THE PENNSYLVANIA STATE UNIVERSITY
SCHREYER HONORS COLLEGE

DEPARTMENT OF CURRICULUM & INSTRUCTION

CREATING AND EVALUATING AN INNOVATIVE ACCOMMODATION IN SECONDARY SCIENCE

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SPRING 2015

A thesis
submitted in partial fulfillment
of the requirements
for a baccalaureate degree
in Physics
with honors in Secondary Education

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ABSTRACT

Accommodations can make it easier for everyone in a classroom of students with diverse needs to learn. We created an innovative accommodation using Doceri presentation software and implemented it in a high school physics classroom. The sample size of this classroom was too small to draw any real conclusions, but this thesis is part of an ongoing collaborative study in the Science Education department. Validity concerns are addressed and suggestions for future researchers are provided.

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Introduction

Today's classrooms are filled with learners with all kinds of diverse needs. Sometimes, in order to be fairly compared to their classmates, these diverse learners require accommodations. Accommodations are discussed extensively in the literature review, but essentially, an accommodation makes sure the bar of achievement is set at the same level for all students. For example, if one were testing reading comprehension skills in a group of students where some of them were blind, this assessment would not accurately describe the reading comprehension skills of the blind students unless they were given the accommodation of a Braille text (and probably extended time, because it takes longer to read Braille). The accommodations help ensure that both groups of students are given the chance to show their true abilities.

Ideally, the accommodations a student needs should be detailed in his or her individualized educational plan (IEP). However, we researchers have found from experience in the classroom that this is not always the case, and often students with the same disability are given the same accommodations whether or not they are necessary for, or even helpful to, the individual students. This study is part of a multi-year research program seeking to find innovative accommodations for students with diverse learning needs.

Goals

- Contribution to the development of our research study plan approved by The Pennsylvania State University's Institutional Review Board
    - Specific creation of the principal consent letter and researcher profiles
- Further development of previous year's literature review (O'Brien, 2014)
    - Specific expansion of section on accommodation of extended time (segments added to the literature review by this author will be placed in italics.)
- Creation of a computer-based project
    - 17 minute video made using Powerpoint and Doceri reviewing Newton's Third Law and Momentum (script provided in Appendix D)
- Investigation of research question: "Does our accommodation of a video intervention provide a differential boost to students with IEPs in a secondary science class?"
    - Null Hypothesis:
        - H_0: Video intervention will provide no differential boost to students with IEPs in secondary science.
    - Alternative Hypothesis:
        - H_A: Video intervention will provide a differential boost to students with IEPs in secondary science.

Literature Review

The literature review in its entirety can be found in "The Game Has Changed: Do Accommodations Level the Playing Field, or Alter the Sport?" O'Brien (2014). Here I have included some essential background information, as well as the section on extended time which I contributed to. My contributions are in italics.

Introduction

The phrase, "leveling the playing field" is rampant in educational research regarding adjusting curriculum to meet the needs of diverse learners. Some ways in which educators adapt curriculum include accommodations, modifications, and interventions (Harrison, Bunford, Evans, & Sarno Owens, 2013). These changes to the expected curriculum of the general student body are said to "level the playing field."

Individualized Education Programs (IEPs) are meant to identify and smooth out these bumps in the playing field (Byrnes, 2008b). IEPs are legally binding documents that educators are required to implement ("Disability law. Individuals with Disabilities Education Act. Fourth circuit holds that parents bear the burden of proof in a due process hearing against a school district. Weast v. Schaffer, 377 F.3d 449 (4th Cir. 2004)," 2005; Howard & Potts, 2013). As of 1993, eleven states required an IEP to list accommodations, and as of 2003 all fifty states require that accommodations be explicitly recorded in an IEP (Lazarus, Thurlow, Lail, & Christensen, 2008). Three of the eleven states in 1993 also specified that the accommodations were to be used both in the classroom and during assessments; as of 2005, forty-seven states now include this stipulation (Lazarus et al., 2008).

Nowadays, most researchers advocate for verisimilitude between testing conditions and instructional conditions (Bolt & Thurlow, 2004; Bunce & Simaska, 2013; Byrnes, 2008a; Dolan, Hall, Banerjee, Chun, & Strangman, 2005; Howard & Potts, 2013; Salend, 2008; Scanlon & Baker, 2012; Scarpati, Wells, Lewis, & Jirka, 2009). Given that these accommodations are meant to help improve the validity of state standardized tests, selecting appropriate and valid accommodations proves to be vital because of the ramifications for everyone from the state down to the individual (Elbaum, 2007; Lazarus et al., 2008). These include, grade promotion, graduation, teacher salaries, and funding for the school (Bolt & Thurlow, 2004).

What makes an accommodation valid? Many researchers agree that for an accommodation to be valid, it must result in a significantly greater gain for the student for whom it is applied than for the rest of the student population (Bouck & Yadav, 2008; S. W. Cawthon, 2007; Elbaum, 2007; Fletcher et al., 2009; Fletcher, Francis, Boudousquie, & Copeland, 2006; Fuchs, Fuchs, Eaton, Hamlett, & Karns, 2000; Harrison et al., 2013; Jiang & Grabe, 2007; Lovett, 2010; Pariseau, Fabiano, Massetti, Hart, & Pelham, 2010; Sireci, Scarpati, & Li, 2005; Thurlow & Bolt, 2001). As Philips (1994) put it, a "differential boost" occurs.

Who decides which accommodations should be valid and listed in a student's IEP? The IEP team consists of: the parents, at least one general education teacher, at least one special education teacher, an administrator, and sometimes the child (Howard & Potts, 2013; Neal, 2012). Of those mentioned, the general education teacher and the special education teacher are most likely to know the most about the available accommodations. Neal (2012) found that only 27% of the general education teachers and 85% of the special education teachers surveyed said they always actively participated in the IEP process.

Not only are a small percentage of general education teachers actively crafting the IEP, but research has also shown that teachers often over award accommodations that the student does not require (Elliott, Kratochwill, & McKevitt, 2001; Fuchs, Fuchs, Eaton, Hamlett, et al., 2000; Fuchs, Fuchs, Eaton, & Hamlett, 2000; Neal, 2012). Accommodations when not needed can have a negative effect on a student's performance. Pariseau et al. (2010) found that students with ADHD are actually negatively affected by extended time, thus making it an invalid accommodation. This can be particularly troubling given that extended time is one of the most common accommodations awarded (Abedi, 2008; Bolt & Thurlow, 2004; Brockelman, 2011; S. W. Cawthon, 2007; Edgemon, Jablonski, & Llyod, 2006; Elliott et al., 2001; Filce & Lavergne, 2011; Newman & Gonzalez, 2006; Ofiesh & Highes, 2002; Pariseau et al., 2010).

This begs the question then, which accommodations are valid? This question is proving harder to answer than one would expect. Extended time may be invalid for some students (Abedi, 2008; Beddow, 2012; Bolt & Thurlow, 2004; Bouck & Yadav, 2008; Byrnes, 2008a; Edgemon et al., 2006; Fuchs, Fuchs, Eaton, Hamlett, et al., 2000; Fuchs, Fuchs, Eaton, & Hamlett, 2000; Lovett, 2010; Pariseau et al., 2010; Sireci et al., 2005; Thurlow & Bolt, 2001). But, others have found evidence to the contrary (Abedi, 2008; Brockelman, 2011; Byrnes, 2008a; Edgemon et al., 2006; Lazarus et al., 2008). Note that many of the studies and reviews listed are found to be both for and against extended time as a valid accommodation.

This echoes a theme in the literature—there is a dearth of research with conclusive data about accommodations (Abedi, 2008; Brown, Cook, Kelly, & Park, 2011; Byrnes, 2008a; Harrison et al., 2013; Jiang & Grabe, 2007; Jindal-Snape, Douglas, Topping, Kerr, & Smith, 2005; Jordan, 2009; Lazarus et al., 2008; Lovett, 2010; Pariseau et al., 2010; Scanlon & Baker, 2012; Thurlow & Bolt, 2001). Another theme of the literature involves throwing out accommodations mostly and moving towards Universal Design for Learning (UDL) (Brand & Dalton, 2012; Brown et al., 2011; Dolan et al., 2005; Elbaum, 2007; Elliott et al., 2001; Fletcher et al., 2009; Gartland & Strosnider, 2004b; Hamilton & Kessler, n.d.; Harrison et al., 2013; Howard & Potts, 2013; Lazarus et al., 2008; Lovett, 2010; Sireci et al., 2005; Stanford & Reeves, 2009; Suritsky, 1993; Thurlow & Bolt, 2001). A third motif from the literature is that of the diversity of learners, as well as the need to consider the student and not their disability alone (Stephanie W. Cawthon & Wurtz, 2010; Dolan et al., 2005; Elliott et al., 2001; Fletcher et al., 2006; Fuchs, Fuchs, Eaton, & Hamlett, 2000, 2000; Hamilton & Kessler, n.d.; Howard & Potts, 2013; Irving, Nti, & Johnson, 2007; Lazarus et al., 2008; Morales, 2011; Salend, 2008; Scanlon & Baker, 2012; Thurlow & Bolt, 2001).

This literature review will address all of the abovementioned topics while addressing the current state of accommodations in practice, the issues with the current way accommodations are used and selected, and finally how implementing Universal Design for Learning may help alleviate some of these issues. The paper begins with the diversity of learners in the classroom today, followed by the legislation that led to the inclusive classroom. Then definitions and differentiations of interventions, accommodations, and modifications, as well as addressing some of the confusion follow. Then a discussion on valid accommodations which flows into the ten most common accommodations as described by Bolt and Thurlow (2001) with evidence for and against most. Another very common accommodation, preferential seating, is then also discussed and used to discuss writing explicit accommodations (Byrnes, 2008b). Bundling different accommodations is next after all the separate accommodations have been addressed. Some of the issues with accommodations and accommodation selection currently are discussed. IEPs are also discussed in the next section. Assistive technologies, and specifically the Livescribe Pen, are then discussed as a potential new technology for accommodations which segues into the idea of Universal Design for Learning. A conclusion draws everything together, and a list of research topics to keep an eye on is also included.

Historical Background

Classrooms are now a source of great diversity. There are your everyday, ‘baseline,’ students. There are your gifted students who generally receive modifications that add to the curriculum (Bossé, 2007; Howard & Potts, 2013). Also there are your students with disabilities. These disabilities have a great range from learning related to bowel and bladder disabilities (Filce & Lavergne, 2011). There are psychiatric disabilities that students may have: depression, Bipolar Affective Disorder (BAD), Borderline Personality Disorder (BPD), schizophrenia; anxiety disorders (Souma, Rickerson, & Burgstahler, 2006). Howard & Potts (2013) also included other disabilities: specific learning disability, emotional disturbances, autism, deafness, orthopedic impairment, traumatic brain injury; visually impairment.

The National Longitudinal Transition Study-2 (NLTS2) found that two-thirds of those receiving special education in secondary schools are considered to have a learning disability (Newman & Gonzalez, 2006). Students with learning disabilities are not limited to elementary or secondary schools; in today’s inclusive environments, students with disabilities are going to postsecondary institutions. Brown et al. (2011) report that 11.3% of college students reported a disability. Souma et al. (2006) report that there are more than 400,000 students reporting a disability.

A variety of learners in the classroom has benefits for everyone. Including students with disabilities in the general education classroom has been known to show benefits for both those with disabilities and those without (Gaona, 2004; Newman & Gonzalez, 2006). Newman & Gonzales (2006) also report that inclusive education has shown evidence for better behavior and higher levels of achievement for students with disabilities, and exposure to, and more comfort with, diversity for students without disabilities.

Another reason to support inclusion is the money it saves. Inclusive classrooms save a district from 25-60% of what it would spend on a student in special education due to costs for more aides and materials (Gaona, 2004). Aron & Loprest (2012) report that in the 1999-2000 school year, the United States government spent roughly $50 billion on special education alone; $27.3 billion for students who spent part of the day in inclusion classrooms. The total—$77.3 billion—represents 21% of the money spent on primary and secondary education that year; nearly 90% more was spent on students in special education compared to those in the general classroom (Aron & Loprest, 2012).

How frequent are some of these diverse learners in the classroom? As of 2001, the United States Department of Education found that 12.8% of students have a disability—with a specific learning disability being the largest subset: specific learning disability 50%, speech-language impairments 28.9%, intellectual disability 10.6%, emotional disturbance 8.3%, “other health impairments” 5.1%, multiple disabilities 2.1%, orthopedic impairments 1.3%, deafness/ hearing impairment 1.2%, developmental delay 0.5%, blindness/ visual impairments 0.4%; traumatic brain injury (Abell & Lederman, 2007).

How are these numbers changing? The United States Department of Education in their 29th Annual Report to Congress on the Implementation of the Individuals with Disabilities Act 2007, found that some disabilities are dynamic and others are static (listed as 0.0% change) from 1996 to 2005: specific learning disability -.3%, speech-language impairments 0.0%, intellectual disability -0.2%, emotional disturbance 0.0%, “other health impairments” +0.6%, multiple disabilities 0.0%, orthopedic impairments 0.0%, deafness/ hearing impairment, developmental delay, blindness/ visual impairments; traumatic brain injury were not listed (2010). These numbers indicate that for the most part, diverse learners are here to stay.

Accommodations, Modifications, and Interventions

Three ways to make not only a test, but the entire curriculum, more accessible for diverse learners is through (1) interventions, (2) modifications, and (3) accommodations. Each has its own definition and different ways of adjusting the general curriculum expected of all students in the classroom so that it is accessible to everyone in the classroom.

Interventions

Interventions are systematic changes to develop or enhance social skills, behaviors, or knowledge (Harrison et al., 2013). Interventions are often linked with behavior modifications, or preventions. It is also often associated with efforts to improve a child's reading skills (Selfridge & Kostewicz, 2011). In regards to behavior modification, in this modern age it includes things like school councilors preventing or controlling sexting (McEachern, McEachern-Ciattoni, & Martin, 2012) and obesity (Belser, Morris, & Hasselbeck, 2012). More classically, interventions for behaviors also include cognitive cue cards for developing cognitive control and correspondence training between what a student says they will do and actually do (Richie, 2005).

Examples. Examples of interventions include providing remedial reading and grade-level reading to a student struggling with literacy skills (Harrison et al., 2013). School councilors' attempts to change inappropriate behaviors like sexting (McEachern et al., 2012) and child obesity (Belser et al., 2012) also constitute interventions.

As mentioned above, interventions are very diverse and include much more than just academics. They are not a focus of this review—instead methods of helping reduce barriers of access to diverse learners is the focus. The two ways to do that in both testing and the classroom are accommodations and modifications.

Modifications

Modifications are deliberate changes made to the curricular expectations of a student (Alquraini & Gut, 2012; Bolt & Thurlow, 2004; S. W. Cawthon, 2007; Hamilton & Kessler, n.d.; Harrison et al., 2013; Howard & Potts, 2013; Lazarus et al., 2008). These are often reductions to compensate for a disability (Alquraini & Gut, 2012; Hamilton & Kessler, n.d.; Harrison et al., 2013). Although Bossé (2007), and Weinfeld et al. (2005) use the word accommodations, what they both are really describing are modifications for gifted learners and twice exceptional learners (gift learners with some type of disability). Thus, modifications are not only for reducing expectations, but also for raising the bar..

Examples. Modifications include a wide array of changes to the curriculum. Allowing a student to take a different English class that tests at a different grade level due to a reading disability would constitute a modification (Harrison et al., 2013). A reduction of homework or class work also constitutes a modification (Hamilton & Kessler, n.d.). A major change to expectations also includes switching from letter grades to a pass/fail system based on work completion (Hamilton & Kessler, n.d.). Nearly 30% of general education teachers modify grading criteria for diverse learners (Newman & Gonzalez, 2006). Modifications can also take on the form of emphasizing communication skills for students with autism (Jindal-Snape et al., 2005). If there is a change to a test construct, then it is a modification (Bolt & Thurlow, 2004; S. W. Cawthon, 2007; Lazarus et al., 2008). In the late 1990’s, the United States Department of Education went even as far as to allow some states to modify standards for students with severe disabilities (Aron & Loprest, 2012; Salend, 2008). If it is not a change to a test construct or curricular expectation, then it is not a modification. Rather, it is most likely an accommodation then.

Accommodations

Accommodations are the means by which a student over comes a barrier which allows him to demonstrate his knowledge without letting his disability interfere, while at the same time not giving an advantage to the student with disabilities (Alquraini & Gut, 2012; Bolt & Thurlow, 2004; Bunce & Simaska, 2013; Edgemon et al., 2006; Elliott et al., 2001; Fuchs, Fuchs, Eaton, Hamlett, et al., 2000; Hamilton & Kessler, n.d.; Harrison et al., 2013; Howard & Potts, 2013; Lazarus et al., 2008; Scanlon & Baker, 2012; Scarpati et al., 2009; Souma et al., 2006; Thurlow & Bolt, 2001). They help "level the playing field" (Bouck & Yadav, 2008; Fuchs, Fuchs, Eaton, Hamlett, et al., 2000; Hamilton & Kessler, n.d.; Sireci et al., 2005). Accommodations increase the validity of assessments by ensuring that assessments are measuring the skill they are intended for (i.e. not reading during a math test), and by increasing accessibility (Beddow, 2012; Byrnes, 2008b; Lazarus et al., 2008; Thurlow & Bolt, 2001).

They are also a right to students with disabilities under the Individuals with Disabilities Education Improvement Act of 2004 (Alquraini & Gut, 2012; Bouck & Yadav, 2008; Byrnes, 2008a, 2008b). It is also important that accommodations are used both on testing and during instruction so that the student becomes acclimated to the accommodations (Bunce & Simaska, 2013; Byrnes, 2008a, 2008b; Scanlon & Baker, 2012). "It is the responsibility of the instructor to provide the accommodations. It is the student's responsibility to fulfill the academic requirements of the course" (Souma et al., 2006, p. 3). Recall, that modifications change the academic requirements, but accommodations do not. Educators have to legally reduce the barriers that prevent a student from achieving in their class, but they are not always legally bound to make the class easier.

Unfortunately, some accommodations on large-scale tests are fairly recent. The National Assessment of Educational Progress (NAEP) tests have been monitoring student progress for years, but it wasn't until 2004 that accommodations first became available ("The nation's report card: Trends in academic progress 2012," 2013).

Valid Accommodations

For an accommodation to be valid it must provide a differential boost for the student with the disability, while not increasing a non-disabled peer's performance significantly (Bouck & Yadav, 2008; Phillips, 1994). The term "interaction hypothesis" conveys the same idea as a differential boost (Fletcher et al., 2006; Sireci et al., 2005). It also focuses on reducing barriers of irrelevant constructs being measured—like the ability to read on a math test—to improve the validity of tests (Byrnes, 2008a; Dolan et al., 2005; Fletcher et al., 2006; Kieffer et al., 2009; Sireci et al., 2005). This is why accommodations for sensory or physical disabilities are not held in high contention (Phillips, 1994; Thurlow & Bolt, 2001). Those accommodations for students with cognitive disabilities are much more controversial though (Thurlow & Bolt, 2001). For example, if all students benefit from extended time, but only those with a disability are allowed to use this accommodation, then the scores of the student with the disability will be inflated and invalid (Fletcher et al., 2006).

The reasoning behind these accommodations is to allow a student to more accurately convey his or her knowledge of the subject matter being tested (Bolt & Thurlow, 2004; S. W. Cawthon, 2007; Elbaum, 2007; Fletcher et al., 2009; Kieffer et al., 2009; Lazarus et al., 2008; Pariseau et al., 2010). Translating a test verbatim for a student who does not speak English could be a valid accommodation. But, if in the translation the test becomes easier—then it is invalid and also a modification (Kieffer et al., 2009).

Beddow (2012) identified three attributes of a valid accommodation: "(a) unchanged constructs, (b) individual need, (c) differential effects…" (p. 103). Tindal & Fuchs also include the stipulation that it should be in regards to individuals, not overall score increases (Tindal & Fuchs, 2000). An unchanged construct is part of the definition of an accommodation (if the construct changes, it is then a modification) (Hamilton & Kessler, n.d.; Tindal & Fuchs, 2000). The individual need is important because if everyone can benefit from it, or requires it, then it should be given to the entire population as a part of the test—not an accommodation to it. This relates to the idea of the Universal Design for Learning (Brand & Dalton, 2012; Brown et al., 2011; Dolan et al., 2005, 2005; Elbaum, 2007; Elliott et al., 2001; Fletcher et al., 2009; Gartland & Strosnider, 2004a; Hamilton & Kessler, n.d.; Harrison et al., 2013; Howard & Potts, 2013; Lazarus et al., 2008; Lovett, 2010; Sireci et al., 2005; Stanford & Reeves, 2009; Suritsky, 1993; Thurlow & Bolt, 2001). Finally, the differential effects are the same idea as Phillips's (1994) differential boost. To sum up, a valid accommodation does not change the construct of the test and provides a differential boost for students with a disability.

Why Are Valid Accommodations Important? When it comes to the state testing NCLB mandates, if the accommodations are not valid, then the results are invalid as well. Test scores are designed to have a high degree of accessibility for all students (Beddow, 2012). Accessibility is the degree to which an assessment allows a student to demonstrate his or her knowledge (Beddow, 2012). Beddow (2012) identifies four major components of accessibility: perception, reception, cognition, and emotion. Perception is sensory access. Reception is the ability to read and understand the text. Cognition involves working memory. Finally, emotions are largely tied to self-efficacy (2012).

The goal of a valid accommodation is to increase access, not the outcome of a test (Byrnes, 2008a; Elliott et al., 2001; Fuchs, Fuchs, Eaton, & Hamlett, 2000; Souma et al., 2006). Thus, if an accommodation increases access to a test it should also increase the validity of the results of the test.

Given the ramifications of state tests from NCLB (Bolt & Thurlow, 2004; Bush, 2001), it is paramount that state-wide assessments allow students to accurately display their knowledge. This will protect school funding and identify what a student actually knows (Bolt & Thurlow, 2004). Identifying what students actually know is the goal of state-wide testing (Darling-Hammond et al., 2005), so valid accommodations are needed to allow the collection of valid data. So what are the accommodations most often given out, and what evidence is there to support these accommodations? Are these accommodations "leveling the playing field" or changing the game entirely?

Extended Time

Extended time is one of the most common accommodations listed for diverse learners (Abedi, 2008; Bolt & Thurlow, 2004; Brockelman, 2011; Stephanie W. Cawthon & Wurtz, 2010; S. W. Cawthon, 2007; Edgemon, Jablonski, & Llyod, 2006; Elliott, Kratochwill, & McKevitt, 2001; Filce & Lavergne, 2011; Lovett, 2010; Newman & Gonzalez, 2006; Ofiesh & Highes, 2002; Pariseau, Fabiano, Massetti, Hart, & Pelham, 2010). Extended time ranges from time and a half, to unlimited time (Abedi, 2008; Ofiesh & Highes, 2002; Sireci, Scarpati, & Li, 2005; Thurlow & Bolt, 2001). (Abedi, 2008; Ofiesh & Highes, 2002; Sireci et al., 2005; Thurlow & Bolt, 2001). The rationale behind extended time is that diverse learners take longer to complete an assignment due to barriers such as reading speed, translations, reading Braille, etc. (Ofiesh & Highes, 2002; Thurlow & Bolt, 2001). This is also why extended time is often given in conjunction with other accommodations in a bundle (Edgemon et al., 2006; Fletcher et al., 2009; Thurlow & Bolt, 2001; Trammell, 2011).

There are differences in how extended time is delivered: how much time, where it is given; on tests and quizzes or tests alone (Byrnes, 2008). If time is not a construct of the test, then extended time is considered an accommodation, but if time is being measured, then extended time would be a modification (Abedi, 2008; Bolt & Thurlow, 2004).

Evidence For. Bolt & Thurlow (2004) examined 21 studies and found evidence supporting extended time as a valid accommodation in six of those studies and mixed results in six studies. Seven studies used a differential boost perspective, and one found a statistically significant boost for students with disabilities (2004). Many educators find extended time easy to use and to implement (Bolt & Thurlow, 2004; Thurlow & Bolt, 2001). Brockelman (2011) found that STEM faculty found extended time to be more effective than non-STEM faculty did. Studies have shown that educators most often use accommodations they perceive as easy and effective (Brockelman, 2011; Stephanie W. Cawthon & Wurtz, 2010; Neal, 2012; Scanlon & Baker, 2012; Thurlow & Bolt, 2001). There are some who believe that extended time is simply good testing practice (Lazarus, Thurlow, Lail, & Christensen, 2008). *The Maximum Potential Thesis claims that extended time does provide a differential boost, because normal students are already performing at their maximum potential, but there is only weak evidence of this (Zuriff, 2000). Lewandowski et al. (2014) surveyed college students and found that extended time was the accommodation most often perceived as effective by both students with and without disabilities. Elliott & Marquart (2004) point out that response time is almost never a construct appearing in state standards, which increases the validity of extended time as an accommodation on state tests designed to measure these standards.*

Evidence Against. In the 21 studies Bolt & Thurlow (2004) examined mentioned above, five of the studies did not find extended time to be a valid accommodation. Of the seven studies using a differential boost as criteria for a valid accommodation, six did not find a statistically significant change (Bolt & Thurlow, 2004). ELL students had mixed results when examined if extended time helped them significantly more (Abedi, 2008). Sireci et al. (2005) also echoed the lack of evidence of the interaction hypothesis. Pariseau et al. (2010) also follows suit in identifying a theme of a lack of a differential boost between students with disabilities and those without.

Whether or not students' scores are increasing with the implementation of extended time is not under contention—it is the differential boost that is the issue at hand. Students with and without disabilities benefited in nearly all of the studies, but only a small fraction of the studies found that diverse learners perform statistically significantly better than their peers (Fuchs, Fuchs, Eaton, & Hamlett, 2000; Thurlow & Bolt, 2001). *In a test of reading comprehension, high school students without disabilities were actually found to benefit more from extended time than their peers with reading disabilities (L. J. Lewandowski, Lovett, & Rogers, 2008). The same inverse differential boost result was found for college students in reading comprehension (L. Lewandowski, Cohen, & Lovett, 2013).* Harrison et al. (2013) in their review of research, said that they cannot conclude that extended time is a valid accommodation because of the lack of coherence over a differential boost.

Other issues with extended time include the possibility that it may change the validity of the test (Beddow, 2012), the scheduling of extended time, and the location (Byrnes, 2008). Another point of contention is what exactly are students benefiting from? The extended time score increases may only be due to a decrease in test anxiety, not the actual increase in time (Lovett, 2010; Thurlow & Bolt, 2001). *Many of the college students surveyed by Lewandowski et al. (2014) thought that accommodations should be available to all students, possibly indicating that they are helping due to some other, non-valid factor. Their opinion also reveals a belief that the boost from extended time would not be differential.*

Attention-deficit/hyperactivity disorder (ADHD) is a continuum of conditions, and thus cannot easily be broadly covered by blanket accommodations (Lovett, 2010). Extended time is frequently given to all students with ADHD (Lovett, 2010; Pariseau et al., 2010). Pariseau et al. (2010) investigated whether or not a fifteen minute (time and a half) increase benefited students with ADHD. The authors found that contrary to what was currently held, the students completed significantly more problems correct per minute in regular time when compared with extended time (2010). *Lewandowski et al. (2007) performed a similar study and also found no evidence of a differential boost for students with ADHD on a speed-based math task with extended time.* Thus, extended time may benefit some students, while it may harm others. This is why blanket accommodations can actually be more harmful than helpful (Abedi, 2008; Dolan, Hall, Banerjee, Chun, & Strangman, 2005; Elbaum, 2007; Elliott et al., 2001).

State Legislation. Out of the fifty states, thirty-two allow extended time, with five states allowing it on some items while banning it on others (Thurlow & Bolt, 2001). Two states prohibit the use of extended time (Lazarus et al., 2008; Thurlow & Bolt, 2001). In Pennsylvania, the Keystone and PSSA tests are technically untimed, so any student is eligible to receive extended time, as long as they are working productively. However, they are not allowed to revisit a section on another day (Pennsylvania Department of Education, 2013).

Methods

Design

This study used two experimental designs. The primary design was a lagged design with post-tests, which can be illustrated like this:

$$N \quad X_1 \quad O_1 \quad X_2 \quad O_2$$

N is the study population, X_1 is regular classroom teaching of a unit without any accommodations, X_2 is regular classroom teaching of a second unit with the addition of our video intervention accommodation, and O_1 and O_2 are the regular class exams for units 1 and 2 respectively. This design was chosen because I was not teaching multiple sections of the same class, so I was limited to working with one group rather than comparing equivalent groups.

The secondary experimental design came about because the second unit was the one for which I was implementing my student teaching unit plan, which required the administration of a pre- and post-assessment. I decided to take advantage of this so we can also look at the growth of students over the course of the intervention unit instead of comparing it with another unit, which can be problematic. The secondary design can be illustrated as:

$$N \quad O_A \quad X_2 \quad O_B$$

where N is the same class of students as before, and X_2 is the same unit with intervention, but O_A and O_B are the pre-assessment and post-assessment respectively.

Study population

As a future high school physics teacher, my population of interest is students in secondary science. The segment of this population which I had access to included the students I taught in a small rural high school during my student teaching experience. Physics tends to not get many special needs students, possibly because it is not a required course, so I chose my Applied Physics class as my sample, because it was the only physics class containing a student with an IEP. This sample is very small, as there were only 13 students in the class. On top of that, only 12 gave permission to have their data used in this study, and only one had an IEP, making our goal of finding a differential boost very difficult. One of the reasons this project is part of a multi-year program is to help solve these low-N problems by combining data from several researchers over several years to get a better look at the picture.

Validity considerations

There are many potential threats to the validity of this study, both internal and external. As far as threats to external validity, post-test effects should not have been a problem, since the students were already used to taking a test at the end of a unit, and this is how most classes operate. Pre-test effects could have been a problem however. The students could have been cued to pay attention to material that was on the pretest. The fact that the pretest was so short probably helped reduce this threat to external validity, since it should be clear that the few items on the pretest aren't the only important things in the unit. Another possible way to handle this validity threat would be to go to the other extreme and have a very long pretest so students are unlikely to remember what was on it to cue into.

The biggest threat to external validity was probably observer effects. Having the researcher be the teacher could definitely have led to research subjects behaving differently than if the teacher were some third party. My students generally liked me and respected me, so the fact that I created the video intervention and it was my voice in it could have caused them to pay more attention to it and value it more highly than if it were just created by some stranger.

One threat to internal validity is maturation. This usually refers to subjects changing during the study, but perhaps more important in this case was the *researcher* changing. Student teaching is a time of rapid growth in teaching skill, and I was likely (hopefully, from my perspective as a teacher) teaching significantly more effectively during the second unit than during the first. This makes it very difficult to tell if differences between the units were due to the video intervention or due to my growth as a teacher.

Another issue that makes it difficult to compare the two units is that these units were very different. The first unit was very heavy on mathematical problem solving, while the second unit was much more conceptual. Therefore it is likely that differences in post-test scores between the units would be at least partially due to students' math skills, and there does appear to be some evidence of this in the results. Even if the two units were based on similar skills, it would still be difficult to say that the two unit tests were of equal difficulty. The students performed worse on average on the second unit test than the first, but it could very well be the case that the second unit test was more difficult than the first one. Finally, the extremely small sample size makes it almost impossible to make any conclusions for this study, but that is why this is part of a multi-year program, so that eventually everyone can put their data together for a large-N study.

Measures

The measures for this study include the two unit tests designed by this researcher for the Applied Physics class and the Newton's Third Law and Momentum unit pre/post assessment. The pre/post assessment was very short and multiple choice. This made the data easier to analyze, but is not the form of test students usually take in this class. It was originally intended to be used just to get an idea of the students' initial understandings, but then I realized it could be useful to measure growth in this study. The pre/post assessment can be found in Appendix A.

The first unit test on Newton's Second Law (F=ma) and Forces is highly mathematical in nature. On the other hand, the unit test on Newton's Third Law and Momentum is much more focused on explaining phenomena, with almost no math. This was because I had made the teaching decision to forego numerical conservation of momentum problems with the Applied Physics class. However, this means the two unit tests are quite different from each other, and it might not be valid to compare performance on one with performance on the other. These unit tests can be found in Appendices B and C.

Procedures

After obtaining permission from the principal to conduct the research in the school, I gave students the Summary Explanation of Research for them to take home and have their parents sign if they consented to having their assessment data used anonymously in this research study. I received 12 out of 13 signed parental consent forms. I then taught a unit on Newton's Second Law and Forces which was a bit lengthy, at about a month, and highly mathematical. At the end, the students took a unit test as they normally would. I then taught a unit on Newton's Third Law and Momentum. At the beginning of this unit, the students who were present took the pre-assessment in Appendix A. They then took this same assessment again at the end of the unit. This unit was about 10 lessons long, although it also lasted around a month due to things like Veterans' Day and Thanksgiving Break. Near the end of this unit, the students watched the video intervention review I had created. They watched it on laptops in the classroom and I let them keep the DVDs I had burned the video onto in case they wanted to watch it again at home. The video itself is about 17 minutes long, but also involves the students pausing to write down answers to questions. At the end of the unit, the students took their unit test as usual. Students were given a full ~50 minute class period to complete the unit test on both occasions.

Results

Out of the 13 students in the class, one did not give permission to have their data used in this study and another did not take the second unit test while I was in the school, so I am also leaving out that student's first unit test score. The unit one and two test scores for the remaining 11 students are shown in Table 1. Originally, the first unit test was out of 80 points while the second unit test was out of 90, but I have converted those scores to a 100 point scale for Table 1.

Table 1. Unit Test Scores

Student	Unit 1 Test Score	Unit 2 Test Score	Unit 2 Score – Unit 1 Score
1	84.50	89.44	4.94
2	66.75	74.44	7.69
3	65.00	72.22	7.22
4	93.75	94.44	0.69
5	94.63	79.44	-15.19
6	95.00	86.11	-8.89
7	90.75	80.56	-10.19
8	95.00	91.11	-3.89
9	94.63	82.56	-12.07
10	93.63	82.22	-11.41
11	96.88	95.00	-1.88
Average	88.23	84.32	-3.91

As Table 1 shows, students did about 4% worse on average on the second unit test, where the intervention had been administered, than on the first unit test. A few students did better on the second unit test, although they tended to be the ones who had done the worst on the first test. This change could possibly be due to regression towards the mean, although there is another possibility. The students who did worst on the first unit test likely did so because they are weak in math, which was a large part of that test. However, there was almost no math on the second unit test, allowing these students to do better.

As mentioned previously, the average score on the unit two test was lower than the average score on the unit one test, but this alone does not necessarily mean the video intervention treatment was ineffective. It could be that the second unit test was just more difficult than the first unit test. However, we can still look for a differential boost. If the IEP student improved from unit one to unit two (or at least declined less than the average) then we could say there was a differential boost. Sadly, this is not the case. The IEP student performed above average on the unit one test and below average on the unit two test, with an above average decline in score. Therefore, if anything, we see a differential drop. Of course, it isn't reasonable to base the presence of a differential boost off of one student, but this study was limited with a small sample size to begin with and then only one special needs student out of that, so there wasn't anything I could do.

In the next table are the results of the pre- and post- assessments given for unit two. Unfortunately, three students were absent for the pre-assessment and a completely different three students were present for the post-assessment, so I only have complete data for 7 of my 13 students. Both assessments are out of 3 points. The student numbers in Table 2 are completely unrelated to those in Table 1.

Table 2. Pre/Post Test Scores

Student	Pre-assessment	Post-assessment	Post minus Pre
1	2	2	0
2	1	3	2
3	1	1	0
4	1	2	1
5	2	2	0
6	1	2	1
7	3	1	-2
Average	1.57	1.86	0.29

Table 2 shows a slight increase on average from the pre-assessment to the post-assessment, at least for the half of the class that took both. Interestingly, the student with the highest score on the pre-assessment received the lowest score on the post-assessment, while one of the lowest scorers on the pre-assessment scored perfect on the post-assessment. Unfortunately, the IEP student was one of those who missed the pre-assessment, so we aren't able to conclude anything about the growth of diverse learners over the second unit.

Conclusions

The results are not able to reject the null hypothesis that the video intervention will provide no differential boost to students with IEPs in secondary science. In fact, there seems to be a differential drop, although that could be due to a number of factors, and is based on a sample size of one IEP student. It seems unlikely that the video intervention would cause diverse learners to perform worse, even if it doesn't help them.

This study was limited primarily by its extremely small sample size. As mentioned before, our research group is attempting to alleviate that problem by combining data from multiple researchers over multiple years in order to one day have a large enough sample to test for statistically significant results. The other big limitation I faced was only having one section of each class I taught. This forced the experimental design to be one which compared the same group of students on two units rather than comparing two groups of students on the same unit. The latter design would have been more ideal, since it would eliminate the issue of the unit tests measuring different skills and being different difficulties. Of course, it would introduce the possibility of the two groups of students being nonequivalent, but one always ends up trading one validity threat for another.

The subject of accommodations in secondary science, especially ones using innovative technologies, is something which has been researched very little, and even if my results don't look very promising, other researchers in my cohort did find positive gains, so it is an area worth investigating further. Hopefully by next year getting the project approved will become a smooth process and the new researchers can begin creating their videos early and have an opportunity to collate their data with each other to achieve a reasonable sample size. One piece of advice I would give to future researchers would be to take the time to write out a script for the video intervention. I have included mine in Appendix D as an example. The narration becomes much more comfortable and easy with a script. Finally, perform your research on a class with multiple sections if at all possible. This will allow you to actually have a control group, rather than using the group as its own control on another unit, making it much easier to compare results.

Appendix A: Newton's Third Law and Momentum Pre/Post Assessment

Pre-Assessment

You are not expected to know any of the answers to this pre-assessment, because you haven't learned the material yet. This is for me to get an idea of what you know before we start this unit and to show how much you learned after the unit is over. So try your best on all of the questions, but this will be graded for completion, not correctness.

1. If the Earth pulls on you with a force of 50 N, with how many Newtons do you pull on the Earth?
    a. More than 50 N
    b. 50 N
    c. Less than 50 N
    d. 0 N –You can't pull on the Earth
2. A stone is dropped from the top of a high cliff with zero initial velocity. In which system is the net momentum zero as the stone falls freely?
    a. the stone and the Earth
    b. the stone itself
    c. the stone and the person who drops it
    d. None of these
3. When an apple falls from a tree and strikes the ground without bouncing, what happens to its momentum?
    a. The momentum of the apple after striking the ground is reversed.
    b. The speed of the apple is equal and opposite to the speed of the Earth.
    c. The momentum of the apple while falling is increasingly smaller.
    d. The momentum of the falling apple is transferred to the Earth.

Appendix B: Newton's Second Law and Forces Exam

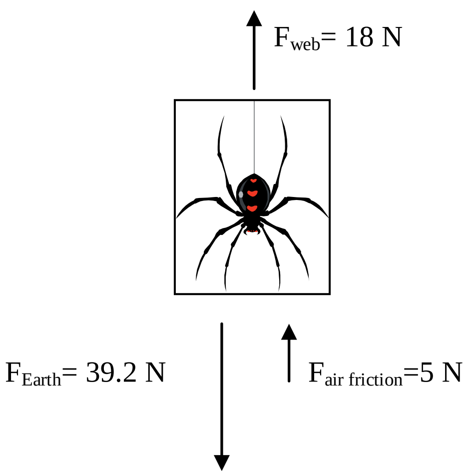
(the original space available to write work and answers to problems has been removed from both exams here in order to save space)

Applied Physics F=ma Test

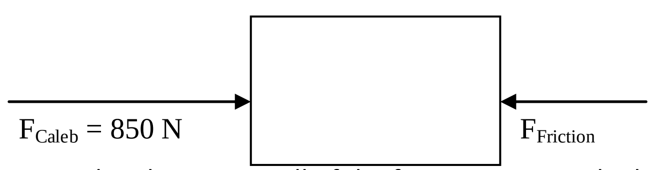
Name: ________________________ Date: _________________

Show work for all problems. Remember: not all forces require trig.

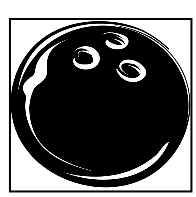
1. Jess is afraid of spiders. Find the vertical acceleration of the giant 4 kg spider lowering itself on its web to land on Jess.



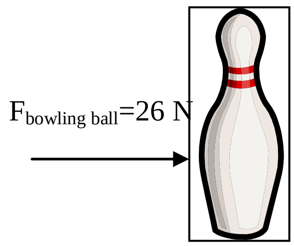
2. Caleb likes to wrestle. If Caleb pushes his 91 kg opponent to the right with 850 N and friction pushes the other way, causing a horizontal acceleration of 6 m/s^2 to the right, find the force of friction.



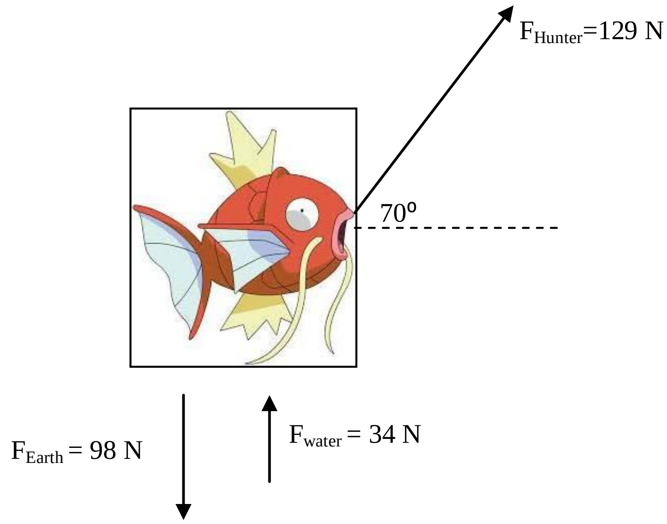
3. Avery likes to go bowling. Draw all of the forces acting on the bowling ball after Avery has let go of it and it is rolling down the lane.



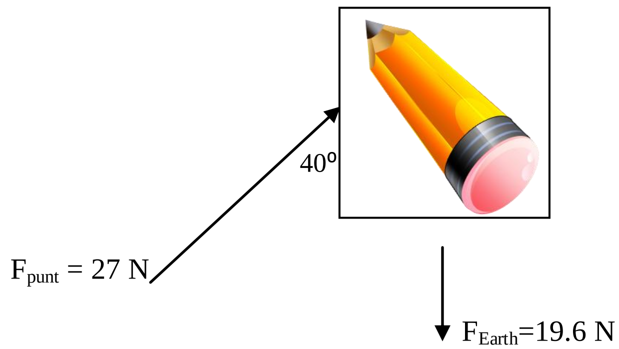
4. Once the bowling ball gets to the end of the lane, it hits the last remaining pin head on and gets Avery the spare! If the bowling ball hit the bowling pin with 26 N, giving it a horizontal acceleration of 17 m/s^2, what was the mass of the pin?



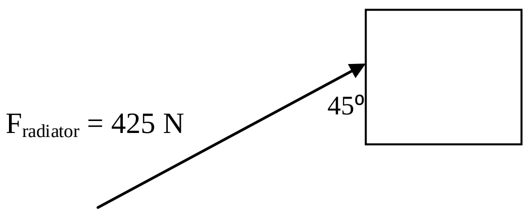
5. Keeping with our theme of recreational activities, Hunter likes fishing. If Hunter tries to pull a (10 kg, 98 N) fish out of the water with 129 N of force, what is the horizontal acceleration of the fish?



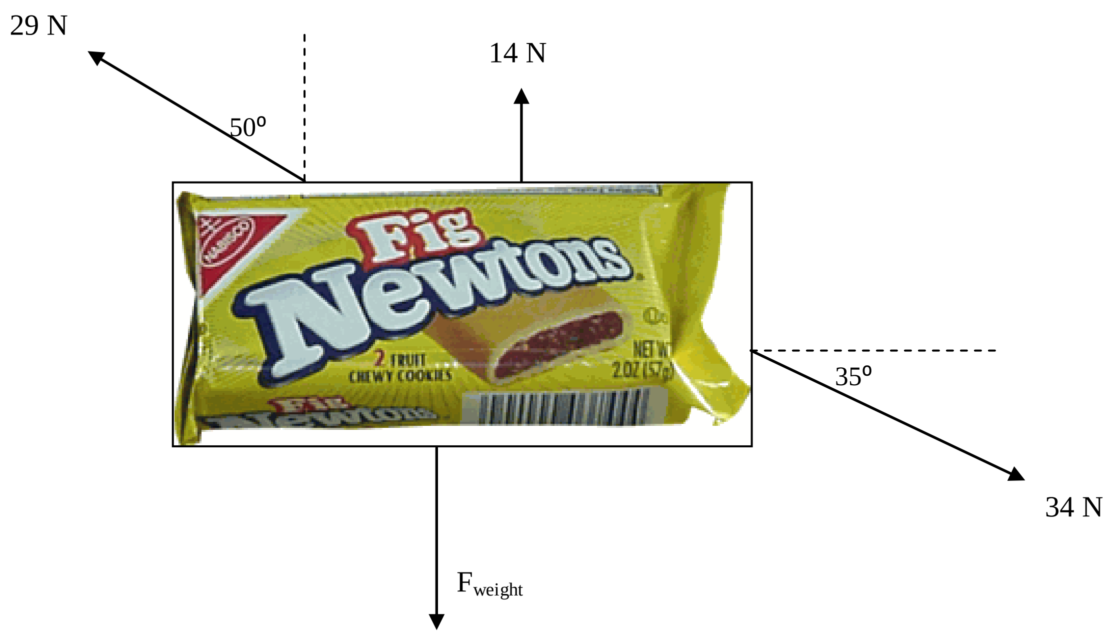
6. Trenton tried to punt a pencil in class and missed hilariously, just about breaking his knee. Let's say that he was successful in punting the (2 kg, 19.6 N) pencil with 27 N of force. What would be the vertical acceleration of the pencil?



7. Taylor hit her head off of a radiator when she was little and had to get stitches. If the radiator exerted a 425 N force on her head, causing a horizontal acceleration of 39 m/s^2, find the mass of Taylor's head as a child.



8. Find the weight of these stationary Fig Newtons.



Appendix C: Newton's Third Law and Momentum Exam

Applied Physics Newton's 3rd Law and Momentum Test

Name: _______________________ Date: ________________

Useful Equations: $a=(v_f - v_i) / t$ $F=ma$ $p=mv$ $p_f - p_i = Ft$

You must provide an explanation for all questions/problems. When explaining, use physics concepts such as force, time, momentum, impulse, mass, and velocity.

1. Hunter claims he got hit way too hard in a football game. Let's say his opponent was 115 kg. (Hunter weighs less than this)
   a. How does the force exerted on Hunter compare to the force he exerted on his opponent if Hunter was standing still when he got hit?
   b. How would your answer change, if it would change at all, if Hunter was the one running into a stunned, stationary opponent?
   c. How would your answer change, if it would change at all, if Hunter and his opponent were both running at each other when they collided?

2. Suppose you're on a spacewalk, fixing some things on the outside of the International Space Station with your wrench, when you accidentally let go of the space station! The last force you felt was the space station pushing on you, so now you are drifting away from the space station at a constant velocity, with no forces to stop your motion. How could you use the 3rd Law and/or conservation of momentum to get back to the space station? Write at least 4 lines

3. Avery likes to play video games. Identify all the forces on this controller AND their 3rd Law pairs.

4. Trenton loves huntin'.
   a. When Trenton shoots his gun, it recoils. Use Newton's 3rd Law and/or conservation of momentum to explain

why this must happen. Write at least 3 lines.

b. Why does the gun not have the same velocity as the bullet? Write at least 3 lines.

5. Tessa and Alexis used to play softball. This winter they decide to go play softball on a frozen pond. Tessa throws the ball to Alexis and starts sliding backwards.
(We're only concerned with momentum in the horizontal direction in this problem.)
    a. Is momentum conserved in the system of Tessa and the ball? How can you tell?
    b. If we include Alexis in the system, is momentum still conserved? Why or why not?

6. What is the momentum of a 90 kg Charizard moving at 25 m/s to the right?

7. What is the momentum of a 6 kg Pikachu moving at 9 m/s to the left?

8. If Charizard and Pikachu from the previous problems collide with each other, and stick together, what will be the momentum of the jumble of Pokémon after the collision?

9. Use the concepts of impulse and momentum to explain how an airbag reduces the force you feel in a collision. Write at least 4 lines.

10. In one of the most tragic stories in comic book history, the Green Goblin throws Spider-Man's girlfriend, Gwen Stacy, off of the Brooklyn Bridge. Attempting to save her, Spider-Man shoots his web down to her and yanks her up just before she hits the water. To his horror, he discovers that Gwen died anyway from a broken neck. Use physics concepts to explain why Gwen would have had a better chance of surviving if Spidey had just let her hit the water instead of yanking her up. Write at least 5 lines.

Appendix D: Doceri Presentation Script

(CLICK refers to when I need to click to advance the slide or animation)

Slide 1

Hey there. Today we're going to take a look at Newton's Third Law and Momentum. You've already learned about everything in this video in class, but I hope this will be a useful review for you before your test. Throughout the video, I'll ask you to pause and write down your answers to questions. Take this seriously and don't just skip through to hear the answer. Actually thinking about the question and writing out your answer will help you learn better. Now let's get started.

CLICK

Slide 2

Newton's 3rd law is often stated as "for every action, there is an equal and opposite reaction," but it can be better stated as "All forces come in equal and opposite pairs." CLICK Let's look at an example to illustrate this. CLICK Imagine we have two objects that touch each other. CLICK CLICK They might be leaning on each other, or have collided and are just together at this moment-it doesn't matter. CLICK

Slide 3

If object A exerts a force on object B, object B exerts an equal and opposite force on object A. CLICK CLICK Notice that the two forces are equal, despite the fact that object A is larger than object B. Newton's third law says that the two forces in an interaction pair will always be the same size, regardless of the masses of the objects involved in the interaction. CLICK

Slide 4

The forces may be the same, but something has to be different between these two objects. Perhaps the answer lies with the motion. How does the motion of object A compare to the motion of object B? It may be helpful to think of the interaction between these objects as a collision. Pause the video and take some time to write your response. … CLICK

Slide 5

Did you get it right? CLICK The accelerations will be different sizes. Specifically, object A will experience a smaller acceleration than object B, because it takes a larger force to accelerate a heavier object at the same rate as a lighter object. CLICK Since the force has to stay the same, you can either have a big mass and a small acceleration or a small mass and a big acceleration. CLICK

Slide 6

Now let's try applying Newton's Third Law to a real-life situation. As many hunters know, when a rifle is fired, it recoils, or "kicks back." Use Newton's Third Law to explain why this happens. Pause the video to write your response. … CLICK

Slide 7

Let's see if you were right. CLICK The rifle exerts a forward force on the bullet, but the 3rd law says the bullet also exerts an equal backward force on the rifle. This backward force accelerates the rifle backwards, which we observe as recoil. CLICK

Slide 8

Now it's time to see if you've been paying attention. How will the acceleration of the rifle compare to the acceleration of the bullet? Will it be greater, smaller, or the same? Make sure you explain your reasoning. That's something you'll have to do on your test. Pause the video to write your response. … CLICK

Slide 9

Let's see if you got it right. CLICK The acceleration of the rifle is smaller than the acceleration of the bullet, because the rifle is more massive than the bullet. CLICK CLICK The same force will accelerate the lighter object more than the heavier object, just like we saw with objects A and B. CLICK

Slide 10

Now let's move on to momentum. CLICK Momentum is the product of mass and velocity and is represented by the letter p. [write p=mv] CLICK You can think of momentum as how hard it is to stop an object. Remember when we tried stopping the bowling ball and bouncy ball in class? Here's another example. CLICK It's hard to stop a fastball because you have to change its velocity a lot to get it down to zero. CLICK It's also hard to stop a car, even a slow one, because it is so massive. CLICK Both of these situations illustrate objects with a large momentum. That's why they were both hard to stop. CLICK

Slide 11

Now let's check your understanding of momentum. Which of these objects has the most momentum? CLICK A frozen turkey sitting on a table? CLICK A puppy running at 3 m/s? CLICK A kitten running at 5 m/s? CLICK Or a baby monkey walking at 1 m/s? Pause the video to answer the question. … CLICK

Slide 12

Let's take a look at the possibilities. CLICK The frozen turkey has the most mass, but it isn't moving, so it has no momentum. CLICK The kitten is moving the fastest, but it is also very light. It has a momentum of 3 x 5 = 15 kgm/s. CLICK Notice that the monkey has the same momentum as the kitten even though its mass and velocity are different. If we multiply the mass and velocity of the puppy we get 6 x 3 = 18 kgm/s, the highest result. CLICK Therefore, the puppy has the most momentum. CLICK

Slide 13

CLICK One of the cool things about momentum is that it is conserved. CLICK Conserved means that the momentum at one point in time is the same as the momentum at any other point in time. In other words, the momentum now equals the momentum later. [write pnow=plater] In science, we like to use the words initial and final to describe this [write pi=pf] although initial and final can refer to any two time we want. CLICK

Slide 14

At this point, you are probably thinking CLICK "If momentum is mass times velocity, and you're saying momentum never changes, does that mean velocity never changes? CLICK Because I know that's not right." CLICK After all, I see things speed up and slow down all the time. CLICK [animation plays] CLICK

Slide 15

You're right that things speed up and slow down all the time. Hopefully you remember from like, the whole first month of class, that this is acceleration. CLICK And hopefully you remember from the whole second month that acceleration is caused by forces CLICK And those forces have to be outside, and unbalanced CLICK Therefore, we can conclude that outside, unbalanced forces (which cause accelerations, which are changes in velocity, which mean the momentum changed) cause changes in momentum CLICK CLICK

Slide 16

So how do we know what's an outside force and what's an inside force? CLICK Systems. CLICK You have the freedom to define a system. It can be whatever you want. What is a system, you ask? CLICK CLICK A system simply defines the line between "inside" and "outside" CLICK Any objects you decide are part of your system are on the "inside" CLICK while anything else is on the "outside" Since we can define our system to be whatever we want, we can always make a system with no outside forces. In other words, we can always make a system where momentum is conserved. CLICK

Slide 17

Our baby animals from before are going to help us look at systems. Let's start by considering the puppy as our system. [circle puppy] There are no forces acting on him, so momentum is conserved. What if we include the kitten in our system? [erase puppy circle and draw circle around puppy and kitten] There are no forces acting on the puppy or the kitten, so momentum is still conserved. Now let's make the monkey our system. [erase circle and draw one around monkey, but not banana] Notice that the banana is not part of our system [use pointer to illustrate this] The banana is an outside force acting on the monkey. Therefore, momentum is not conserved in this system. In order to get to a system where momentum is conserved, we need to expand our system to include the objects causing the outside forces. [erase monkey circle and draw circle around monkey and banana] Now the force from the banana is an inside force, and inside forces don't change the total momentum of our system. Now momentum is conserved. CLICK

Slide 18

Now let's check your understanding of systems. I'm going to draw some systems around these blocks and you're going to decide in which systems momentum is conserved. When I'm done drawing the four systems, you can pause the video to answer the question. [Circle one in one, two in another, 4 on left in another, and all in the last.] … Let's see how you did. Momentum is not conserved in the top two systems. There are forces from blocks outside the system acting on the system. [indicate this with pointer] Momentum is conserved in the bottom two systems. There are no outside forces acting on these systems. Notice that it doesn't matter whether the block on the right is included in the system or not [indicate with pointer] There are no forces on it, so it doesn't affect conservation of momentum. CLICK

Slide 19

Remember when we said an outside, unbalanced force can change momentum? CLICK That change in momentum is called impulse. CLICK If we apply some force for some amount of time, we will change the momentum by some amount. Written as an equation, this looks like this CLICK Notice that we can get conservation of momentum from this equation. If the force is zero, that is, there is no outside force, then the change in momentum will be zero, that is, momentum is conserved. CLICK

Slide 20

CLICK If we apply a larger force, that will change the momentum more. CLICK This is why cars with bigger, more powerful, engines can go faster CLICK We can also apply the force for a longer time to change the momentum more. CLICK This is why a baseball player follows through with their swing. The bat stays in contact with the ball for a longer time, causing its momentum to change more so it goes faster. CLICK

Slide 21

Time for one last question. Which of these will require the greatest force? CLICK Stopping a charging rhino in 400 s? CLICK Pushing a giraffe up to 5 m/s in 10 s? CLICK Or keeping a gorilla moving at 5 m/s for 20 s? Pause the video to answer the question. Don't forget to write an explanation. … CLICK

Slide 22

Let's take a look at each of the options. CLICK The rhino has an initial momentum of 200 x 10 = 2000 kg m/s and a final momentum of zero. CLICK Its change in momentum is 2000 kg m/s CLICK This change happens in 400 s CLICK The force is the change in momentum divided by the time. $F = (p_f - p_i) / t$ CLICK The force required to stop the rhino is 2000/400 = 5 N CLICK

Slide 23

CLICK The giraffe has an initial momentum of zero and a final momentum of 50 x 5 = 250 kg m/s Its change in momentum is 250 kg m/s CLICK This change happens in 10 s CLICK We can use the same formula to find the force as before. CLICK The force required to stop the rhino is 250/10 = 25 N CLICK Even though the giraffe's momentum changed less than the rhino's, it happened much faster, so it required a greater force. CLICK

Slide 24

And finally, we have the gorilla. CLICK The gorilla has an initial momentum of 100 x 5 = 500 kg m/s and a final momentum of 100 x 5 = 500 kg m/s CLICK Its change in momentum is zero CLICK The momentum doesn't change, so no force is required. CLICK

Slide 25

Well, that's all folks. I hope you found this video review helpful and enjoyable and good luck on your test! [stop recording]

Appendix E: Selected Screenshots from Doceri Presentation

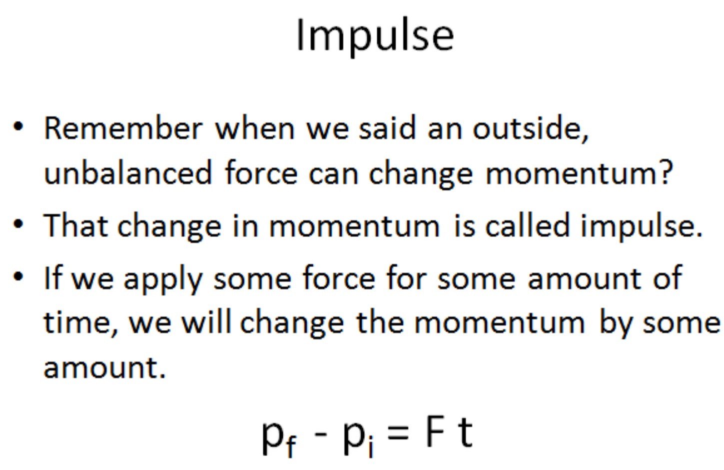


Figure 1. Slide 19

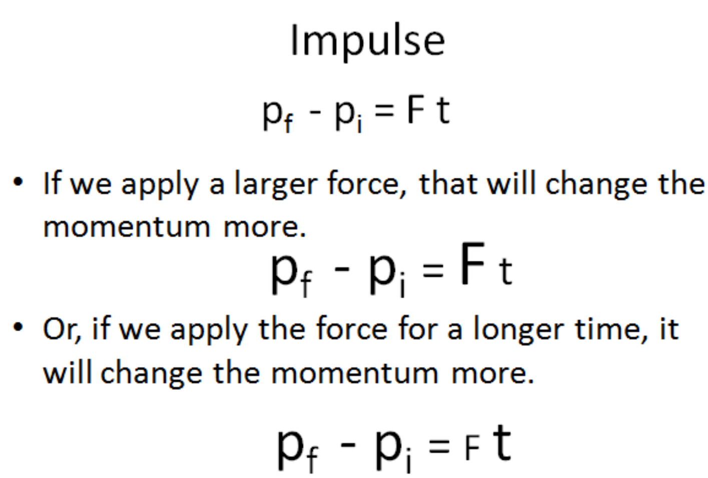


Figure 2. Slide 20

- Which will require the greatest force?
  - Stopping a 200 kg rhino charging at 10 m/s in 400 s
  - Pushing a 50 kg giraffe from rest up to 5 m/s in 10 s
  - Keeping a 100 kg gorilla moving at 5 m/s for 20 s

Figure 3. Slide 21

Pushing a 50 kg giraffe from rest up to 5 m/s in 10 s

- The giraffe has an initial momentum of zero and a final momentum of 50 x 5 = 250 kg m/s
- Its change in momentum is 250 kg m/s
- This change happens in 10 s
- The force is the change in momentum divided by the time. $F = (p_f - p_i) / t$
- The force required to stop the giraffe is 250/10 = 25 N
- Even though the giraffe's momentum changed less than the rhino's, it happened much faster, so it required a greater force.

Figure 4. Slide 23

BIBLIOGRAPHY

Abedi, J. (2008). Utilizing accommodations in assessment. *The Encyclopedia of Language and Education*, *7*, 331–348.

Abell, S. K., & Lederman, N. G. (Eds.). (2007). *Handbook of research on science education*. Mahwah, N.J: Lawrence Erlbaum Associates.

Alquraini, T., & Gut, D. (2012). Critical components of successful inclusion of students with severe disabilities: Literature review. *International Journal of Special Education*, *27*(1), 42–59.

Aron, L., & Loprest, P. (2012). Disability and the education system. *The Future of Children*, *22*(1), 97–122.

Beddow, P. A. (2012). Accessibility theory for enhancing the validity of test results for students with special needs. *International Journal of Disability, Development and Education*, *59*(1), 97–111.

Belser, C. T., Morris, J. A., & Hasselbeck, J. M. (2012). A call to action: Addressing the childhood obesity epidemic through comprehensive school counseling programs. *Journal of School Counseling*, *10*(23), n23.

Bolt, S., & Thurlow, M. (2004). Five of the most frequently allowed testing accommodations in state policy: Synthesis of research. *Remedial and Special Education;*, *25*(3), 141–152.

Bossé, M. J. (2007). Mathematically Talented Children: How Can Parents. Retrieved from http://masaflorida.org/pdf/Mathematically_Talented.pdf

Bouck, E., & Yadav, A. (2008). Assessing calculators as assessment accommodations for students with disabilities. *Assistive Technology Outcomes and Benefits*, *5*(1), 19–28.

Brand, S., & Dalton, E. (2012). Universal design for learning: Cognitive theory into practice for facilitating comprehension in early literacy. The Forum on Public Policy.

Brockelman, K. F. (2011). Faculty members' ratings of the effectiveness of academic strategies for university students with psychiatric disabilities. *Journal of Postsecondary Education and Disability*, *24*(1), 43–52.

Brown, S., Cook, B., Kelly, R., & Park, H. J. (2011). Universal design for instruction in postsecondary education: A systematic review of empirically based articles. *AHEAD*, *24*(1), 5–15.

Bunce, C., & Simaska, D. (2013, October 15). Guidelines for selection and use of accommodations for Keystone exams and PSSA tests. Pennsylvania Department of Education.

Bush, G. W. (2001). *No Child Left Behind*. US Department of Education Washington, DC. Retrieved from http://education.ucf.edu/mirc/Research/NCLB%20-%20Bush.pdf

Byrnes, M. (2008a). Educators' interpretations of ambiguous accommodations. *Remedial and Special Education*, *29*(3), 306–315.

Byrnes, M. (2008b). Writing explicit, unambiguous accommodations: A team effort. *Intervention in School and Clinic*, *44*(1), 18–24.

Cawthon, S. W. (2007). Accommodations use for statewide standardized assessments: Prevalence and recommendations for students who are deaf or hard of hearing. *Journal of Deaf Studies and Deaf Education*, *13*(1), 55–96. doi:10.1093/deafed/enm029

Cawthon, S. W., & Wurtz, K. A. (2010). Predictors of assessment accommodations use for students who are deaf or hard of hearing. *The Journal of Educational Research & Policy Studies*, *10*(1), 17–34.

Darling-Hammond, L., Rustique-Forrester, E., & Pecheone, R. (2005). *Multiple measures approaches to high school graduation*. School Redesign Network at Stanford University. Retrieved from http://216.78.200.159/Documents/RandD/Other/Multiple%20Measures%20-%20Darling-Hammond.pdf

Disability law. Individuals with Disabilities Education Act. Fourth circuit holds that parents bear the burden of proof in a due process hearing against a school district. Weast v. Schaffer, 377 F.3d 449 (4th Cir. 2004). (2005). *Harvard Law Review*, *118*(3), 1078–1085.

Dolan, R., Hall, T. E., Banerjee, M., Chun, E., & Strangman, N. (2005). Applying principles of universal design to test delivery: The effect of computer-based read-aloud on test performance of high school students with learning disabilities. *The Journal of Technology, Learning and Assessment*, *3*(7). Retrieved from http://napoleon.bc.edu/ojs/index.php/jtla/article/view/1660

Edgemon, E., Jablonski, B., & Llyod, J. (2006). Large-scale assessments: A teacher’s guide to making decisions about accommodations. *Teaching Exceptional Children;*, *38*(3), 6–11.

Elbaum, B. (2007). Effects of an oral testing accommodation on the mathematics performance of secondary students with and without learning disabilities. *The Journal of Special Education*, *40*(4), 218–229.

Elliott, S. N., Kratochwill, T. R., & McKevitt, B. C. (2001). Experimental analysis of the effects of testing accommodations on the scores of students with and without disabilities. *Journal of School Psychology*, *39*(1), 3–24.

Elliott, S. N., & Marquart, A. M. (2004). Extended time as a testing accommodation: Its effects and perceived consequences. *Exceptional Children*, *70*(3), 349–367.

Filce, H., & Lavergne, L. (2011, January 24). Educational needs and accommodations for children with bowel and/or bladder dysfunction. The University of Southern Mississippi.

Fletcher, J., Francis, D., Boudousquie, A., & Copeland, K. (2006). Effects of accommodations on high-stakes testing for students with reading disabilities. *Exceptional Children*, *72*(2), 136–150.

Fletcher, J., Francis, D., O’Malley, K., Copeland, K., Mehta, P., Caldwell, C., … Vaughn, S. (2009). Effects of a bundled accommodations package on high-stakes testing. *Exceptional Children;*, *75*(4), 447–463.

Fuchs, L., Fuchs, D., Eaton, S., & Hamlett, C. (2000). Using objective data sources to enhance teacher judgments about test accommodations. *Exceptional Children*, *67*(1), 67–81.

Fuchs, L., Fuchs, D., Eaton, S., Hamlett, C., & Karns, K. (2000). Supplementing teacher judgments of mathematics test accommodations with objective data sources. *School Psychology Review*, *29*(1), 65–85.

Gaona, J. (2004). The effects of the No Child Left Behind Act on career and technical education: Implications for students with special needs. Retrieved from http://scholar.lib.vt.edu/ejournals/JITE/v41n2/gaona

Gartland, D., & Strosnider, R. (2004a). NJCLD Position Paper: State and District-Wide Assessments and Students with Learning Disabilities: A Guide for States and School Districts. *Learning Disability Quarterly*, *27*(2), 67–76.

Gartland, D., & Strosnider, R. (2004b). State and district-wide assessments and students with learning disabilities: A guide for states and school districts. *Learning Disability Quarterly*, *27*(2), 67–76.

Hamilton, K., & Kessler, E. (n.d.). Accommodations and modifications: Wait, they're not the same? National Dissemination Center for Children with Disabilities. Retrieved from http://nichcy.org/accommodations-and-modifications

Harrison, J., Bunford, N., Evans, S., & Sarno Owens, J. (2013). Educational accommodations for students with behavioral challenges: A systematic review of the literature. *Review of Educational Research*, *83*(4), 551–597.

Howard, L. A., & Potts, E. (2013). *Including students with disabilities in advanced science classes*.

Irving, M., Nti, M., & Johnson, W. (2007). Meeting the needs of the special learner in science. *International Journal of Science Education*, *22*(3), 109–118.

Jiang, X., & Grabe, W. (2007). Graphic organizers in reading instruction: Research findings and issues. *Reading in a Foreign Language*, *19*(1), 34–55.

Jindal-Snape, D., Douglas, W., Topping, K. J., Kerr, C., & Smith, E. F. (2005). Effective education for children with autism spectrum disorder: Perceptions of parents and professionals. *INTERNATIONAL JOURNAL OF SPECIAL EDUCATION*, *20*(1), 77–87.

Jordan, A. (2009, April 20). Appropriate accomodations for individual needs allowable by state guidelines. UNIVERSITY OF CINCINNATI.

Kieffer, M. J., Lesaux, N. K., Rivera, M., & Francis, D. J. (2009). Accommodations for English language learners taking large-scale assessments: A meta-analysis on effectiveness and validity. *Review of Educational Research*, *79*(3), 1168–1201. doi:10.3102/0034654309332490

Lazarus, S. S., Thurlow, M. L., Lail, K. E., & Christensen, L. (2008). A longitudinal analysis of state accommodations policies: Twelve years of change, 1993--2005. *The Journal of Special Education*, *43*(2), 67–80. doi:10.1177/0022466907313524

Lewandowski, L., Cohen, J., & Lovett, B. J. (2013). Effects of extended time allotments on reading comprehension performance of college students with and without learning disabilities. *Journal of Psychoeducational Assessment*, *31*(3), 326–336. doi:10.1177/0734282912462693

Lewandowski, L. J., Lovett, B. J., Parolin, R., Gordon, M., & Codding, R. S. (2007). Extended time accommodations and the mathematics performance of students with and without ADHD. *Journal of Psychoeducational Assessment*, *25*(1), 17–28. doi:10.1177/0734282906291961

Lewandowski, L. J., Lovett, B. J., & Rogers, C. L. (2008). Extended time as a testing accommodation for students with reading disabilities does a rising tide lift all ships? *Journal of Psychoeducational Assessment*, *26*(4), 315–324. doi:10.1177/0734282908315757

Lewandowski, L., Lambert, T. L., Lovett, B. J., Panahon, C. J., & Sytsma, M. R. (2014). College students' preferences for test accommodations. *Canadian Journal of School Psychology*, *29*(2), 116–126. doi:10.1177/0829573514522116

Lovett, B. J. (2010). Extended time testing accommodations for students with disabilities: Answers to five fundamental questions. *Review of Educational Research*, *80*(4), 611–638. doi:10.3102/0034654310364063

McEachern, A. G., McEachern-Ciattoni, R. T., & Martin, F. (2012). Sexting: New challenges for schools and professional school counselors. *Journal of School Counseling*, *10*(20), 2012.

Morales, M. (2011). An exploration of equitable science teaching practices for students with learning disabilities. The Florida State University.

Neal, T. (2012). Teachers' knowledge and participation in choosing student accommodations. Walden University.

Newman, L., & Gonzalez, P. (2006). Facts from NLTS2 July 2006. Retrieved from http://www.nlts2.org/fact_sheets/nlts2_fact_sheet_2006_07.pdf

O'Brien, S. (2014). The game has changed: do accommodations level the playing field, or alter the sport?

Ofiesh, N., & Highes, C. (2002). How much time? A review of the literature on extended test time for postsecondary students with learning disabilities. *Journal of Postsecondary Education and Disability*, *16*(1), 2–16.

Pariseau, M. E., Fabiano, G. A., Massetti, G. M., Hart, K. C., & Pelham, W. E. (2010). Extended time on academic assignments: Does increased time lead to improved performance for children with attention-deficit/hyperactivity disorder? *School Psychology Quarterly*, *25*(4), 236–248. doi:10.1037/a0022045

Pennsylvania Department of Education. (2013, November 12). Accommodations guidelines. Retrieved from http://www.whsd.org/uploaded/documents/district/profdev/2014_Accommodations_Guidelines.pdf

Phillips, S. E. (1994). High-stakes testing accommodations: Validity versus disabled rights. *Applied Measurement in Education*, *7*(2), 93–120. doi:10.1207/s15324818ame0702_1

Richie, G. (2005). Two interventions that enhance the metacognition of students with disabilities: Cognitive cue cards and correspondence training. *Kairaranga*, *6*(2), 25–32.

Salend, S. J. (2008). Determining appropriate testing accommodations: Complying with NCLB and IDEA. *Teaching Exceptional Children*, *40*(4), 14–22.

Scanlon, D., & Baker, D. (2012). An accommodations model for the secondary inclusive classroom. *Learning Disability Quarterly*, *35*(4), 212–224. doi:10.1177/0731948712451261

Scarpati, S. E., Wells, C. S., Lewis, C., & Jirka, S. (2009). Accommodations and item-level analyses using mixture differential item functioning models. *The Journal of Special Education*, *45*(1), 54–62. doi:10.1177/0022466909350224

Selfridge, K., & Kostewicz, D. (2011). Reading Interventions for Four Students With Learning Disabilities. *Precision Teaching and Celeration*, *27*, 19–24.

Sireci, S., Scarpati, S., & Li, S. (2005). Test accommodations for students with disabilities: An analysis of the interaction hypothesis. *Review of Educational Research*, *75*(4), 457–490.

Souma, A., Rickerson, N., & Burgstahler, S. (2006). *Academic accommodations for students with psychiatric disabilities*. DO-IT, University of Washington. Retrieved from http://www.sos.wa.gov/library/docs/uw/psych_2008_003850.pdf

Stanford, B., & Reeves, S. (2009). Making it happen: Using differentiated instruction, retrofit framework and universal design for learning. *Teaching Exceptional Children Plus*, *5*(6), 4.

Suritsky, S. (1993). Notetaking difficulties and approaches reported by university students with learning disabilities. *Journal on Postsecondary Education*, *10*(1).

The nation's report card: Trends in academic progress 2012. (2013). U.S. Department of Education.

Thurlow, M., & Bolt, S. (2001). *Empirical support for accommodations most often allowed in state policy. Synthesis report* (No. 41). Technical Report 34). Minneapolis, MN: University of Minnesota, National Center on Educational Outcomes. Retrieved from http://www.cehd.umn.edu/NCEO/OnlinePUbs/TechReport34.pdf

Tindal, G., & Fuchs, L. (2000). *A summary of research on test changes: An empirical basis for defining accommodations*. Mid-South Regional Resource Center. Retrieved from http://www.specialed.us/discoveridea/topdocs/msrrc/Tindal%26Fuchs.PDF

Trammell, J. (2011). Accommodations for multiple choice tests. *AHEAD*, *24*, 251.

U.S. Department of Education. (2010). *29th Annual report to Congress on the implementation of the Individuals with Disabilities Education Act, 2007* (pp. 1–476). Washington, DC: Author.

Weinfeld, R., Barnes-Robinson, L., Jeweler, S., & Roffman Shevitz, B. (2005). Enabling or empowering? Adaptations and accommodations for twice-exceptional students. *TEACHING Exceptional Children Plus*, *2*(1), 6.

Zuriff, G. E. (2000). Extra examination time for students with learning disabilities: An examination of the maximum potential thesis. *Applied Measurement in Education*, *13*(1), 99–117. doi:10.1207/s15324818ame1301_5

ACADEMIC VITA

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EDUCATION:

The Pennsylvania State University — University Park, PA
B. S. in Physics with a Minor in Mathematics
M. Ed. in Curriculum & Instruction with Science Education emphasis
Intend to graduate May 2015

STUDENT TEACHING:

Linked Pre-Service/Student Teaching — Spring 2014, Fall 2014
Bellwood-Antis High School — Bellwood, PA

- Taught Academic Physics, Applied Physics, and Energy and Environment
- Used formative assessment to guide instructional decisions
- Performed teacher duties such as planning lessons, grading, attendance, etc.

RELATED EXPERIENCE:

Curriculum Mentor — Summer 2014
Science-U — State College, PA

- Facilitated learning in small group of children in a summer science camp
- Managed behavior while creating an exciting learning experience

Instructor — Dec 2013-Aug 2014
Mathnasium — State College, PA

- Tutored K-12 students in Math
- Utilized a “teach and move on” method to foster student independence

Teaching Intern — Summer 2013
MIT Teaching Opportunities in Physical Science Program — Cambridge, MA

- Planned a curriculum
- Taught physics to middle and high school students

Laboratory Teaching Assistant Fall 2012 –Spring 2013
Pennsylvania State University University Park, PA

- Assisted students in introductory physics classes with laboratory activities
- Graded student lab reports and promptly recorded grades

Peer Tutor Fall 2011 – Spring 2012
Penn State Schuylkill Center for Academic Excellence Schuylkill Haven, PA

- Conducted individual and group tutoring sessions in math, physics, chemistry, etc.
- Completed and submitted documentation to faculty

EMPLOYMENT:

Researcher Summer 2012
Penn State Research Experience for Undergraduates Program University Park, PA

- Constructed and implemented cosmic ray detectors
- Worked with others in a laboratory group setting
- Assisted in organizing a convention on particle astrophysics for high school teachers

ACTIVITIES AND AWARDS:

Member of Phi Beta Kappa

Member of Penn State's Schreyer Honors College

Member of Sigma Pi Sigma Physics Honor Society

Presented poster session, "Easy Java Simulations in First Semester Physics" at American Association of Physics Teachers conference, March 2011

Assisted physics professor with summer Science Scholars program "Amusement Park Physics," June 2011

Penn State Schuylkill Academic Leader Scholarship recipient

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