of period 5 is the only time that you see some staff stationary. Mid-week, staff can be found there marking and planning, but on Fridays staff are much more likely to be unoccupied and open to chatting, and I found that this was the best time to review my notes, ponder my experiences of the week, and converse with others to share my thoughts, ask questions, and hear their responses. Finding this time and settling into a routine of using it for discussion was essential to engaging in effective communication with other members of staff. Fred, one of 12X's Mathematics teachers, and Joe, 12X's other Physics teacher, just so happened to be among those who engaged in these discussions regularly and with gusto, evincing an intrinsic desire to engage in conversations about educational practice. I would often flick back through my notebook and ask them questions, sometimes about specifics from the curriculum such as the Mathematics in a past paper question and how we might go about teaching it and modelling it for students, but on more general matters of educational technique. These discussions would influence my lesson planning, objectives and techniques for the following weeks. These mini-cycles of observation, reflection, planning, and acting over the course of the autumn term formed my Identification Phase, allowing me to identify the problem that this research aims to solve: I could be doing more as a teacher to develop my students as independent learners. I continued to keep these notebooks as a short-term cognitive holding pen for daily matters relating to the study and kept a separate notebook for other school related matters that seemed less relevant.

3.5.2 Lesson Observations

Once 12X had been chosen for study I observed lessons when they were taught Mathematics by Joe and Physics by Fred. I made notes in a ledger that was kept until the end of the study so that these notes could be reviewed before future observations and during the reflective phase of the research cycle. The first of these observations were explorative. I did not have a specific observation goal in mind but wanted to observe the style of teaching, what the teacher did and what the students did. I noted some 'procedural matters' of the lesson such as the start time, the way that students were invited into the room, what was on the board, when the teacher took the register, what handouts the students were given, what equipment the students were expected to have, how the lesson was concluded and how students were allowed to leave the room. I noted specifics about the work set during the lesson; how the teachers gave the instructions either verbally, written on the board, or on a hand out; how the teacher provided support to these tasks such as answering an individual's question quietly or sharing that point with the whole class; how students went about the work independently, seeking confirmation about the task from their teacher and fellow students, seeking help with the task from their notes, textbooks, neighbours or the teacher. This was useful but led to great deals of notetaking which limited the time that I had to observe the specifics of the way that students were working. For future observations I prepared structured sheets to aid observations (Appendix 4) so that the same specific information could be captured more efficiently, allowing me to concentrate on the observation itself. This included one side of A4 to note the name of the class, allowing individual names and details to be identified later by the school's register system, the topic of the lesson, and general notes about the lesson, dividing the hour into 10 minute sections. Within these I would note the specific time that something happened such as tasks issued and concluded. Another side of A4 allowed details

of homework, classwork, and other tasks such as responding to the fire alarm and leaving the room, to be noted. The third sheet allowed specific questions to be noted down along with who asked it and who answered it, such as the teacher, student, textbook or internet, and if it was answered what the answer was. Meeting with the teacher beforehand allowed some of this data to be captured, such as the topic of the lesson, details of the starter task and planned in lesson tasks, and details of the homework to be set, collected, or reminded of.

3.5.3 Student Questionnaires and Discussions

In creating the student questionnaire (Appendix 5), questioning techniques and note taking, two draft questionnaires were written to be trialled with some year 13 Physics students whom I taught. These drafts were first shown to some collaborative teachers in the Science department. Opinions were taken as to the ease of reading of the questions, space afforded to written answers, the time expected for reading each question and writing each answer, the possibility of issuing simpler questionnaires to the whole year group, and the possibility of recording interviews with students rather than notetaking. When the draft questionnaires were trialled with students, as well as discussing with them their opinions on learning and teaching I discussed with them the format of the questionnaire, interview and other possible methods. It was commonly held by students that recording the conversation would likely make people nervous and that the requirement to seek parental permission would be “another thing to do” (a year 13 student) so they would be less likely to take part. Interviewees regularly had to stop and ask what was meant by questions and seek clarification; they often did not know how to express their answer in written words and would rather just tell me orally; and those interviewed individually commented that this made them feel uncomfortable while those involved in small group discussions felt much more at ease and able

to express themselves. What one student said led to others contributing more, and not just agreeing with previous statements, so this discussion format felt like it generated the greatest volume of valuable information.

While this trial gave some limited information as to the year 13 students as independent learners, this was not the primary aim. The aim was to establish an effective format for the questioning in which students could think deeply about the questions, respond openly, honestly, and would result in worthwhile notes for me as the researcher at the end of the session. This experience along with guidance from the literature was used to design the questionnaire-interview format that I shall now outline.

Students from 12X were invited to informal discussion sessions, first during the identification phase, then again with the same students after the first intervention cycle. The sessions were held in communal areas of the school, with different groups of between 2-4 students scheduled at different times depending on when they had free periods. A further session with the same students was held in the spring term, after the first intervention cycle. All students from the first session were able to take part in the second session, though scheduling meant that the combination of students in each discussion was different from the first round of discussions.

Each student had the purpose of the discussion explained to them, that the intention was to find out more about them as learners, how they learned, and how best teaching might be adapted and improved to suit their learning. Each was given the consent form (Appendix 2), given time to read it through before ticking the boxes to indicate consent, signing the form and returning it to me. Each student was given the document 'Supporting Students in Physics- Questionnaire' (Appendix 5) and a pencil with a rubber on the end. In designing this questionnaire I considered firstly the

information that I wanted to receive from my students, the questions that I wanted the discussions to answer, and the most effective way of ensuring that this information was honest, detailed and useful to me. This requires that the students understand the format of each question and the way that their answers will be given, have had some time to reflect and consider their opinions, feel comfortable in giving their honest answers, do not feel fatigued during the process, and the resulting discussions between students and with me should be open and productive.

This questionnaire includes 17 questions, or statements to which the students could rate their agreement according to a five-point Likert scale (Lavrakas 2008). Students were asked not to begin filling out the questionnaire immediately, as the format for the answers needed to be explained, and each statement was to be discussed by the group one at a time and answered by the individuals before moving on. Likert scales are commonly used in a variety of contexts, but it cannot be assumed that students are already familiar with the format. Overfamiliarity could weaken the value of the data, as some will have developed strategies for filling out such forms without carefully considering their answers. The five-point Likert scale asks students to select whether they strongly disagree (1), somewhat disagree (2), neither agree nor disagree (3), somewhat agree (4) or strongly agree (5), with statements such as "1. I am confident that I will pass my Physics A-level." The 5 point scale was chosen as an odd number of options allows a middle neutral option, as opposed to a 4 point scale of strongly disagree (1), somewhat disagree (2), somewhat agree (3) or strongly agree (4), which forces the respondent to have an opinion one way or the other which may not otherwise be forthcoming. Forcing an opinion in this way firstly skews data toward the extreme, which can lead to drawing grander conclusions than truly warranted, and can lead to a negative feeling that adds to fatigue when completing the questionnaire, so answers further down in the list are more likely to be skewed. Five points rather

than seven points were used, as in the trials with year 13 students it was found that a seven-point scale resulted in students asking more questions about the format of the scale and not the actual questions, which left less time for discussions.

The reduction of fatigue is a reason for pausing after each question. If a respondent answers a long list of questions there is a tendency to read and carefully consider the first few questions, before accelerating, skim reading and quickly answering questions without deeply considering them, as had been noted in the year 13 trial when the questions were given in one go and a longer conversation took place at the end. This fatigue was avoided in part by pausing after each question for a discussion about it. This allowed students to give an answer, discuss it, reconsider, and change their answer. As the answers were selected in pencil, if answers were changed this could still be seen when analysing students answer sheets, and they were usually quite open about changing their answers in the discussion.

The conversations were not recorded as this would require further written permission to be sought from students' parents or guardians, and in the year 13 trial students expressed the opinion that this would make them more nervous and less open. I noted parts of the conversations down in a ledger and sometimes asked students to add something they'd said to the additional space provided on the questionnaire sheet. Since they were asked to carefully consider each statement before selecting an answer, this gave me ample time to write down the results of the conversation, though exact quotes of extensive dialogues were not possible.

Students were asked to carefully read each statement, ensure that they were happy with their selection, ask any questions about their meaning, and make any comments that they had including anything relevant to their Physics A-level and improving teaching for their learning. This led to

extended conversations about teaching and learning practice, and students seemed happy to give up extra time for this as their opinions were listened to and valued. An analysis of the Likert scale answers, written statements and verbal statements can be found in the results section of this document.

Student interviews and discussions will continue with classes 12Y and 12Z in the next academic year. Their first intervention tasks have been designed based on the results captured with 12X; students from 12Y and 12Z will be asked to volunteer for discussion sessions in the same manner as those described above for 12X, entirely voluntarily and when convenient for them in small discussion groups of 2-4 students. The discussions will be supported by similar Likert scale style questionnaires, with the statements written based on the results of their first intervention assignments, where 12Y will have been issued the full version of the intervention (Appendix 6) and 12Z will have been issued the control version (Appendix 7). The aim of these interviews will be to discern whether the format of the intervention tasks is effective in improving students' confidence with independent learning and their use of the study skills that the interventions have been designed to share or teach. At the conclusion of each interview session I will reflect on my notes and analyse their responses on the Likert scale, which will inform my discussions with other collaborative teachers, before planning the next specific intervention.

3.5.4 Student's Submissions to Intervention Assignments

After the identification phase of this research an action research cycle took place in which an independent homework assignment (Appendix 8, 'Forces and Energy') was designed with some collaboration with Fred, Joe and some other teachers from the science department (the planning phase). This was issued to students (the action phase) using Google Classroom, (GC), a digital learning platform. Some assignments and instructions had previously been given this way, but this was the first where submission was only accepted online. Students are now much more familiar with the use of Google Classroom, having used it extensively during the period of school closures, but at the time of the first intervention assignment this was still a somewhat foreign element. The task used Google Forms to pose some 'simple' questions regarding the application of students' knowledge of energy, forces and motion, to an everyday physical phenomenon: the lifting of a textbook and placing it on a chair while in the Earth's gravitational field. The task first asked students to select correct definitions from a multiple-choice list where several answers could be considered correct, 12 of the 18 students in 12X completed this assignment within the time set and their responses were recorded digitally for marking purposes and retrospective analysis. In a lesson the following week these responses were shared with the class, without any indication of which student had provided which answer. These answers were discussed and students asked to give their opinions. During these discussions I took notes of the questions and comments that students made. Students were asked about their thinking process in answering the questions, which were deliberately open ended, and specifically what resources they used when answering them, such as the course textbook, revision guides, web sites, the opinions of other students, their calculator and their equation booklet.

The first intervention assignment, described above, was the only one that could take place in full with 12X due to the partial closure of schools. The results of the assignment influenced the design of future assignments to be used with 12Y and 12Z in the next academic year, and the methods of data collection informed improved methods to be used in future research cycles as I shall now describe.

Students will be asked to keep a 'digital learning diary' (DLD), which is a continuously updated record of their submissions to homework assignments, class work and class notes. While working at home during the school closures 12X were regularly asked to carry out a task such as making notes on a chapter before submitting a photograph of their work as part of the assignment on GC. This was mainly to ensure that work was in fact done, but allowed teachers to scrutinise the work by students, seeing the various methods with which they approach a task. The majority of students were able to do this using a camera on their phone and an internet connection at home, which is now commonplace among Year 12 students so the practicalities of completing such tasks next year should not pose significant problems. It is possible that students will not always be able to complete the photographing and uploading themselves, in which case they will be asked to hand in their work so that it can be scanned and uploaded by myself. Each assignment will include the instruction to photograph the work completed, submit this as part of the assignment, and save the photographs to their DLD folder which is shared with their teacher via the GC. Upon marking the assignment teachers will examine these photographs and add constructive comments. These photographs and comments will be reviewed and reflected upon within each research cycle and will be saved until the end of the research for a final analysis. Any progression or regression in students learning methods can be seen in their DLD, a continuous story of their learning that both teacher and student can usefully examine.

Within their DLD students will be regularly tasked with completing a self-assessment document. (Appendix). This has sections to complete at the start of a unit, before and during revision for the end of unit assessment, after the assessment and having received the feedback, and before mock examinations. These documents will help both students and teachers monitor their learning, keeping a record of what questions they had, problems that they identified, answers that they found, and actions taken to solve the problems. Teachers can add key questions and points to these, specific to the unit, before distributing them to students through the GC and in hard copies.

The DLD and self-assessment could be considered as intervening to enhance the students' independent learning in both groups. They both encourage students to interact with their own learning and can help them to become more independent learners. They are a powerful tool for observing the work of students and in the context of the planned investigation, analysing the difference in the development as independent learners between the intervention group, 12Y, and the control group 12Z. It could be considered unfair to provide for one class a system of DLDs and self-assessment, but not for another class, when they can quite easily be provided to both. It is possible or even likely that further localised school closures could occur in the next year and it would be advantageous for all students to be familiar with uploading work to a DLD so that this can continue with work set while in isolation at home. Self-assessments give specific opportunities for students to rate their confidence and record elements of their independent learning for me to assess.

3.5.5 Student Performance in Examinations

During Year 12, the first half of the A-level Physics course, students are required to revise material and study for six multiple choice mid-topic tests, six end of unit tests and two mock examinations. The results of these tests are analysed in order to form a 'working at' grade and a 'predicted' grade. These grades are compared to their 'target' grade, with students expected to progress throughout the year until their predicted grade matches their target grade, with their 'working at' grade possibly one grade lower than this. Some students will set themselves a more extreme target, and even ask that their predicted grade be raised one grade above their existing target grade to aid them in applications for university courses, which is allowed if students have made exceptional progress. The performance and progression of class 12Y, who will receive the benefits of the full intervention, and 12X who will receive the control version of the intervention, will be compared at the conclusion of each of their full mock examinations. These mocks use full, secured, past exam papers and are completed in exam conditions, in an exam hall, under the supervision of external invigilators, and as such are very good demonstrations of students' ability to perform. Students are aware of the topics that will be included ahead of time and although some lessons are dedicated to revision by teachers and specific revision assignments are set, the revision and preparation is ultimately student led and completed independent of the input of the teacher. Teachers are of course available in lessons, after school, and via email or the GC to provide support and answer questions, and will give specific feedback to students after assignments concerning areas for development. The onus is on the students to identify individual targets for improvement, areas that require additional revision, and plan their revision timetable assigning the appropriate amount of time to each subject. Students' performance in examinations is a good indicator of the effectiveness of their independent learning and study skills. End of unit results and mock results

will be used to measure students' progression and a comparison made between the progression of the intervention group, 12Y, and the control group, 12Z.

3.6 Intervention Design and Data Analysis

This section will outline the way that data has been analysed in the academic year 2019-20, how this influenced the design of the interventions, and how I intend to analyse further data to be collected in the new research cycles in 2020-21.

During the initial identification phase note-booking and lesson observations were used to collect data concerning the current best practice by teachers in the school. A reflective process without specific aims or objectives to begin with this data is not suitable for a formal analysis, it was purely qualitative and predominately undirected. This data was reflected on in order to form hypotheses and questions that could be shared and discussed with other collaborating staff members at convenient times such as *ad hoc* conversations over coffee or more formal conversations conducted during after school team meetings, if the points and questions were relevant to the topic of the meeting. The hypotheses and questions arising from these were ultimately discussed with more senior members of the science faculty and the senior leadership team of the school, including the head of Physics, head of Science, a deputy head and the head of the school. This was done so that broad approval could be given to the aims and objectives of the research and boundaries set so that any intervention would not unfairly advantage or impair any student and would not create unreasonably large amounts of unnecessary work for any teachers.

The initial intervention assignment (Appendix 8) was designed based on the analysis of the initial lesson observations and discussions with teachers. This intervention focussed on allowing students an opportunity to think and approach the problem in a way that they felt suitable. The

research was not yet focussed on the teaching of specific study skills, but was more an attempt to encourage independent learning and independent thinking. The questions prompted students to mention factors such as the forces, motion, and energy of the object in each question, but did not prescribe a number of marks or style of answer, except that students should answer in full sentences but that an essay was not required.

4 Results

4.1 Results of Note-booking and Collaborative Discussions

In regularly keeping notes for weekly cycles of collaborative discussions with staff members a number of questions and statements that met with general agreement were formed which serve here to summarise the results of these conversations:

“Some students are much better at learning independently than others.”

It seems as though some students are always one step ahead of the teacher and, having already found for themselves effective independent learning methods and having well developed study skills, will describe specific tasks set by teachers as ‘beneath them’ or ‘not worth the time’ and would much rather learn, revise and prepare in their own way. Some students will resist independent work set by teachers, but teachers often associate this with a lack of intrinsic motivation or ‘laziness’. Some students are motivated to learn, but having limited study skills and independent learning strategies they struggle with learning outside of the classroom and away from the teacher without specifically structured work. The instruction ‘Revise chapter 12 for your end of unit test next Thursday’ will result in some students not knowing what to do and requesting specific instruction, which is sometimes identified by teachers as requests for information as to what content is to be examined.

“A students’ ability to learn independently is a determining factor in their success in A-level studies and, it is supposed, in their university studies.”

Those who it seems have well developed independent learning abilities at the conclusion of their GCSEs typically go on to succeed in their A-level studies. Some students excel at GCSE who do not

have good independent learning strategies and study skills, and these students tend to struggle in the more demanding A level course. Other factors such as a lack of intrinsic motivation are considered to compound the problem of not being able to learn independently and needing explicit and regular guidance from their teachers, or 'spoon feeding' as many teachers discussed.

"Teachers regularly consider their students independent learning when designing the learning environment for their students, but do not focus on explicitly teaching independent study skills."

Teachers were quite honest about not having the time or mental space to specifically plan tasks that teach students study skills. The focus of tasks and elements of the learning environment is on the familiarisation of knowledge and encouraging students to think in a variety of ways while doing this. Once the variation of the level of study skills among students became evident, teachers were open to implementing the teaching of specific study skills such as effective reading and question formation as they felt this would have clear immediate and long term benefits to the student's learning.

4.2 Interviews and Likert Responses

Students during the first research cycles in 2019-20 were interviewed and asked to complete the Likert scale questionnaire (Appendix 8). A total of 12 students were interviewed in small groups of 2-4 and completed the questionnaire during the first research cycle and before the first formal intervention; 11 of these students were available to take part in similar discussions with the same questionnaire two months later during the spring term, following the first formal intervention assignment. I shall briefly report here the results of these discussions, the analysis of their questionnaire answers, and the changes in attitude and answers between the two sets of interviews. The Likert scale asked students to rate their agreement with the statement from 1 to 5, and an overall response from the group is recorded by adding together the responses of the 11 students who took part in both sessions, before dividing this number by 5 and rounding the answer to the nearest 0.1.

1. I am confident that I will pass my Physics A level.

In the first round this scored an average response of 2.9 which increased to 3.8 in the second round. Student confidence increased significantly and students reported that this was due to them becoming more familiar with the course, having a better idea of the skills and knowledge that they would need to succeed in the exam, and having had several opportunities for success in end of module tests.

2. I have a grade that I would like to achieve in my Physics A-level.

In the first round this scored an average response of 3.2 with most students having a good idea of the grades that they would like to achieve. This rose to 3.8 as students indicated that they had begun to think about university applications and had set new targets for their achievement.

3. I am confident that I will achieve my target grade in my Physics A-level.

This score increased from 2.8 to 3.2 as some students had formed a more aspirational grade, while others continued to grow in confidence that they would achieve their original target grade.

4. Achieving my target grade in Physics is important for my post A-level options.

This scored highly at 4.2 and increased to 4.4 as students became more aware of their post A-level options.

5. I understand what is required of me to pass / achieve my target grade.

This scored quite low at 1.8 increasing to only 1.9 as students continued to be unsure of what would be expected of them. Students reported speaking to year 13 students or those who had previously completed the A-level and being told that the difficulty increases greatly, and students were not sure about the way that it could become more difficult.

6. For the units of work I have completed so far, I understand what is required to pass / achieve my target grade.

This scored higher than statement 5, 2.6 increasing to 3.2. Students reported that being given list of skills and knowledge required in each unit that they could use to self assess allowed them to be much more confident. Many felt that as more units had been completed, they were better able to attempt the more difficult past paper questions with success.

7. For the units of work I have completed so far, I have gained the knowledge and developed the skills needed to pass / achieve my target grade.

Somewhat oddly this decreased from a score of 3.3 to 2.5 with students reporting that they had initially been overconfident and although they now had a better understanding of the requirements, they had not yet met those requirements.

8. My teachers have provided clear information as to what I need to be able to do at the completion of a unit.

This consistently scored highly with a 4.4 progressing to 4.5. Students fed back that they style of revision using target check lists and self assessment, followed by the modular assessment and feedback that focussed on the points on these lists, left them confident in what they needed to be able to do to succeed.

9. My teachers have provided clear instruction as to which tasks need to be completed in lessons.

This scored highly at 3.9 but dropped to 3.1 and students reported that some lessons were less structured and clear than those toward the start of term.

10. My teachers have provided clear instruction as to which tasks need to be completed independently.

This scored highly at 3.7 but decreased greatly to 2.2 as they felt that independent assignments were not being set as prescriptively as they had been at the start of term. Most agreed that the tasks set by their other Physics teacher had been highly prescriptive at first but they had become less structured.

11. I can confidently plan my own independent work.

This scored highly at 3.9 but dropped to 3.2. Students reported that it had become harder to find resources such as relevant past paper questions and that it was more common for them to find resources that referred to units not yet completed, so planning their own work was more challenging. They greatly appreciated their teachers providing banks of relevant questions that they could choose from.

12. I routinely plan and carry out my own independent work.

This scored very highly at 4.2 but dropped significantly to 2.4. Students reported that at the start of the year they had been asked to plan out what they would complete in their free periods and were given time to do this in form time. While this was commendable and useful, the increased workload in their A-level courses led to them forming long lists of tasks to achieve and the feeling that they did not have enough time in which to complete them, let alone planning time for other independent work.

13. My teachers give useful feedback on work I have completed.

This scored highly at 3.7 and rose to 4.3. Students reported that the feedback on mid topic and end of topic assignments was well planned and effective, though several did desire more assignments to be marked and fed back on that were not in a test format.

14. I find that the feedback from teachers enables me to work independently more effectively.

This scored quite low at 1.9 and stayed low at 1.8. Students appreciated feedback such as listing specific topics that they needed to revise, but more general indications such as the need to practice 'show that' questions left many students unsure of how to address those issues.

15. I find that feedback from teachers is more effective when given with specific tasks for improvement.

This scored a middling 3.0 and increased to 3.5. Students appreciated when teachers fed back that they needed to concentrate on a specific skill and that a specific task could help them to

achieve this, but felt that in practice teachers would prepare two or three tasks relevant to the whole class and that this feedback did not feel specific to them.

16. I would like to be given feedback on marked work more regularly.

This scored highly at 3.7 increasing to 3.8 with students continuing to appreciate having work marked and appropriate feedback given. Students tended not to want additional work set that would be marked, as they felt the workload from their courses was already at a high level and that additional work could not be completed to the best of their ability, which would limit the effectiveness of the feedback.

17. I would like the feedback I am given on marked work to be given differently.

This scored quite low at 2.9 and dropped to 1.7. When given feedback students were appreciative and found that the feedback was useful, although they again made clear that the provision of prescribed tasks for improvement specific to them would be more effective than the more generalised 'all class' feedback that was given.

Overall the results of the interview and questionnaire process indicate that students are highly engaged with their learning, motivated toward achieving their goals, and happy to work extensively to achieve these. A key problem seems to be the modification of teaching and task assignment to improve their ability to learn independently without creating large amounts of additional work that students feel they do not have the time or mental capacity to complete.

5 Conclusion

This study aimed to investigate the relationship between students' ability to learn independently and their specific study skills, and how teachers can act to enhance these through providing structure or scaffolding to students work outside of the classroom. It seems clear that my students, are better able to learn independently if they've developed good study skills in the past and that teachers play a key role in building, maintaining and improving these skills in their students. I shall now look back at my research questions in turn and attempt to draw conclusions based on the data captured in this research, and what implications these have for myself as a teacher, the rest of the Physics department, and the wider teaching establishment of the school.

To what extent can teaching study skills encourage advanced level Physics students to become more independent learners?

The interventions carried out were broadly successful in teaching students study skills, specifically those of notetaking, analysis of texts, self-analysis of successful learning, and identification of future learning goals. The students who engaged most with these intervention tasks were already quite confident in their ability to display these skills, while those who engaged less found the tasks themselves more challenging and were less confident in their use of these skills at the start of the research. Throughout Year 12 all students involved gradually increased their ability to display these skills, and their confidence in learning independently had increased. However, most students, including those who had previously become quite adept at using these skills, did so less and less during the period of school closures when these tasks were not regularly set. Students tended to continue to make detailed notes and made good use of the texts provided, but started to take individual tasks set as they came, and tended to self-analyse and identify learning goals

less. This could be due to the lack of end of module testing and short term assessment goals, as these same students returned to good self-assessment habits when modular testing was reintroduced to them in September. So, the teaching of study skills can encourage students to become better independent learners, but a continuing overarching structure to their learning with opportunities for them to learn independently, provided by their teachers or similar educational structures, seems the most effective.

How can teachers encourage students to develop their study skills?

This study was limited to ways that teachers could encourage students to develop their study skills through independent homework assignments, so other interventions such as timetabled hours for teaching the study skills themselves are beyond the scope of this research. Some use of in class time to review the homework and give students a chance to share their study skills did prove to be worthwhile and did not take a significant amount of time away from regular teaching. Within the remit of independent homework assignments, I've found that giving specific, structured assignments that directly task students with using a particular skill are the most effective at encouraging students to develop these skills. However, it is when the students are given the agency to choose which skills to employ that their confidence with their use of study skills improves, and with it the likelihood that they will continue to find them useful and continue to use them. Occasional tasks set that require the use of particular skills, along with regular tasks where students can make their own choice about methods used, seems the most effective.

What effect does the teaching of study skills have on students' performance in assessments?

There was one opportunity to analyse students' performance in assessments, in their end of year mock examination which was completed as an online 'open book' task. The results showed no

conclusive link between students that had increased their confidence with study skills and those who had not. The major determining factor in their performance was their overall engagement with the work that had been set during the isolation period, and not their engagement with homework assignments set more than three months prior to the exam. This question will be returned to when regular modular testing and mock examinations will take place so that exam data can be analysed alongside data from their DLDs.

What effect does the teaching of study skills have on students' confidence as learners?

Students reported that engaging with exercises intended to develop their study skills had made them more confident as learners in the long run. In the short-term tasks could seem overly prescriptive and the benefits of the task design were not immediately clear. After completing some tasks, similar tasks repeated with different subject content were attempted with more confidence and success, leading to students engaging more with the idea of developing their study skills as they could see the benefit of their continued progression as independent learners. I will continue to monitor student confidence as I use the teaching of study skills to enhance independent learning in the coming year.

6 Reflections

Teachers of A-level Physics, have a responsibility to provide supportive learning environments for their students, including all the interactions between the student and their learning, whether face to face with their teacher, with other students, or entirely independently. The design of the learning environment that the teacher has control of, such as lesson activities and homework, should be made such that it positively influences the students independently learning. This is key to the success of in lesson teaching, student's achievement in their A-level examinations, and future learning opportunities. To achieve this, teachers should consider the opportunities they afford their students to learn independently, how they can provide scaffolding to allow students to enter the proximal learning zone, give opportunities for students to exhibit agency and choose the way that they will construct their new knowledge and learning schemata. Teaching should encourage students to consider their learning journey, seek intrinsic motivation for self-development, engage in becoming more independent and self-regulated learners.

The school and Physics department in which I teach contains many teachers who are passionate about teaching their subjects and helping students to develop into more self-reliant and independent learners so that they can achieve their utmost in their studies within the school and in their future. I continue to collaborate with teachers from the Physics department to deliver high quality teaching while enhancing independent learning in our students, developing new methods of teaching to achieve this. I will continue to learn from the experiences of others within the department; I will share my experiences and help other staff to consider their students learning journey and the learning environments that we create for them. This research continues to enhance the independent learning of one class directly, and another as a control, which I must

ensure leads to positive learning outcomes for all students involved. The results of this research will continue to influence the methods and approaches of other teachers in the department, and I hope that this leads to continually improved learning for students across the school.

I've learned that in my teaching practice I can help my students to become more independent learners by scaffolding the specific assignments set in ways that encourage them to use new and varied study skills, and regularly returning to core skills such as effective reading and note resource creation is effective in increasing engagement with and confidence in students learning. This is a principle at the centre of the continuing research, in which students will be regularly directed toward tasks designed to engage them in disseminating knowledge from a variety of sources and creating their own learning resources. The intention is for students to continually be encouraged to fit new knowledge into their intellectual schemata and to find ways of reorganising their internal schemata to develop a new learning paradigm, a more independent way of learning. Where this research has been limited by the partial closure of schools in 2020, it continues to expand in the following academic year informed by the current partial conclusions drawn. I posit that I could do more to encourage students to analyse their own learning and be more a part of the development of their learning journey. By consistently reviewing not only their knowledge but their methods of learning and study skills, I believe that my students will become more intrinsically motivated and engaged with becoming more independent learners.

Through this research I've gone on my own personal journey as a teacher and a learner. I've learned to view my students more as active learners than as passive receptacles of knowledge, more as developing and improving minds with the ability to learn how to learn remarkably faster than I had thought. Having reflected on and reconstructed my own internal learning schemata,

I’ve developed my ability to scaffold students learning; I’ve created an appropriate learning environment that enhances students’ independent learning by developing their study skills.

References:

Adelman, C., 1993. Kurt Lewin and the origins of action research. *Educational action research*, *1*(1), pp.7-24.

Alfred, S., 1992. An interview study analysis of the study skills and independent learning strategies of selected secondary homebound students in a county school system in East Tennessee.

Anderson, G.L., Herr, K. and Nihlen, A.S. eds., 2007. *Studying your own school: An educator's guide to practitioner action research*. Corwin Press.

Blackburn, C., 2018. 11. Researching with young and developmentally young children. *BERA BITES*, p.45.

Bolhuis, S. & Voeten, M.J.M., 2001. Toward self-directed learning in secondary schools: what do teachers do? Teaching and teacher education, 17(7), pp.837–855.

Breen, R. and Lindsay, R., 1999. Academic research and student motivation. *Studies in Higher Education*, *24*(1), pp.75-93.

British Educational Research Association British Educational Research Association, 2018. *Ethical guidelines for educational research.* British Educational Research Association. Available at: https://www.bera.ac.uk/publication/ethical-guidelines-for-educational-research-2018-online [Accessed 15/09/20]

Carr, W. & Kemmis, S., 1986. *Becoming critical: education knowledge and action research*, Victoria: Deakin University.

Carr, Tony, ed. (1996) Broadening perspectives in action research. Brisbane: ALARPM.

Charlton, J.P., Barrow, C. and Hornby-Atkinson, P., 2006. Attempting to predict withdrawal from higher education using demographic, psychological and educational measures. *Research in Post-Compulsory Education*, *11*(1), pp.31-47.

Coghlan, D. & Brannick, T., 2001. *Doing action research in your own organization*, London: SAGE.

De Houwer, J., Barnes-Holmes, D. & Moors, A., (2013). *What is learning? On the nature and merits of a functional definition of learning.* PSYCHONOMIC BULLETIN & REVIEW, 20(4), pp.631–63142.

de Jong, L., Meirink, J. and Admiraal, W., 2019. School-based teacher collaboration: Different learning opportunities across various contexts. *Teaching and Teacher Education*, *86*, p.102925.

Denzin, N.K., 1989. *Interpretive biography* (Vol. 17). Sage.

Dickens, L. and Watkins, K., 1999. Action research: rethinking Lewin. *Management Learning*, *30*(2), pp.127-140.

Dickens, L. & Watkins, K., 1999. Action Research: Rethinking Lewin. Management Learning, 30

Driver, R. et al., 1994. Constructing Scientific Knowledge in the Classroom. *Educational Researcher*, 23(7), pp.5–12. (2), pp.127–140.

Fellmeth, A.X. & Horwitz, M., 2009. In loco parentis. Guide to Latin in International Law, pp.Guide to Latin in International Law.

Harvey, V.S. & Chickie-Wolfe, L.A., 2007. *Fostering independent learning [electronic resource] : practical strategies to promote student success*, New York: Guilford Press.

Herr, K., & Anderson, L. G. (2005). The action research dissertation. A guide for students and faculty. London: SAGE.

Higher Education Statistics Agency (2019) Non-continuation summary: UK Performance Indicators 2017/18. Retrieved from: https://www.hesa.ac.uk/news/07-03-2019/non-continuation-summary [Accessed 15/09/20]

Hollingworth, H.L., (1932). *What Is Learning?* The Scientific Monthly, 35(1), pp.63–65.

Hussain, S.T., Lei, S., Akram, T., Haider, M.J., Hussain, S.H. and Ali, M., 2018. Kurt Lewin's change model: A critical review of the role of leadership and employee involvement in organizational change. *Journal of Innovation & Knowledge*, *3*(3), pp.123-127.

Jenkins, E., 2000. Constructivism in School Science Education: Powerful Model or the Most Dangerous Intellectual Tendency? *Science & Education*, 9(6), pp.599–610.

Lavrakas, P. J. (2008). *Encyclopedia of survey research methods* (Vols. 1-0). Thousand Oaks, CA: Sage Publications, Inc. doi: 10.4135/9781412963947

Lewin, K., 1946. Action research and minority problems. *Journal of social issues*, *2*(4), pp.34-46.

Marshall, J. and Reason, P., 1993. Adult Learning in Collaborative Action Research: reflections on the supervision process. *Studies in Continuing Education*, *15*(2), pp.117-132.

Mazenod, A., Francis, B., Archer, L., Hodgen, J., Taylor, B., Tereshchenko, A. and Pepper, D., 2019. Nurturing learning or encouraging dependency? Teacher constructions of students in lower attainment groups in English secondary schools. *Cambridge Journal of Education*, *49*(1), pp.53-68.

Oxford English Dictionary Online (2020) '*knowledge, n.*' Oxford University Press Retrieved from:

https://www.oed.com/view/Entry/104170?rskey=bQy7PF&result=1&isAdvanced=false#eid

[Accessed 15/09/20]

Oxford English Dictionary Online (2020) '*learning, n.*' Oxford University Press Retrieved from:

https://www.oed.com/view/Entry/106723?rskey=g2OnTJ&result=2#eid [Accessed 15/09/20]

Perez-Adamson, C. and Mercer, N., 2016. How do different types of schools prepare students for life at Cambridge?. *Cambridge Journal of Education*, *46*(1), pp.19-35.

Piers, M.W. & Piaget, J., 1972. *Play and development : a symposium* [1st ed.]., New York: Norton.

Popper, K.R., 1972. *Objective knowledge: an evolutionary approach*, Oxford: Clarendon Press.

Popplewell, R (2012) *Impact Measurement Approaches and Methodologies: Action Research* INTRAC Available at: http://www.elrha.org/wp-content/uploads/2015/01/ActionResearch.doc [Accessed 15/09/20]

Seel, N.M., (2012) Encyclopedia of the Sciences of Learning Retrieved from: https://link.springer.com/referenceworkentry/10.1007%2F978-1-4419-1428-6_142#:~:text=Constructivist%20learning%20is%20a%20theory,by%20reflecting%20on%20their%20experiences. [Accessed 15/09/20]

The Guardian (2020) Cryptic Crossword #28239 Retrieved from: https://www.theguardian.com/crosswords/cryptic/28239 [Accessed 15/09/20]

Thomas, L., Jones, R. and Ottaway, J., 2015. Effective practice in the design of directed independent learning opportunities. *Higher Education Academy*.

Tofel-Grehl, C. and Callahan, C.M., 2014. STEM high school communities: Common and differing features. *Journal of Advanced Academics*, *25*(3), pp.237-271.

UK Department for Business Innovation & Skills, Department for Education (2016) '*Post-16 Skills Plan*' Retrieved from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/536043/Post-16_Skills_Plan.pdf [Accessed 15/09/20]

Unicef, 1989. Convention on the Rights of the Child. Available at: https://digitalcommons.ilr.cornell.edu/cgi/viewcontent.cgi?article=1007&context=child [Accessed 15/09/20]

UK Department for Education (2013) '*Teachers' Standards Guidance for school leaders, school staff and governing bodies*' Retrieved from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/665520/Teachers__Standards.pdf [Accessed 08/09/20]

UK Government Office for Science (2017) '*Future of Skills & Lifelong Learning*' Retrieved from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/727776/Foresight-future-of-skills-lifelong-learning_V8.pdf [Accessed 14/08/20]

Vygotskiĭ, L.S. & Cole, M., (1978). *Mind in society : the development of higher psychological processes*, Cambridge.

Wadsworth, B.J., 1989. *Piaget's theory of cognitive and affective development* 4th ed., New York; London: Longman.

Wallace, S. 2015 "independent learning." In *A Dictionary of Education*: Oxford University Press, 2015

Webb, O., Wyness, L. and Cotton, D., 2017. Enhancing Access, Retention, Attainment and Progression in Higher Education: A Review of the Literature Showing Demonstrable Impact. *Higher Education Academy*.

Wellington, J.J. & Ireson, G., 2012. *Science learning, science teaching* 3rd ed., London: Routledge.

Appendices

Appendix 1: Participant Consent Form

XX Name of researcher
XX Contact email of researcher
Teacher of Physics and MSc Student
XX University email of researcher

PARTICIPANT CONSENT FORM

Central University Research Ethics Committee (CUREC) Approval Reference: xxxxx

"Supporting Students in Physics"

Purpose of Study: To investigate and establish best practices to support students in learning about Physics

		Please initial each box
1	I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.	☐
2	I understand that my participation is voluntary and that I am free to withdraw at any time, without giving any reason, and without any adverse consequences or penalty.	☐
3	I understand that research data collected during the study may be looked at by authorised people outside the research team. I give permission for these individuals to access my data.	☐
4	I understand that this project has been reviewed by, and received ethics clearance through, the University of Oxford Central University Research Ethics Committee.	☐
5	I understand who will have access to personal data provided, how the data will be stored and what will happen to the data at the end of the project.	☐
6	I understand how this research will be written up and published.	☐
7	I understand how to raise a concern or make a complaint.	☐
8	[If applicable] I consent to being audio recorded	☐
9	I understand how audio recordings will be used in research outputs	☐
10	I give permission to be quoted directly in research outputs but only fully anonymously	☐
11	I do not wish to be directly quoted	☐
12a	I agree to take part in the study	☐
		☐

12 b I agree that my personal contact details can be retained in a secure database so that the researchers can contact me about future studies

_____	dd / mm / yyyy	_____
Name of Participant	Date	Signature
_____	dd / mm / yyyy	_____
Name of person taking consent	Date	Signature

Appendix 2: Participant Consent Form (Student Version)

XX Name of researcher
XX Contact email of researcher
Teacher of Physics and MSc Student
XX University email of researcher

PARTICIPANT CONSENT FORM

Central University Research Ethics Committee (CUREC) Approval Reference: xxxxx

"Supporting Students in Physics"

Purpose of Study: To find out how best to support students in learning Physics

		Please initial each box
1	I am happy to take part in this study and have been made aware of what is involved.	☐
2	I understand that my participation is voluntary and that I am free to withdraw at any time.	☐
3	I give permission to be quoted directly but only fully anonymously.	☐

_____	dd / mm / yyyy	_____
Name of Participant	Date	Signature
_____	dd / mm / yyyy	_____
Name of person taking consent	Date	Signature

Appendix 3: CUREC 1A Form

CENTRAL UNIVERSITY RESEARCH ETHICS COMMITTEE (CUREC)

Form CUREC 1A Checklist for the Social Sciences and Humanities

The University of Oxford places a high value on the knowledge, expertise, and integrity of its members and their ability to conduct research to high standards of scholarship and ethics. The research ethics clearance procedures have been established to ensure the University is meeting its obligations as a responsible institution. They start from the presumption that all members of the University take their responsibilities and obligations seriously and will ensure that their research involving human participants is conducted according to the established principles and good practice in their fields and in accordance, where appropriate, with legal requirements. Since the requirements of research ethics review will vary from field to field and from project to project, the University accepts that different guidelines and procedures will be appropriate.

- Please check **"Where and how to apply for ethical review"** and the **CUREC flowchart** first to see if you need ethics approval.
- Please complete this form using a word processor and email it, together with your supporting documents, to your **Departmental Research Ethics Committee (DREC)** (**if applicable**). If you don't have a DREC please email this form to **ethics@socsci.ox.ac.uk** using your official **ox.ac.uk email** address. **Only type-written, emailed applications will be accepted.**

SECTION A: Filter for CUREC 2 application This section determines whether your study raises more complex issues requiring the completion of a full application for ethical review, known as the CUREC 2 application. **(Please mark 'X' in the Yes/No column.)**		
1. Are research participants classed as **people whose ability to give free and informed consent is in question**? (This may include under 18s (although see "competent youths"), prisoners, or adults "at risk".) Your attention is drawn to the University's **Safeguarding Code of Practice** and its implications for researchers involving children or adults at risk. This includes the need for the work to be risk assessed and for researchers to undertake related training. (**Note**: If any of your participants are aged 16 or under, answer 'Yes' here **and** also answer question 5 below.)	Yes ☒	No ☐
2. By taking part in the research, will participants be at risk of criminal prosecution (e.g. by providing information on drug abuse or child abuse)?	Yes ☐	No ☒
3. Does the research involve the **deception** of participants?	Yes ☐	No ☒
4. Does your research raise issues relevant to the **Counter-Terrorism and Security Act (the Prevent duty)**, which seeks to prevent people from being drawn into terrorism? Please see advice on this on our **Best Practice Guidance web page**.	Yes ☐	No ☒
If you answered 'No' to all the questions above, go to **Section B**. If you answered 'Yes' to any question above, continue to question 5 below.		
5. Is your project covered by a CUREC **Approved Procedure** (formerly known as "CUREC Protocols")?	Yes ☒	No ☐
If yes, give the specific Approved Procedure number(s): MSc modus operandi		
If you answered '**Yes**' to **ANY** of questions **1-4**, **and** answered '**No**' to question **5**, **stop completing this checklist and do not submit it for ethical review**. Instead, complete the CUREC 2 application form from the CUREC website, then submit that for ethical review. If you answered '**Yes**' to ANY of questions 1-3, **and** answered '**Yes**' to question 5, go on to **Section B**.		

SECTION B: Contact details and project description	
Contact details:	
1. **Principal investigator** OR supervisor (if student research) (give title and full name)	XX Name of researcher
2. Name of student (if student research)	XX Name of researcher
3. Degree programme (if student research), e.g. BA, BSc, MSc, MPhil, DPhil	MSc Learning and Teaching
4. Department or Institute name	Oxford University Department of Education
5. Address for correspondence (if different from above)	
6. University (**not** private) e-mail address and telephone number	XX Contact email of researcher
7. Name and status of others taking part in the project (e.g. third year undergraduate; postdoctoral research assistant)	N/A

Project description:	
8. Title of research project	"Supporting Students in Physics"
9. List of location(s) where project will be conducted	XX Address of school
10. If your research involves overseas fieldwork or travel and your department requires a travel risk assessment, will you have completed and returned a risk assessment form beforehand? (This must be approved by your department before you travel. If you are travelling overseas, you are strongly advised to take out University travel insurance.) Please also address any physical or psychological risks for Oxford researchers and local fieldworkers in Section 16 below and discuss with your safety officer.	Yes ☐ No ☐ Not required in this instance ☒
11. Anticipated duration of overall research project	10 months or years (maximum 5)
12.a) Anticipated start and end dates of the part of the research project involving human participants and/or personal data	From: (01/11/19) To: (01/08/20) **Note**: You will need ethics approval **before** you start your research. CUREC 1As may take up to 30 days to process. **Retrospective ethics approval cannot be granted.**
12. b) In the case of international or collaborative research, will you submit or have you submitted this project for ethical review or consideration elsewhere (e.g. collaborator's/local ethics committee, or other local approval)?	Yes ☐ No ☐ If 'Yes', please attach ethics or other approvals and give more details below. If 'No', please explain your reasons below. Please also refer to the Best Practice Guidance on Ethical Review of social-sciences based research conducted outside

	the UK (BPG 16), which includes an Ethics Issues Checklist for International Research (Appendix A)
13. **External** organisation funding the research (if applicable)	

14. a) Title and brief description of **research** (about 150 words) in lay language.
When describing the research, include your methodology, how you are applying professional guidelines, and the use to which results/data will be put. **Please also declare any conflicts of interest here.**

"Supporting Vulnerable Students in Physics"

This research will take place in an Oxfordshire secondary school, conducted by myself who teaches in that school will some collaboration with other teachers, teaching assistants, learning mentors and student teachers undertaking their initial teacher training. Observations will be made of classes that contain students who are considered in the school's terms as 'vulnerable', that is having a special educational need such as autistic spectrum disorder, dyscalculia, dyspraxia, dyslexia or speaking English as an additional language. Initial observations will take place in classes across the core subjects (English, Mathematics and Science) across key stages 3, 4, and 5 to establish what is currently considered to be 'best practice' within the school with relation to structuring lessons, independent study, and overall schemes of work to suit all students, including those identified as 'vulnerable'. Observations will also be made of other organisational practices such as work in the 'Communication and Interaction Resource Base' where some students work individually with learning mentors, 'Homework Club' where any students are welcome to get help with their homework, and after school clubs such as the 'Olympiad Club' where students attempt challenging Physics problems and this is open to all students to join, so some may be relevant to this study.
Following each lesson observation students will be selected to be interviewed or will be invited to join a group discussion about the lesson and the unit, and teaching professionals will meet to discuss the results. The selection of students will be based on their needs, with a focus on those who are termed 'vulnerable', but could include other students who are not identified as 'vulnerable'. The interviews and group discussions will take place during school hours (from 8.15am to 5.00pm) and should last between 10 to 30 minutes and no longer. For year 12 and 13 students these can take place during a free period or after school so that it does not disrupt their time in lessons. For other year groups the discussions will be kept to 15 minutes or less so that students can be given permission to leave a lesson 15 minutes early, or arrive to a lesson 15 minutes late, giving time for a short discussion. Teaching professionals will then collaborate in writing a set of advice points for teachers, particularly new or trainee teachers, to consider when planning lessons and schemes of work so that vulnerable students' needs are met. These points will be trialled with teachers before a further round of observations, reflections by teachers, and interviews with students and teachers. Should the results be successful then advice points will be finalised and shared with teachers in the school.

Questionnaires will be used to canvass the opinions of teachers involved with the study, with each of the proposed advice points being shared via a questionnaire so that teachers can give feedback before further drafts and a finalised set of advice points can be written.

As professional educators in a secondary school all adults taking part will have as their primary concern the welfare and good quality education of the students, following the professional guidelines as set out by the Department for Education in their 'Teachers Standards'. There is no significant conflict of interest, accepting that the good quality education of the students is paramount and takes priority over any research aims.

14.b) Description of participants and how you will **obtain informed consent** to take part in the research (about 200 words in total)

1. Description of participants **and** your criteria for inclusion/exclusion

Adult participants or collaborators will include teachers and other teaching professionals such as teaching assistant and learning mentors. Teachers who have not yet gained Qualified Teacher Status will not be approached when establishing best practice, but may be asked to collaborate in trialling the advice that results from the research.

Students will participate in observed lessons with a small number of those present in observed lessons invited to take part in interviews, group discussions or some out of lesson interventions.

2. Your method(s) of recruitment

Participants will be approached in person or via electronic mail. All participants will be either employees within or students at XX Name of school.

3. Your processes for obtaining consent from participants

Adult participants will be invited to take part in the research; it will be made clear that their participation is optional and not mandatory.

Students taking part in observations will not need to give consent as this does not require any more of them than would usually be expected during the school day.

Students taking part in interviews or group discussions will need to give their consent with it made clear to them that their participation is entirely optional and that they can choose to withdraw at any time

Please **attach separate supporting documents (in Word)** if appropriate for your research (English language versions only). Tick those you are submitting below. If appropriate supporting documents are not submitted, you will be asked to provide these separately, which may delay the ethical review process.

- ☐ Recruitment and advertisement material (e.g. a poster, social media recruitment text, or brief invitation letter/ email)
- ☐ Information for participants to read (or hear) before they agree to take part (e.g. written information or, if applicable, an outline oral information script).
- ☒ A document to record informed consent. Templates for written consent forms and/or oral information scripts (in case of an oral consent process) are available from the CUREC website
- ☒ Questions to be asked of participants (e.g. interview questions, or a preliminary scope of questions, or a sample questionnaire)
- ☐ (If relevant) debriefing document after participants have taken part
- ☐ If you feel the above approaches are not appropriate for your study, provide details on how you will obtain consent from participants
- ☐ Please complete section 15 if you cannot obtain informed consent

Please add any further details here.

15. If you cannot obtain informed consent from participants according to CUREC guidelines and good practice in your discipline, please give a brief explanation and justification of this decision below.

16. What are the ethical issues connected with your research and what steps have you taken to address them? **Please do not answer 'none'.** We need to see evidence that you have identified potential ethical issues with respect to your research and have taken steps to address them. If applicable, please address:

- Participant burdens and/or risks

  Students involved in the research will be under the age of 18 and so can be considered 'at risk'. Some students may also be considered to be particularly vulnerable as they may have Special Educational Needs such as Autistic Spectrum Disorder or Behavioural, Emotional and Social Difficulties. Students may be interviewed individually so that they can be more relaxed and open to talk about their needs. These interviews will be conducted in an 'open space' such as a classroom with two clearly open doors, or sat on outside benches. As the research involves both teachers and students there is a power imbalance between the two. It should be stressed that involvement in the project is entirely optional and that at any point in the research participants may withdraw their consent.

  Teachers taking part in the study may be observed teaching a lesson, which involves no more burden or risk than they would expect in their day to day work. Any additional work by teachers, such as workshopping with other teachers and students would occur in a safe work environment such as a classroom within the school, within the normal operating hours of the school (Between 8.15am and 5.00pm). The burden or risk due to this would be no more than is accepted in the day to day responsibilities of a teacher, such as administering an after school homework club. Teachers would not be asked to spend any additional time alone with students or other members of staff, with all such workshops being attended by XX Name of researcher.

- Your own physical and psychological safety as a researcher or of fieldworkers you may employ (see the University's and Social Science Division's Safety in Fieldwork guidance)

  Any participants in the research should consider their professional role as paramount and at no point should participation in this research jeopardise their role as a professional or the education of the students.

- Data protection/ confidentiality (also see Section 18).

Any communication about students should be carried out in private if verbal, and if written should be devoid of students' names or distinguishing details that could lead to their identification. Physical forms of data will be stored in a lockable area within the school site. Digital forms of data will be stored on password protected computers within the school site. Students will be identified by a number linked to their name, with a list of these numbers and names locked securely on the school site, to be destroyed by shredding at the completion of the research.

For more guidance on ethical issues, please see
http://researchsupport.admin.ox.ac.uk/governance/ethics/resources

Discuss other ethical issues here

Students will be asked to discuss their needs in lessons in an informal manner. Sensitive issues such as their needs being due to special educational needs such as autism or speaking English as an additional language may be discussed. To avoid students feeling that they are being forced to take part or share information about such sensitive issues, these conversations will be devoid of any mention of these sensitive issues unless they are raised by the student. Some students will be quite comfortable talking about an issue such as autism, so if they raise it in conversation some follow up questions may be asked. If the student does not mention it, no questions will be asked about it.

17. Will your research involve discussing sensitive issues? This could be information relating to race or ethnic origin, political opinions, religious beliefs, physical/mental health, trade union membership, sexual life or criminal activities.	Yes ☒	No ☐

If you answered 'Yes', make sure you include some supporting information (as directed in Section 14 b.) above, showing the range of questions covering these issues.

Students may be asked to discuss how their particular needs, such as autism, impact their needs as students. However, questions will never directly address the sensitive issue in question, instead asking about the students' needs and preferences, with links to possibly sensitive indicators being analysed post discussion. If students are being interviewed individually then they may raise sensitive issues if they choose to, and follow up questions may be asked about. These sensitive issues will not be raised by the interviewer. If such sensitive issues are raised during a group discussion among students, they will be thanked for their contribution before the conversation is either moved on to the next question or terminated. If one student feels comfortable talking about it while another isn't, they should not feel an element of peer pressure, that they should also be comfortable talking about it. The individual who raised the sensitive issue may then be asked about it in an individual conversation.

18. Management and handling of personal and other research data

For the purpose of completing this section, all information provided by participants is considered **research data**. Any research data from which participants can be identified is known as *personal data*; any personal data which is sensitive is considered *special category data*.

Management of **personal data** and **special category data** of human participants, either directly or via a third party, must comply with the requirements of the General Data Protection Regulation (GDPR) and the Data

Protection Act 2018, as set out in the University's Guidance on Data Protection and Research. In answering the questions below, please also consider the points raised in the Data Protection Checklist. For advice on research data management and security, please consult with the University's Research Data Team (researchdata@ox.ac.uk) and/or your local IT department, and the University's web pages on research data management. a.) **Please mark 'X' against the data you will collect for your research**

Consent records (written consent forms, audio-recorded consent, assent forms (for research involving minors) including participant name	☒
Online consent (may be anonymous)	☐
Opt-out forms	☐
Contact details for research purposes only (destroyed when no longer needed for this research)	☒
Contact details kept for future studies	☐
Audio recordings (preferably using PIN-protected audio recorder and stored on device's hard drive)	☒
Video recordings	☐
Transcript of audio/video recordings	☒
Photographs	☐
Task results (e.g. paper/online tasks, diary completion)	☒
Questionnaire answers	☒
Field notes	☒
Other (please specify below)	☒
Existing records kept by the school will be analysed, such as previous modular test results, results of mock examinations, identification and monitoring of special educational needs, and behavioural records.	

b.) For **each** of the types of data selected above, state how this will be physically transferred from where it is collected to a local secure storage site (and backed up as necessary). This includes paper records and data captured electronically.
All data will be stored on the XX Name of school site. Electronic data will saved onto the school's servers and will not be transferred elsewhere. Physical data, such as students' work, will be kept in a secure location on the school site so that only an employee at the school with keys to a secure storeroom could have access to this data.
c.) How and where will **each type of data** be stored during the research (until the end of all participant involvement)? Describe the arrangements for ensuring confidentiality, i.e. location of storage (e.g. Nexus 365 OneDrive for Business, SharePoint), security arrangements and de-identification of such data. Do not store unencrypted data in freely available cloud services or unprotected USB drives.
Digital data is to be stored on the XX Name of school servers. Physical data is to be stored in a lockable storeroom on the XX Name of school site.

d.) Will you use a unique participant number on research data instead of a participant name? If **yes,** state whether or not you will retain a list of participant names against numbers (i.e. pseudonymisation via a linkage list). Where will the list be stored, and when will it be destroyed?		
Students will be assigned a unique participant number. This will be linked to a participant name, with the linkage list kept in a lockable store room. The list will be destroyed at the conclusion of the research when the final research dissertation has been marked and returned, presumably in the latter half of 2020 and before January 2021.		
e.) Who will have access to the research data?		
The research data may be shared with members of staff at the XX Name of school, limited to those who took part in the study, the line managers of those who took part, the head teacher, deputy heads, assistant heads and members of the Research Champion Team.		
f.) If research data is to be shared with another organisation, how will it be transferred / disclosed securely?		
N/A		
g.) When and how will identifiable data (including audio/video recordings & photos) be destroyed or deleted? **Note:** Records of consent should be retained for a **minimum of three years after publication or public release**. Some funders may require longer periods (see http://www.dcc.ac.uk/resources/policy-and-legal/overview-funders-data-policies). If you wish to retain contact details in order to re-approach participants about future studies, you must detail this in information provided to them and obtain specific consent for this.		
No 'identifiable data' relating to students will be kept. Some identifiable data relating to adults taking part, such as audio recordings of discussions with collaborating teachers, will be kept until conclusion of the research which should be in September 2020.		
h.) Please confirm that you will store **other research data** safely for at least 3 years after final publication or public release and adhere to any additional research funder policies. For more information about the University policies, please see the University's web pages on research data management.	Yes ☒	No ☐
If '**Yes'**, please give details of who will store the data and on storage format, location and security. Note that open science is encouraged. If **'No',** please provide further details below.		
Other data may continue to be stored on the XX Name of school site, in a lockable storeroom.		
i.) Does your research involve the use of secondary (i.e. previously collected) data? Common sources of secondary data include censuses, information collected by government departments, organisational records and data that was originally collected for other research purposes (If "**No**", please go to section **19**.)	Yes ☐	No ☒
j.) Do you have data access agreements for the use of this secondary data? (If so, please attach these.)	Yes ☐	No ☐
k.) Is your use of this secondary data compatible with what data subjects/participants agreed that their data should be used for?	Yes ☐	No ☐

l.) Could this data be linked back to an individual or individuals? If yes, address how securely any personally identifiable data will be transferred to you, and where and for how long it will be stored during or after the research. Who will have access to it?	Yes ☐	No ☐

19. Publication and dissemination of research data	
How will you disseminate and feedback project outcomes at the end of the research?	This research will not be published or made available to the general public. It may be shared with other staff within the school at the discretion of the head teacher.

SECTION C: Methods and procedures to be used	
Method used: Please ensure you have addressed any potential ethical issues related to these methods in Section 14 and in your Participant Information Sheet	**Please mark 'X'**
1. Analysis of existing records	☒
2. Snowball sampling (recruiting through contacts of existing participants)	☐
3. Use of casual or local workers e.g. interpreters	☐
4. Participant observation	☒
5. Covert observation	☐
6. Observation of specific organisational practices	☒
7. Participant completes questionnaire in hard copy	☒
8. Participant completes online questionnaire or other online task	☒
9. Using social media	☐
10. Participant performs paper and pencil task	☒
11. Participant performs verbal or aural task (e.g. for linguistic study)	☐
12. Focus group	☒
13. Interview	☒
14. Audio recording of participant (you will generally need specific consent from participants for this)	☒
15. Video recording of participant (you will generally need specific consent from participants for this)	☐
16. Photography of participant (you will generally need specific consent from participants for this)	☐
17. Others (please specify below)	☐

SECTION D: Professional guidelines and training		
1. In this section, please mark 'X' against at least one of the following professional guidelines you aim to adhere to. You should use the principles listed in your chosen guideline(s) in conducting your own research. **Note**: this is not an exhaustive list.		**Please mark 'X'**
Research specialism/ methodology	**Association and guidance document**	
Anthropology	Association of Social Anthropologists of the UK and Commonwealth	☐
Computer Sciences	ACM Code of Ethics and Professional Conduct	☐
Criminology	http://www.britsoccrim.org/ethics/	☐
Education	British Educational Research Association Ethical Guidelines for Educational Research	☒
Geography	Association of American Geographers Statement on Professional Ethics	☐
History	Oral History Society of the UK Ethical Guidelines	☐
Internet-based Research	British Psychological Society: Conducting Research on the Internet Association of Internet Researchers Ethics Guide ACM Code of Ethics and Professional Conduct Also see our Best Practice Guidance on internet-based research	☐
Law (Socio-Legal)	Socio-Legal Studies Association: Statement of Principles of Ethical Research	☐
Management	Academy of Management's Professional Code of Ethics	☐
Political Science	American Political Science Association (APSA) Guide to Professional Ethics in Political Science	☐
Politics	Political Studies Association. Guidelines for Good Professional Conduct	☐
Psychology	British Psychological Society Code of Ethics and Conduct	☐
Social Research	Social Research Association: Ethical Guidelines	☐
Sociology	The British Sociological Association: Statement of Ethical Practice	☐
Visual Research	ESRC National Centre for Research Methods Review Paper: Visual Ethics: Ethical Issues in Visual Research	☐
Other professional guidelines. Please specify the other guidelines used here:		☐
2. Please indicate what training in research ethics (or research methodology) the researchers involved with this study have received, e.g. the title of the course and date completed (online training available at http://researchsupport.admin.ox.ac.uk/support/training/ethics), or discussions between researchers and supervisors, if applicable.		
Research Integrity Social and Behavioural Sciences- Online training (Not yet undertaken)		

SECTION E: Signatures or email endorsements (The SSH IDREC Secretariat accepts either option below. If you have a DREC, check which signature option it prefers.)

- **Option 1:** Email confirmations from a University of Oxford email address can be accepted. Separate emails should come from each of the relevant signatories as outlined below, indicating acceptance of the relevant responsibilities. Pasted images of signatures cannot be accepted.
- **Option 2:** Handwritten (wet-ink) signatures. Please scan them and the rest of the checklist pages to create a single PDF document and email to us.

Please ensure this checklist is signed by:

For staff research:	For student research:
1. Principal investigator	1. Principal investigator (project supervisor)
2. Head of Department (or nominee)	2. Head of Department (or nominee)
	3. Student researcher

1. Principal Investigator signature/supervisor signature (if student research)

I understand my responsibilities as principal investigator as outlined in the CUREC glossary and guidance on the CUREC website.

I declare that the answers above accurately describe the research as presently designed, and that a new checklist will be submitted should the research design change in a way which would alter any of the above responses so as to require completion of CUREC 2 (involving full scrutiny by an IDREC). I will inform the relevant IDREC if I cease to be the principal investigator on this project and supply the name and contact details of my successor if appropriate.

Signature (or email endorsement using the above declaration): ……..

Print name (block capitals): …….. **Date**: ……...

2. Departmental endorsement signature

I have read the research project application named above. On the basis of the information available to me, I:

(i) consider the principal investigator to be aware of her/his ethical responsibilities in regard to this research;
(ii) consider that any ethical issues raised have been satisfactorily resolved or are covered by relevant professional guidelines and/or CUREC approved procedures, and that it is appropriate for the research to proceed (noting the principal investigator's obligation to report should the design of the research change in a way which would alter any of the above responses so as to require completion of a CUREC 2 full application);
(iii) am satisfied that: the proposed project design and scientific methodology is sound; the project has been/will be subject to appropriate peer review; and is likely to contribute to existing knowledge and/or to the education and training of the researcher(s) and that it is in the public interest.

Signed by Head of Department or nominee *(example nominees for student research include the Director of Graduate Studies/ Director of Undergraduate Studies)*:

Signature (or email endorsement using the above declaration): ……

Print name (block capitals): …….. **Date**: ……...

3. Student signature (if student research)

I understand the questions and answers that have been entered above describing the research, and I will ensure that my practice in this research complies with these answers, subject to any modifications made by the principal investigator properly authorised by the CUREC system.

Signature by student (or email endorsement using the above declaration): ……..

Print name (block capitals): …….. **Date**: ……...

Appendix 4: Lesson Observation Sheets

Lesson Observation:

Timings:

Class:	Start:	End:
Topic:		
	What the teacher did	What the students did
Before lesson		
0-10min		
10-20min		
20-30min		
30-40min		
40-50min		
50-60min		
After Lesson		

Tasks:

Classwork tasks:	
Homework tasks:	
Other tasks:	

Questions:

Question:	Who asked it?	Who did they ask?	Answer:

Appendix 5: Interview Questionnaire

Supporting Students in Physics- Questionnaire

This questionnaire aims to find out about how your school supports you in Physics classes, and how this may be improved. The responses are anonymous; **please do not indicate your name.**

For each statement indicate if you strongly disagree (1), somewhat disagree (2), neither agree nor disagree (3), somewhat agree (4) or strongly agree (5) by circling the appropriate number. If you would like to provide further detail about your responses, please do so on the space provided at the bottom of this sheet.

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
1. I am confident that I will pass my Physics A level.	1	2	3	4	5
2. I have a grade that I would like to achieve in my Physics A level. *If so, please indicate this grade here:*	1	2	3	4	5
3. I am confident that I will achieve my target grade in my Physics A level.	1	2	3	4	5
4. Achieving my target grade in Physics is important for my post A level options.	1	2	3	4	5
5. I understand what is required of me to pass / achieve my target grade.	1	2	3	4	5
6. For the units of work I have completed so far, I understand what is required to pass / achieve my target grade.	1	2	3	4	5
7. For the units of work I have completed so far, I have gained the knowledge and developed the skills needed to pass / achieve my target grade.	1	2	3	4	5

Please give any additional information here:

……
……
……
……
……

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
8. My teachers have provided clear information as to what I need to be able to do at the completion of a unit.	1	2	3	4	5
9. My teachers have provided clear instruction as to which tasks need to be completed in lessons.	1	2	3	4	5
10. My teachers have provided clear instruction as to which tasks need to be completed independently.	1	2	3	4	5
11. I can confidently plan my own independent work.	1	2	3	4	5
12. I routinely plan and carry out my own independent work.	1	2	3	4	5
13. My teachers give useful feedback on work I have completed.	1	2	3	4	5
14. I find that the feedback from teachers enables me to work independently more effectively.	1	2	3	4	5
15. I find that feedback from teachers is more effective when given with specific tasks for improvement.	1	2	3	4	5
16. I would like to be given feedback on marked work more regularly.	1	2	3	4	5
17. I would like the feedback I am given on marked work to be given differently.	1	2	3	4	5

Please give any additional information here:

.....
.....
.....
.....
.....
.....
.....

Homework Assignment Task Class: Due date:

This assignment should take between 30 and 60 minutes.

Task 1:
During your advanced level Physics course you will need to be able to exhibit the knowledge, understanding and skills in the table on the reverse page, some of which you will be familiar with from your Key Stage 4 studies. Read pages 6-7 of the textbook, then Indicate your confidence for each statement in the table, giving a rating from 1 to 10 in the 'before reading' column, where 1 represents little to no understanding of the terms and minimal confidence in your ability, and 10 represents a complete understanding and full confidence in your ability.
You should return to this table to reassess your confidence after having read the module in full, after revising for the end of module test, and after completing the feedback work at the conclusion of the end of module test.

Task 2:
Before reading pages 8-9, describe the following terms:

Quantity:

SI base unit:

Unit symbol:

Prefix:

Task 3:
Read pages 8-9 of the textbook and answer these questions:

1. Why did the 'Mars Climate Orbiter' disintegrate?
2. What is a quantity?
3. List the SI base units, what quantity they measure, and the symbol used to represent them.
4. What are prefixes? List the prefixes that you are already quite familiar with, such as 'kilo' or 'k' stands for '1000' or '10^3'. Now make a list of the prefixes (as given in Table 2 on page 9) that you are less familiar with. You should spend some time trying to learn these, such as 'femto', 'f', stands for '10^{15}'.

Task 4:
Answer the 'Summary Questions' on page 9.

Task 5:
Write down any questions that you have about chapter 2.1, pages 8-9.

Task 6:
Upload a picture of your work as a submission on the Google Classroom. You may prefer to work in and upload a Google Doc or similar document. Please ensure that your work is legible so that the work can be read from any pictures taken.

Task 1:
Indicate your confidence for each statement in the table, giving a rating from 1 to 10 in the 'before reading' column, where 1 represents little to no understanding of the terms and minimal confidence in your ability, and 10 represents a complete understanding and full confidence in your ability.

	Confidence Rating			
	Before reading	After reading	Before module test	After unit test
Use vector diagrams to illustrate forces, a net force, and equilibrium situations.				
Explain the vector-scalar distinction as it applies to displacement, distance, velocity, and speed.				
Make calculations using ratios and proportional reasoning to convert units.				
Recognise and make use of appropriate units in calculations.				
Use calculators to find and use power functions.				
Use sin, cos and tan in physical problems.				
Visualise and represent two-dimensional and three-dimensional forms, including 2D representations of 3D objects.				
Use Pythagoras' theorem and the angle sum of a triangle.				
Estimate results.				
Find arithmetic means.				
Identify uncertainties in measurements and use simple techniques to determine uncertainty when data is combined.				

Appendix 7: Control Homework Assignment

Homework Assignment Task

Class:

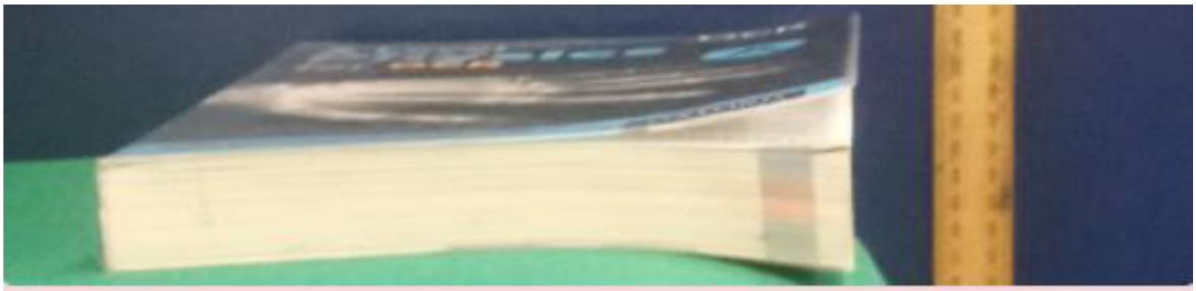
Due date:

Task 1:
Read and make notes on pages 6-9 in the textbook.

Task 2:
Answer the 'Summary Questions' on page 9 in the textbook.

Task 3:
Upload a picture of your work as a submission on the Google Classroom. You may prefer to work in and upload a Google Doc or similar document. Please ensure that your work is legible, so pictures should be taken so that the work can be read.

Appendix 8: Forces and Energy Intervention Assignment



Forces and Energy

This exercise is intended to help you better understand forces and energy. You may already have a good understanding of these concepts and are able to use the key terminology effectively. It may be that you have some misconceptions, misunderstandings, or are using the key terms incorrectly. This exercise intends to help you and your teacher identify such misconceptions, leading you to better understand the underlying Physics and being more able to write answers to such questions with confidence in the exam.

Some of the questions will be multiple choice, while some will be more open ended. All open ended questions should be answered using full sentences, however an essay is not required.

*Required

Email address *

Your email address

Name *

Your answer

A force can be defined as... *

- [ ] A push, pull, or twist, measured in newtons
- [ ] A force of one newton will accelerate a mass of 1 kilogram by 1 metre per second each second
- [ ] The rate of exchange of momentum
- [ ] The work done per unit of distance
- [ ] The product of mass and acceleration
- [ ] Strength or energy as an attribute of physical action or movement.

What keeps an object moving.

Force is the push or pull on an object with mass that causes it to change velocity (to accelerate).

A measure of the acceleration of an object

$kgms^{-2}$

kgms^-2

Acceleration per unit of mass

How hard one object pushes on another

A measurement of the newtons in an interaction

Make a way through or into by physical strength; break open by force.

Make (someone) do something against their will.

Weight

Coercion or compulsion, especially with the use or threat of violence.

What is a force? (You should be as detailed as you can and try to use all of the relevant key terms that you have used so far in your A level course) *

Your answer

Energy can be defined as... *

- [ ] A measure of the speed of the particles in an object
- [ ] Power derived from the utilization of physical or chemical resources, especially to provide light and heat or to work machines.
- [ ] The strength and vitality required for sustained physical or mental activity.
- [ ] The ability to make something change
- [ ] The ability to make something move
- [ ] A measure of the chemical bonds in a material
- [ ] The capacity for doing work, measure in joules.
- [ ] The ability to enact forces
- [ ] The capacity or power to do work, such as the capacity to move an object (of a given mass) by the application of force.
- [ ] How much potential an object has

Energy can be defined as...(You should be as detailed as you can and try to use all of the relevant key terms that you have used so far in your A level course)

Your answer

A 1500g book is at rest on a chair, 47cm from the ground. Describe the motion, forces acting on the book and any energy transformations that may be occuring. You should include any relevant calculations in your answer and show your working for these in full. *



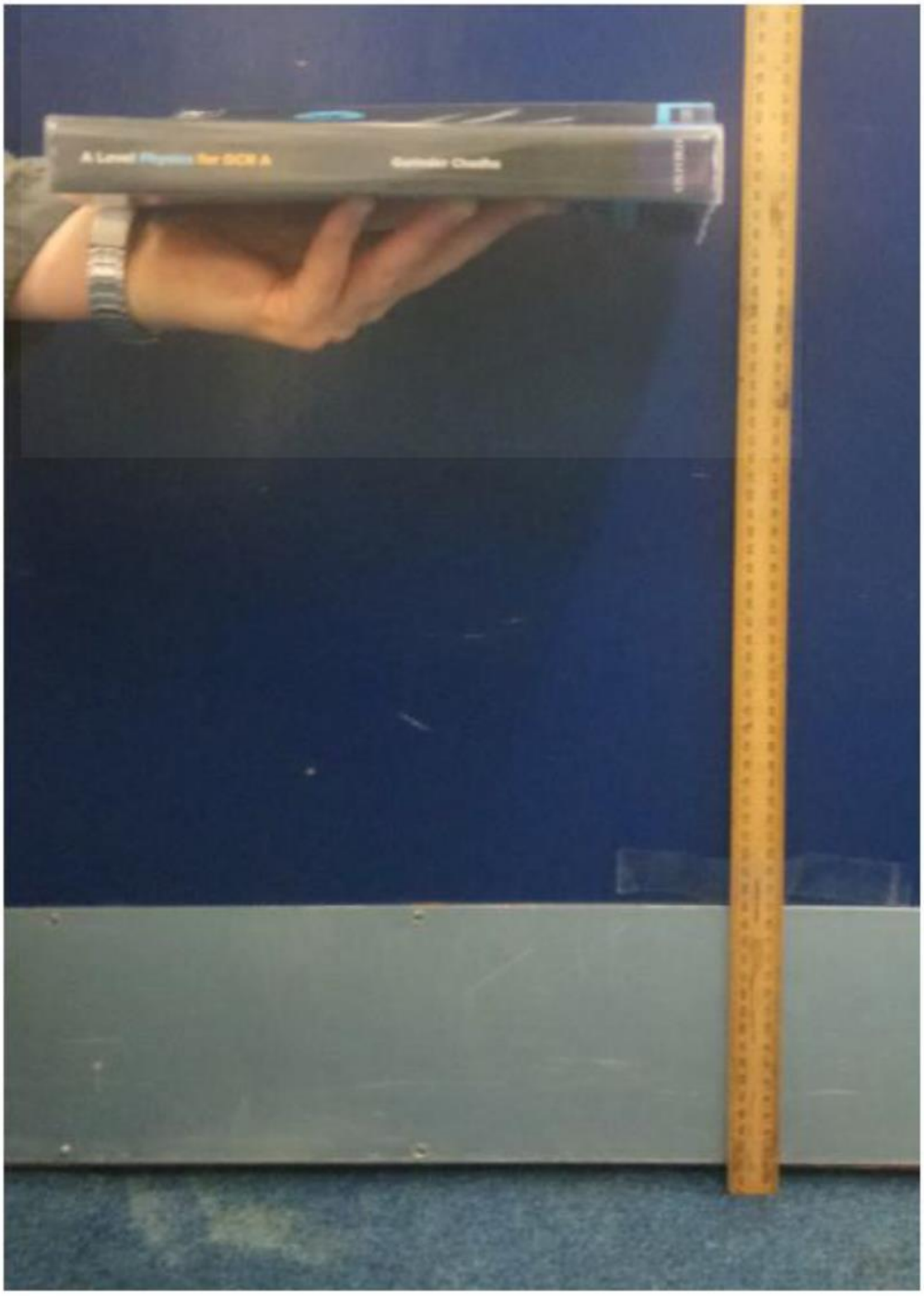
Your answer

A 1500g book is at rest on a chair, 47cm from the ground. The chair is removed. Describe the motion, forces acting on the book and any energy transformations that may be occuring. You should include any relevant calculations in your answer and show your working for these in full. *



Your answer

A 1500g book is held 57cm from the ground. Describe the motion, forces acting on the book and any energy transformations that may be occuring. You should include any relevant calculations in your answer and show your working for these in full.



Your answer

A 1500g book is raised from 57cm above the ground to 82cm above the ground. Describe the motion, forces acting on the book and any energy transformations that may be occuring. You should include any relevant calculations in your answer and show your working for these in full.

