ANALYZING AP SYLLABI FOR PROBLEM SOLVING, AUTHENTIC LEARNING,

AND

COLLABORATIVE LEARNING

PRACTICES

by

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DISSERTATION ABSTRACT

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Title: Analyzing AP Syllabi for Problem Solving, Authentic Learning, and Collaborative Learning Practices

A rubric was used to determine the frequency of college-readiness practices of Problem Solving, Authentic Learning, and Collaborative Learning present in Advanced Placement Calculus and English syllabi. Chi square tests were conducted and determined Problem Solving, Authentic Learning, and Collaborative Learning were found significantly more often in the English syllabi than in the Calculus syllabi. Problem Solving and its subcomponents understanding the problem and strategizing, as well as the Collaborative Learning subcomponent dialogue, were found in the English syllabi more than in the Calculus syllabi. The Collaborative Learning subcomponent reciprocal teaching was found more frequently in the English Literature and Composition syllabi while peer review was found most often in English Language and Composition syllabi and not analyzed for its presence in the Calculus syllabi. No significant differences were found between subjects for the Problem Solving subcomponent hypothesizing, Authentic Learning or any of its subcomponents, nor the Collaborative Learning subcomponents using out of class time for study group learning or group projects.

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CHAPTER I

INTRODUCTION

Statement of the Problem

Secondary schools around the country have come under attack for their inability to prepare students adequately for life after high school. A study by Achieve (2004) found no state adequately prepared their high school students for life after graduation. High School diplomas no longer provide all the skills necessary to land jobs offering upward mobility (Achieve, 2007). In 1950 73% of jobs were classified as unskilled. In 2002 only 30% were labeled as such. The remaining 70% of the jobs were skilled or professional jobs requiring higher levels of education and training (Achieve, 2007), demonstrating the importance of preparing students to meet postsecondary expectations regardless of whether students pursue educational or work goals following graduation. Wendler et al. (2012) report that "between 2010 and 2020, about 2.6 million new and replacement jobs are expected to require an advanced degree" (p. 2). Studies indicate that the same skills are needed by high school graduates to succeed in both college and the workplace, and what was once considered college preparation is now needed for all (Achieve, 2007; Carnevale & Desrochers, 2003).

A nationwide study conducted by the National Center of Education Statistics (NCES, 2003) found that in 2000 remediation rates at the postsecondary level reached 28%, proving secondary institutions were not preparing 28% of the students for postsecondary coursework. Postsecondary education remediation rates are important because the likelihood of degree completion decreases when students require remedial courses (American Diploma Project, 2004). Many students are attending college but

currently half of these students require remedial courses, which is a strong predictor for failure of undergraduate degree completion (Adelman 1999, 1999a & 2006; Camara, 2003; The College Board, 2009; NCES, 2003). Only half (53%) of the students enrolled in college finish their undergraduate degree within six years, and about a quarter (23%) do not complete a degree and are no longer enrolled after six years of college enrollment (Adelman 1999, 1999a & 2006; Camara, 2003; The College Board, 2009; NCES, 2003). Carnevale and Desrochers (2003) report that two-thirds of the new jobs in the next decade will require additional education or training beyond the high school diploma, yet the business community and post-secondary institutions report high school graduates do not enter postsecondary education prepared to perform expected activities (Achieve, 2007 & 2007a; Conley, 2003). To compete for available jobs, students must have the skills needed to succeed in this post-high school training.

Although not all students may choose to attend college, college graduates will usually earn higher annual incomes than those of workers who have only a high school diploma (Carnevale & Desrochers, 2003). "Advanced education levels continue to be associated with lower unemployment rates and higher salaries" (Wendler et al., 2012, p. 2), so students who receive better preparation for meeting post-secondary education requirements may be more likely to complete their undergraduate degrees and earn the higher income needed to support themselves and their families. Thus students must have the skills needed to succeed in such post-high school training to compete for available jobs. In order for secondary schools to improve postsecondary outcomes for students, however, secondary school instruction must change.

Addressing the Problem

To improve student preparation for post-secondary performance requirements, states have made a variety of changes. Some states have increased graduation requirements to increase the rigor and relevance of high school curricula (Achieve, 2007 & 2007a). One strategy for strengthening secondary education graduation requirements involves increasing the academic rigor in required courses. Research has shown that increasing academic rigor in high school helped close the gap between student performance in the United States and student performance abroad (American Federation of Teachers (AFT), 1999). In the workplace, increasing rigor at the secondary education level is believed to help graduates meet the increasing skills demanded on the job (Carnevale & Desrochers, 2003). By increasing rigor, students are better able to improve their performance and meet postsecondary career demands.

Increasing rigor in high school also has positive results in postsecondary education outcomes. Increasing rigor for high school students improves their postsecondary outcomes in several ways. Research identifies improving the rigor of high school courses as one method for increasing the likelihood of postsecondary degree completion (Adelman, 2006; Dounay, 2006). The better prepared students are to meet post-secondary education requirements, the more likely they will be to complete their undergraduate degrees and increase their competitiveness in the job market. Implementing Advanced Placement (AP) programs is one method for high schools to increase curricular rigor and improve postsecondary outcome for their students.

History of AP

The AP program began in 1952 to address several challenges in public education. One element of the AP program involved engaging students who were dropping out of high school due to boredom. The AP program was designed to provide students more challenging, college-level coursework thus increasing their engagement in secondary school curriculum and keeping them out of the work force during a time when jobs were scarce (Blackner et al., 1952). This coursework was originally intended for a few elite students, not as support for curricular reform for all students (Blackner et al., 1952). Only the most talented students were expected to participate in the AP program.

Another purpose of the AP program concerned minimizing repetition for college freshman and sophomores once they transitioned from secondary to postsecondary education institutions. Some students were finding their high schools prepared them extremely well for college coursework, unfortunately resulting in repetition and boredom during their first two years of college (Rothschild, 1999). Consequently, many students dropped out of college and pursued interests other than postsecondary education. The AP program allowed students to take an exam at the end of an AP course, or without taking a course at all, and if a score of three (3) or higher was earned they could be granted college credit for an entry level course in that subject. Earning a score of three (3) or higher on the AP exam eliminated the need for students to repeat the course in college, allowing them to enroll in more challenging coursework at the beginning of their college career and increasing the likelihood that they would complete their degree. AP courses better prepare students for college academic work requirements by offering college level

courses to high school students. Incorporating AP courses in high school is one strategy for improving students' postsecondary success.

Importance of High Quality Syllabi

Attention has been turned to the effectiveness of using high quality syllabi as a tool for improving student success in secondary and postsecondary coursework (Bottoms, Pucel, & Phillips, 1997; O'Brien, Millis, & Cohen , 2008). High quality syllabi provide students with explicit information describing the skills and outcomes they will need to succeed in the course. This may include information about the key learning objectives as well as detailed schedules of activities (O'Brien, Millis, & Cohen, 2008). Including learning objectives in high quality syllabi help instructors develop the best instructional strategy for helping students meet the declared objectives (Arreola, 1998). Learning objectives help instructors think more deeply about what strategies they want students to use before the course even begins. Once instructors identify the learning objectives for their course, they then identify the objectives in the syllabus (Arreola, 1998).

Detailed schedules of activities throughout the course are also present in high quality syllabi. Clarifying the activities in which students will be expected to participate while they work towards meeting the learning objectives improves the likelihood of their success. Students may be expected to engage in problem solving activities, including participation in assignments that require them to actively engage with the material or collaborate with peers (Bottoms, Pucel, & Phillips, 1997; O'Brien, Millis, & Cohen, 2008). The more information students have at the beginning of a course, the more likely they will be able to meet instructor expectations.

If high quality syllabi include detailed description of activities required for students, best practices that support student success should be found on the syllabi. Researchers have identified many teaching and learning strategies that promote student success. Three learning activities that show up in the research together are those of Problem Solving, Authentic Learning, and Collaborative Learning. When each of these learning activities are described in the literature, examples of best practices for each one often include descriptions of all three styles. King (1994) describes Problem Solving groups that incorporate peer collaboration (Collaborative Learning) while using experience based questioning (Authentic Learning) as a best practice for increasing student comprehension and student success. Situated cognition learning theorists state that all learning is situated in context, which is socially and culturally defined (Brown, Collins & Duguid, 1989). Using ordinary practices of culture to teach new concepts (Authentic Learning), especially within collaborative Problem Solving groups that require students to reflect on and evaluate new information, results in better understanding of this new information (Brown, Collins & Duguid, 1989). Freire (1970) also describes problem-posing education that incorporates collaboration and connects to students' lives outside of school (Authentic Learning) as being the most successful strategy for teaching.

If high quality syllabi include detailed description of activities required for students, evidence should be present in the syllabi describing activities involving Problem Solving, Authentic Learning, and Collaborative Learning. Research shows incorporating Problem Solving activities in to instruction improves students' postsecondary success (Hiebert et al., 1996; Higgins, Flower, & Petraglia, 1992; Kolb, 1984; Webb et al., 2008).

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Chaffee (1992) highlights the need for students entering college to possess critical thinking skills, with Problem Solving skills described as one of those essential skills. Both Chaffee (1992) and Boylan (2002) encourage teaching students these skills prior to postsecondary education experiences to better prepare students for success. When Authentic Learning and Collaborative Learning activities are combined with these Problem Solving activities, success increases still further (Brown, Collins & Duguid, 1989; Kolb, 1984; Lave & Wenger, 1991; Newmann & Wehlage, 1993; Webb et al., 2008).

Definitions and descriptions of Collaborative Learning vary, but usually include some aspect of Problem Solving within a group of peers (Boylan, 2002; Chaffee, 1992; Gross & Kientz, 1999). Authentic Learning definitions also may vary by author, but common components include the use of Problem Solving strategies to resolve real-world problems (Boylan, 2002; Chaffee, 1992; Freire, 1970; Gross & Kientz, 1999; Newmann & Wehlage, 1993; Stein, Isaacs, & Andrews, 2004; Tochon, 2000). Both Authentic Learning and Collaborative Learning strategies incorporate Problem Solving. While each of these learning styles increase student success on their own, when used together these best practices become even more effective.

If postsecondary instructors are encouraged to create high quality syllabi for their courses, then AP teachers offering courses that offer college-level instruction in a high school setting should also be encouraged to create high quality syllabi. If AP courses use high quality syllabi, evidence of best practices such as Problem Solving, Authentic Learning, and Collaborative Learning should be found in the syllabi even though students will not be evaluated on these learning styles on the AP exam at the end of the course.

Examining AP syllabi for evidence of Problem Solving, Authentic Learning, and Collaborative Learning may illuminate how these best practices are being implemented in AP courses.

In my review of AP syllabi for evidence of Problem Solving, Authentic Learning, and Collaborative Learning, I plan to focus my research on the following questions:

1. To what degree will entry-level college curricula taught in the College Board's Advanced Placement courses in Calculus AB show evidence of Problem Solving (as demonstrated in the syllabi authored by teachers of the courses).

2. To what degree will entry-level college curricula taught in the College Board's Advanced Placement courses English Language and Composition and English Literature and Composition show evidence of Problem Solving (as demonstrated in the syllabi authored by teachers of the courses).

3. To what degree will entry-level college curricula taught in the College Board's Advanced Placement courses in Calculus AB show evidence of Authentic Learning (as demonstrated in the syllabi authored by teachers of the courses).

4. To what degree will entry-level college curricula taught in the College Board's Advanced Placement courses English Language and Composition and English Literature and Composition show evidence of Authentic Learning (as demonstrated in the syllabi authored by teachers of the courses).

5. To what degree will entry-level college curricula taught in the College Board's Advanced Placement courses in Calculus AB show evidence of Collaborative Learning (as demonstrated in the syllabi authored by teachers of the courses).

6. To what degree will entry-level college curricula taught in the College Board's Advanced Placement courses English Language and Composition and English Literature and Composition show evidence of Collaborative Learning (as demonstrated in the syllabi authored by teachers of the courses).

7. To what degree will the frequency of the three learning types (Problem Solving, Collaborative Learning, Authentic Learning) differ between AP Calculus and AP English.

8. To what degree are there differences in how evident these practices are in either subject area (Calculus or English).

CHAPTER II

LITERATURE REVIEW

Importance of Problem Solving in Curricula

The importance of Problem Solving in the preparation for post-secondary education has been well-documented. While the reasoning may change, the definition of Problem Solving remains fairly stable.

Problem Solving Skills Defined

The definitions for Problem Solving identify three major themes to the Problem Solving process. A focus on the process and strategies used in Problem Solving emerges most frequently in the definitions of Problem Solving. In addition, the potential for multiple correct strategies appears to be important to the process of Problem Solving and its effectiveness as a learning tool. The third major theme to emerge from the literature defining Problem Solving is the importance of identifying obstacles or barriers to the Problem Solving process.

Process/strategies. One way that Problem Solving has been defined is by focusing on the process and/or strategies used to solve problems. One of the first mathematicians to explicitly explain the Problem Solving process involved in mathematics, Polya (1945, 1962) defines Problem Solving as having three key phases: understanding the problem, making a plan, and carrying out the plan. Suggested strategies for understanding the problem include looking at the problem from various perspectives, and restating the problem (Polya 1945; 1962). By stating the problem in a different way, students are better able to understand all the components involved in solving the problem and less likely to get blocked by failing to account for potential

barriers these components may cause. The next phase of the Problem Solving process requires making a plan to solve the problem by looking for patterns and identifying possible strategies for finding a solution (Polya, 1945; 1962). In mathematical Problem Solving, as well as in other subject areas, looking for patterns in how components of a problem are connected can help students identify potential solutions. Polya (1945, 1962) emphasizes the importance of considering multiple strategies in this process, as well as an understanding that there is not likely only a single solution that could yield correct results. The third major phase of Polya's (1945, 1962) process involves the student carrying out the plan by checking work completed, reviewing the work for errors, and discussing the solutions with fellow students. For students to better comprehend the knowledge gained in the Problem Solving process, verbally processing the information with a peer or instructor is necessary.

Polya's Problem Solving phases are reflected in other researchers' definitions of Problem Solving. To better understand the skills needed for students to succeed in post-secondary education, research by the Educational Policy Improvement Center (EPIC) identifies Problem Formulation as one of five strategies that lead to student success (EPIC, n.d.). Problem formulation is defined by EPIC as a process requiring students to hypothesize and strategize by demonstrating that they clearly understand the problem; generate possible solutions to the problem; and devise strategies for solving all parts of the problem (EPIC, n.d.). This definition overlaps with Polya's process in many ways, including the importance of understanding the problem and generating multiple solution strategies.

The potential for multiple correct strategies. Building on Polya's emphasis that multiple strategies to solving the problem may exist, Brown, Collins and Duguid (1989) describe Problem Solving as a process that supports thinking most effectively when more than one solution strategy exists. This requires students not just search for the one correct answer, but weigh their options and predict the success of all potential strategies. At the college level, Davis (1993) defines Problem Solving similarly as a process that supports multiple strategies for reaching a solution and challenges students more than learning processes where only one correct answer exists. Rittle-Johnson and Star (2007) also researched 7th grade students' math performance when comparing and contrasting multiple correct strategies to see which solution best fits each problem, an instructional approach supported by research in cognitive science. This aspect of Problem Solving in regards to multiple correct strategies adds another dimension to the definition of Problem Solving in curricula.

Identifying obstacles. Marzano and Kendall (2007) Define Problem Solving as not just the process of overcoming the obstacles to accomplishing a specific task, but also identifying alternative strategies to these obstacles, evaluating these possible strategies, then selecting and implementing the most likely solution to the problem. Similarly, other authors define Problem Solving as a process that involves assessing the task, as well as potential strategies for approaching the task (Higgins, Flower, & Petraglia, 1992). Marzano, Pickering and Pollock (2001) define the Problem Solving process as involving the skills of generating and testing hypotheses, as well as predicting potential solutions. They describe a framework for this process that overlaps significantly with Polya's phases of problem-solving: Identifying the goal, describing barriers, developing solutions

for overcoming the barriers and hypothesizing likely solutions, implementing potential

solutions, and explaining whether the hypotheses are correct (Marzano, Pickering, &

Pollock, 2001). If the current solution does not yield the desired results, students must

engage in this process again until the desired results are obtained. Justifying the Problem

Solving process selected, as well as the solution reached, are important components

involved in identifying and overcoming barriers to potential solutions.

Problem Solving Instruction: Teaching Practices Defined

Incorporating Problem Solving activities in the classroom has been called

different names, but each of the definitions refers to the practice of assigning students a

problem to solve to further their learning. Some authors call this problem-posing

education (Freire, 1970), while others frame the practice as the problem based approach

(Hiebert et al., 1996). Problem centered instruction is yet another way of describing how

students are immersed in complex problems that they must analyze and solve together

despite multiple possible ways of resolving the problem (Smith & MacGregor, 1992).

Benefits of Including Problem Solving in Curricula

Incorporating Problem Solving activities into teaching practices can produce

increases in student motivation, comprehension, and achievement. The use of Problem

Solving activities has also been shown to increase student readiness for postsecondary

activities.

Increased motivation, comprehension, and achievement. Literature shows that

using Problem Solving activities in the classroom benefits the students by increasing

learning potential in a variety of ways. While teachers can choose from multiple teaching

strategies in the classroom, Freire (1970) writes about the dangers of classrooms that

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focus on lecture and reading as the only forms of or the majority of learning activities. Teachers relying on this style of teaching are at risk for decreasing motivation and student empowerment (Freire, 1970). Students may lose interest and wonder why they should even try to succeed in the classroom if the learning activities do not seem relevant to their current or future lives. One strategy for increasing student motivation and engagement is to include Problem Solving activities. Freire (1970) writes that through the encouragement of critical thinking with problem-posing methods, students' motivation and participation will increase. If students are more motivated to participate in their academic coursework, they will likely learn the content more deeply and develop a better understanding of the material.

Increasing comprehension and understanding of course content is important for student success in both K-12 and postsecondary education. Block and Duffy (2008) report that the strategy of prediction, one component of the Problem Solving process, has been researched and validated to be highly successful for reading comprehension. Increasing comprehension can also positively impact student academic achievement. The better students are able to understand the material in their coursework, the more likely they are to be able to perform the academic activities required and increase their academic achievement. Problem Solving activities involving student reflection in the planning stages of writing increase the quality of the writing plans, resulting in higher quality writing assignments that better meet teacher requirements (Higgins, Flower, & Petraglia, 1992). Activities that include sustained student reflections on writing such as evaluating the plan for strengths and weaknesses, testing these plan options and considering alternate plans, and justifying plans helped increase student achievement

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(Higgins, Flower, & Petraglia, 1992). These reflection activities are all components of Problem Solving and demonstrate how Problem Solving activities can increase student achievement. As their motivation and achievement increase, students are better able to apply their knowledge to other coursework, increasing their preparation to succeed at the postsecondary level.

Schlais & Davis (2001) report that Problem Solving activities increase student performance in several ways. As students engage in Problem Solving activities, they perceive the concepts involved more deeply and develop more understanding about the topic (Hiebert et al., 1996). Students can read and hear new information about a topic, but this information must be acted upon somehow before the information transforms in to knowledge (Kolb, 1984; Polya, 1962). Problem Solving activities provide an opportunity for students to turn this information into knowledge. With deeper understanding and better comprehension of the material, students' ability to transfer this new knowledge to other disciplines also increases (Polya, 1962).

As students explain their Problem Solving process and justify solutions reached in the activity, they internalize the information (Webb et al., 2008). With internalization of the principles and concepts taught, student comprehension and ability to transfer this knowledge to other situations also increases (Webb et al., 2008). One way to do this in math courses is to provide students with the opportunity to compare and contrast multiple correct solutions to mathematical problems. Rittle-Johnson and Star (2007) found that 7th grade students who had this opportunity were better able to transfer newly gained conceptual knowledge to new situations and made larger learning gains than peers who viewed potential solutions to problems one at a time. Incorporating these Problem

Solving activities in the classroom benefits student learning and can result in higher comprehension.

The opportunity to explain their thinking during Problem Solving activities also helps students correct any errors in their thinking, strengthening their understanding in a way that just giving the answer without justification may not (Webb et al., 2008). A positive relationship was found between students explaining their thinking and student achievement in a 2005 study by Veenman, Denessen, van den Akker, and van der Rijt. The more opportunities a student has to explain the thinking behind responses, the higher student achievement results. Webb et al. (2008) also found a near zero/negative relationship between opportunities for students to provide answers only without explaining the thinking behind responses and student achievement. The opportunity for students to explain their thinking is positively related to achievement and demonstrates the importance of engaging in Problem Solving activities in education (Webb et al., 2008). Explaining students' thinking behind their responses not only gives them a chance to fix conceptual errors, but also provides a chance to students to rework the problem after explanation (Webb et al, 2008). This process increases student understanding and provides an opportunity for increased student achievement.

These findings demonstrate the importance of providing activities, such as Problem Solving activities, to offer students opportunities to explain the thinking behind their process and justify their responses. With increased opportunity to explain their thinking, student achievement can also increase. Problem Solving activities can better prepare students for success at the next level of their education by increasing their comprehension of material covered, and increase the students' ability to apply concepts

learned in one course to other courses within the same or even different disciplines. Increasing students' abilities to transfer knowledge from high school courses to college courses will improve students' success at the postsecondary level. By utilizing Problem Solving activities in high school courses, students will leave high school better prepared to succeed in college.

Direct impact on college readiness. One solution to the problem schools face in preparing students for postsecondary success has been increasing the rigor of high school coursework. Chaffee (1992) identifies activities for increasing the rigor of college courses that include Problem Solving activities; developing and evaluating ideas; analyzing work and assessing it for a reasonable logic chain; looking at a problem from multiple perspectives; applying knowledge learned in one situation to a variety of new situations; and becoming aware of one's own thinking process in order to correct errors and better direct thinking to more suitable results. Each of these activities can also increase the rigor in high school coursework and can be the result of Problem Solving activities, as stated previously. The more Problem Solving activities are utilized, the more likely students will benefit from increased motivation, comprehension, and achievement. Activities that increase the rigor in post-secondary courses will also increase the rigor in AP courses. Including more of these problem-solving activities will provide students the opportunity to practice these skills, increasing students' success at the post-secondary level.

Direct impact on postsecondary success including the workplace. Employers report dissatisfaction with the quality of employee they are finding on the market (Achieve, 2007 & 2007a; Achieve & Jobs for the Future, 2004). Kolb (1984) reports that whether workers come straight from high school or after college, the employees have

difficulty solving problems on their own if they have not learned how to deal with that one specific issue (Kolb, 1984). Education environments that teach students there is always one correct answer can stifle employees from using creative strategies for solving problems on the job (Kolb, 1984). One of the best ways to learn how to think creatively in a Problem Solving situation is to participate in a real-world experience where the student is expected to apply the knowledge they already have to a new situation with which they are not familiar (Schon, 1987). Research by Mevarech and Werner (1985) finds that experiential learning is the most efficient way to develop Problem Solving skills, with the highest Problem Solving score occurring when an experiential learning task was used. It is difficult to teach students to solve problems creatively, but through experience, and reflection on this experience, students can slowly learn how to apply the abstract theory learned in school to real-world situation (Schon, 1983 & 1987). Reflection helps students and employees think about why they chose to act in a certain manner and how to improve their performance in the next situation, increasing their understanding, comprehension and transfer of knowledge to similar future situations (Schon, 1983). Reflection can therefore improve performance and potentially employer satisfaction.

If students have the opportunity to practice these skills early and use them in K-12 coursework, they will be better able to comprehend knowledge from courses which will better transfer to postsecondary courses, increasing success in college. Being able to think and problem-solve in a variety of different ways helps graduates not only succeed in their career of choice, but also helps them change careers easily at a later date (Kolb, 1984). As students' comprehension and transfer of knowledge increases through Problem Solving activities, their potential for success in multiple careers also increases. Because

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Problem Solving has proven essential to people in both the workplace and school, postsecondary institutions place a great deal of importance on teaching Problem Solving skills (Schon, 1983). Both acceptance into college and the hiring process for most jobs evaluate a candidate's Problem Solving ability (Chen, 2008), and for this reason it is crucial that Problem Solving skills be taught in the lower levels of education. High school and AP courses that provide multiple Problem Solving opportunities, especially those with real-world applications, will likely improve postsecondary success for graduates.

Authentic Learning

Authentic Learning practices prepare students for life after high school. Research and literature show that success in the adult world, or life after high school, requires problem-solving skills. The benefits of Problem Solving activities in the classroom can increase when paired with Authentic Learning (Hart, 1983; Kolb, 1984; Lave & Wenger, 1991; Mevarech & Werner, 1985; Polya, 1945 & 1962; Schon, 1983& 1987; Turner & Paris, 1995; Webb et al., 2008).

Authentic Learning Defined

Merriam-Webster's Dictionary ("Authentic", n.d.) defines authentic as "not false or imitation; actual, real; true to one's own personality, spirit, or character". For learning activities to be considered authentic, they need to provide one or more of the following opportunities throughout the course of the activity: Active or experiential activities, connection to student lives outside of school, and/or an opportunity to engage in activities that professionals in the real-world engage in during their work activities.

Active or experiential learning. Situated learning theorists believe that all meaning assigned to new information results from an ongoing negotiation between the

student, their world outside of school, activity, and the student's individual learning process (Lave & Wenger, 1991). Transforming new information into knowledge requires a constant interaction between understanding and experience with this new information (Lave & Wenger, 1991). Situated learning theorists consider knowledge acquisition an ongoing activity rather than the result of universal learning mechanisms that work for all students, regardless of students' abilities to assimilate new information (Lave & Wenger, 1991). To apply situated learning theories of knowledge acquisition, teachers must focus on strategies to increase student participation through active learning and consider the student's socio-cultural community by individualizing or differentiating instruction for all students (Lave & Wenger, 1991). Authentic Learning provides teachers the opportunity to individualize instruction by giving students activities in which they can apply new information. As students apply the information in their own unique ways, teachers have the opportunity to identify and support knowledge acquisition processes that need support. Providing students individualized instruction and support through these Authentic Learning activities better prepares students for postsecondary success and increases their learning potential.

Students learn more when they are actively engaged with the material (Freire, 1970). Hands-on activities that require application of new knowledge fit in to this category of Authentic Learning (Stone, 2004). Hart (1983) reports that student learning results are better if students experience learning in their own random way, rather than sitting in a classroom engaging in a linear step by step process. Situated learning theorists reject the idea that learning can be separated from action, and accept that to maximize learning students must perform rather than just talk about the knowledge in the classroom

(Lave & Wenger, 1991). Similarly, Freire (1970) states that students learn more in the classroom if they are actively participating in their education. This means that students who are applying the knowledge learned may be getting more out of their education than students learning in a traditional lecture-based education model. Students must practice new ideas in order to really learn them (Freire, 1970). When students are directly involved in creating their own learning rather than being passive recipients of instruction, able to explore knowledge for themselves rather than only be told the information is correct, they are better able to process new information (Freire, 1970). Any activity that provides students an opportunity to participate actively in their learning process could increase student learning: including discussion activities, labs, simulations, and field experiences (Davis, 1993). Having some sort of hands-on learning activity helps students process the new information as they apply it to an activity (Davis, 1993). As students apply new information and reflect on their actions, they are practicing new ideas in order to really learn them (Freire, 1970). This can increase comprehension and academic achievement, better preparing them for postsecondary success.

Connection to life outside of school: real-world. One strategy for better preparing students for postsecondary success is to connect their classroom education to their lives outside of school. This is also known as the real world. There are several ways to connect instruction to the real world, such as using instruction strategies that highlight relevance and meaning of new information to students' lives, engaging students in real-life projects, and providing students with choice.

Relevance and meaning. Looking at life outside of the school walls and incorporating that in to instruction is one way to apply Authentic Learning strategies.

Freire (1970) defines authentic thinking as "thinking that is concerned about reality" (p.77), where reality includes students' current lives outside of school as well as future directions. Wlodkowski and Ginsberg (1995) define a relevant learning goal as one that is authentically connected to the student's world, which is their life outside of school. Making connections to events taking place in the real world to student learning (Swan, 2004; Webb, 1996), or focusing on how concepts apply to students' lives (Stone, 2004) are some ways to operationalize Authentic Learning. Gourgey (1992) reports that instruction is more effective when topics are related to specific, real-life applications drawn from students' experiences. This is largely because connecting learning to students' lives outside of school can increase motivation and participation (Wlodkowski & Ginsberg, 1995).

Meaning is constructed from our experiences and background knowledge (Fingeret, 1991), explaining why teachers find value in using students' culture, language, heritage, and experiences to connect to learning (Klingner & Vaughn, 2004). Individuals' worlds are socially and culturally constructed, and we derive meaning from what we have already experienced (Lave & Wenger, 1991; Fingeret, 1991). These experiences are also known as prior knowledge, and using this prior knowledge can help students more easily connect new information to knowledge they have already learned. New information does not always translate to understanding or learning for students unless the new information is based in the students' reality (Hart, 1983). Each learner needs to actively process new information and will do that by connecting new information to past learning and experiences to develop meaning for these new concepts (Hart, 1983). The more often

teachers use students' prior knowledge to connect to new information, the more often students will comprehend the material.

Authentic Learning strategies meet the students' need to understand the importance of putting out effort to learn new information. Students need to understand why what they are learning is important or relevant to their lives. Using relevance and meaning to connect to students' experiences outside the classroom highlights the significance behind learning specific information in the classroom (Wlodkowski & Ginsberg, 1995). Students must be given all the information about subjects, not just the information on which they will be tested (Freire, 1970). Connecting the new information to students' lives provides them with a better context for knowledge to help them create meaning (Freire, 1970). Through the use of this form of authentic instruction, students can clearly see how new concepts connect to their lives and why they are important to master. As students understand the importance of learning new information and how it is relevant and meaningful to their lives, their comprehension and academic achievement can increase. This increase in comprehension and academic achievement can prepare students for postsecondary success.

Real-life projects. Authentic instruction may also engage students in real-life projects. Rather than work on a theory in the abstract, students focus on the relevance of concepts and how these concepts apply to their lives (Stone, 2004; Newmann & Wehlage, 1993). Students may solve real world problems or use personal experiences as a context for applying knowledge (Newmann & Wehlage, 1993). As students engage in these real-life projects, they may also engage in Problem Solving activities to solve a problem in their community.

Authentic Learning strategies may also involve engaging in activities that professionals in the field may engage in. Rather than stacks of completed worksheets, students become active participants in reading and writing for real purposes and real audiences (Headley, 2008). These activities could take the form of reading about an issue that impacts students' lives, writing letters to politicians, and conducting a service learning activity to address the problem. Similarly, students could read discipline-related journals that professionals in the field read to keep updated on current research, or work on problems that professionals address. According to situated learning theory, applying knowledge gained by practicing this knowledge and engaging in activities that professionals in the community engage in yields the most benefits to student learning (Lave & Wenger, 1991). As students engage in learning activities that help their communities or that are engaged in by professionals, they are better able to understand the importance of this knowledge and how it can directly benefit them. Students whose learning activities extend beyond their classrooms and in to their daily lives and community activities through purposeful reading, writing, and thinking tend to benefit more from their instruction (Headley, 2008). Students' comprehension increases as they better understand how new information is relevant to the real world. As students' comprehension increases, they are better prepared for postsecondary success.

Choice. Another aspect of Authentic Learning involves choice. Giving students choices in how they engage in their education provides an opportunity to learn more from the instruction (Freire, 1970). When students are given the choice to select reading materials or writing topics, as well as how they will demonstrate acquisition of their knowledge to teachers, they are more likely to actively participate in their education. As

Freire (1970) and Hart (1983) state, the more practice students have with new information, the more likely they will understand them in more depth. Assigning tasks to students without providing options for student choice along the way is not a useful teaching strategy. Asking them what they hope to learn while monitoring the rigor and grade level of activities is much more effective (Freire, 1970). Offering student choices can also increase the relevance of reading activities by allowing them to select texts by topics of interest and relevance to students' lives that may involve issues students are currently dealing with or include people who have similarities with students (Tatum, 2006).

Turner and Paris (1995) found that two of the six key factors for increasing literacy motivation for students included students' ability to choose literacy activities and materials, as well as control their learning goals. Rather than having a teacher select activities and materials for the students, active participation in their learning increased when students were allowed to make these choices (Turner & Paris, 1995). The more motivated students are to learn new information and practice skills, the more likely these skills with strengthen. More interaction with new information results in more exposure to these new concepts, raising students' comprehension and potentially their academic achievement (Marzano, 2004). Having the opportunity to make choices in their education provides students increased exposure to new information, potentially leading to higher comprehension and academic achievement. This better prepares students for postsecondary success.

Benefits of Including Authentic Learning in Curricula

Instruction that includes Authentic Learning strategies results in many student benefits. Research shows that Authentic Learning strategies increase students' critical thinking skills, academic achievement, motivation and engagement, as well as comprehension and transfer of knowledge.

Critical thinking skills. Literature in the field demonstrates that critical thinking skills can be increased through Authentic Learning experiences. Critical thinking skills can be defined as those used to form logical arguments and reasoning, to analyze information, and the ability to apply these skills to the understanding and solving of problems (Chaffee, 1992). All of these skills are also required for the Problem Solving skills helpful for success in all educational levels but relied upon more heavily in postsecondary educational settings. Chaffee (1992) reports that critical thinking skills are increased through active learning, one form of Authentic Learning. These skills are not only beneficial for K-12 success, but are beneficial for success at the college level as well.

Authentic Learning experiences can be used to teach critical thinking skills to students. Success rates for college students increase when critical thinking skills are increased, yet students are rarely taught these skills in high school or in their early college courses (Chaffee, 1992). Critical thinking instruction contributes to a variety of postsecondary student successes including improved grades, increased ability to transfer Problem Solving and critical thinking skills to multi-disciplinary content areas, and increased pass rates on writing exit exams (Boylan, 2002). Not only do increased critical thinking skills improve students' postsecondary success within courses, but these skills

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also increase retention. The lack of well-developed critical thinking skills is often the cause in the failure of developmental students who already begin their postsecondary education academically behind (Chaffee, 1992). As students' critical thinking skills increase their postsecondary course completion rates also increase (Boylan, 2002). Students who are taught critical thinking skills at the beginning of their postsecondary education also score higher on reading skills assessments (Boylan, 2002). When students bring higher reading skills to their postsecondary education, the likelihood of success will also be higher. If students are taught these skills earlier in their academic careers, they will be better prepared for postsecondary success. Authentic Learning strategies can be used to teach these skills to students at elementary and secondary levels more systematically.

Increased academic achievement. Authentic Learning can benefit students' academic achievement in a variety of ways. Results can include increased learning and academic success as well as increased rigor in written work and reading texts.

Increased learning and academic success. One benefit of Authentic Learning is increased learning and academic success. Situated learning theorists Lave and Wenger (1991) state that learning cannot be separated from actively applying it, and one way to maximize learning is through this activity. Projects that allow students to apply, practice, and review their knowledge, such as long term projects that involve generating and testing hypotheses increase comprehension and student achievement (Marzano, Pickering, & Pollock, 2001). Authentic Learning experiences increase students' learning potential by providing activities for students to apply their knowledge and deepen understanding. Providing authentic, active learning experiences offers teachers

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opportunities to correct students in the middle of the activity so students can reflect on the error and learn to apply new knowledge correctly (Schon, 1987). This prevents students from learning incorrect information during the activity and improves their learning process.

Traditional education practices do not aid student learning as well as Authentic Learning experiences. Lave and Wenger (1991) assert that practice and application of new information in the learning process are more useful than access to instruction alone and may be the conditions for effective learning to take place. This assertion emphasizes the effectiveness of practicing and applying new information over solely receiving instruction and the role Authentic Learning activities play in successful student learning. Brain-based researcher Hart (1983) agrees that practice is essential for learning to occur. Providing experiential activities for students to learn through action produces learning outcomes that may not be found in traditional lecture and note-taking education practices (Schon, 1987). If students are not able to connect new information through experience or action, the result is a shallow depth of knowledge which limits the use of new knowledge by the context within which it was learned (Schon, 1987). Without authentic, active learning experiences it is difficult for students to transfer knowledge to other situations. AP courses that require rigorous content coverage without active learning components of instruction increase the likelihood of students only performing well on the AP test or assignment they are preparing for rather than preparing them for long term success following course completion. Better learning occurs when content information and experience are knit together (Schon, 1987). Authentic Learning strategies in the form of active, experiential opportunities result in increased comprehension and transfer of

knowledge. When students have a deeper understanding of the concepts, they are better able to transfer their knowledge to courses both within and outside the original content area learned. This better prepares students for postsecondary success.

Learners must actively participate in learning for instruction to be effective in preparing students for success in postsecondary opportunities. Explicit instruction alone is not effective for learning to take place (Lave & Wenger, 1991). Learning requires participation, and only once full participation is reached can mastery of concepts be achieved (Lave & Wenger, 1991). The use of Authentic Learning in AP courses can help students achieve mastery and increase both comprehension as well as transfer of knowledge to improve postsecondary success. Connecting instruction to the real world through experience in real life situations increases postsecondary learning success in both college and career endeavors (Schon, 1987). Once students have the experience solving problems and dealing with real life challenges, they are better prepared to apply the knowledge learned to new challenges in the future. One complaint voiced by both postsecondary education faculty as well as employers is that the people they work with are not prepared to meet the requirements of work or school (Hart, 1983). One problem with traditional educational tasks is the absence of contextual Problem Solving activities that transfer to the real-world (Brown, Collins & Duguid, 1989). Currently, schools teach strategies that aren't useful outside of school (Brown, Collins & Duguid, 1989). Secondary students may possess basic knowledge and skills required for graduation, but they are not prepared to apply them when the context differs from the original knowledge acquisition context. Authentic Learning experiences is one strategy for weaving Problem Solving activities together with practicing or applying new information to real world

problems. Experiencing the application of knowledge in a variety of settings different from the one originally learned in helps students better comprehend new concepts and better prepares them to meet postsecondary challenges.

Learning and academic achievement can also be increased by connecting new information to students' lives outside of school. When students are able to make meaningful connections to new information, these connections have the potential to build their knowledge base (Malloy & Gambrell, 2008). Not only do Authentic Learning experiences increase learning by helping students make meaningful connections to new information, but students also learn more efficiently when instructional materials reflect and incorporate students' prior experiences and culture (Fingeret, 1991; Davis, 1993). Positive rates of academic achievement cannot be expected if education fails to incorporate students' experiences outside of school and cultural background in the educational process (Freire, 1970). Learning about abstract theories is meaningless if they cannot be made relevant to the situation at hand by relating to learners' real worlds and tying this new knowledge to their real life experiences (Lave & Wenger, 1991). Connecting new information to students' lives outside of school increases student learning and knowledge acquisition.

While increasing relevance and meaning can increase learning, the absence of these Authentic Learning strategies can impede learning. When teachers rely on instruction that ignores students' prior knowledge, the curriculum actually limits resources for student learning (Lave & Wenger, 1991). When students do not have common prior knowledge to connect new information to, teachers can use Authentic Learning strategies to build background knowledge through direct and indirect

experiences (Marzano, 2004). Direct experiences such as field trips can often be costly and unavailable to most teachers, but indirect experiences like simulation activities or games could provide experiences for students without the cost of direct experiences (Marzano, 2004). The use of Authentic Learning experiences such as games increases academic achievement, specifically for the comprehension of vocabulary (Marzano, 2004). A meta-analysis conducted by Powell (1980) discovered interventions offered to students to improve vocabulary performance produced higher mean scores when non-linguistically-based interventions were used rather than linguistically based strategies, yielding an average effect size of 1.0 and a gain of 34 percentile points in vocabulary learning. Examples of non-linguistically- based strategies include using graphic representations of words during assessments rather than only written or oral representations, asking students to begin sentences with vocabulary words rather that only asking them to define the words, encouraging the use of mental pictures, and acting out definitions through skits or role plays (Powell, 1980). These examples of non-linguistically-based strategies align with Authentic Learning experiences by providing relevance and meaning to vocabulary words for students. These strategies improve word recall by using imagery rather than rote learning to attach meaning to words that do not yet connect to students' lives outside of school (Powell, 1980). Establishing meaning through these Authentic Learning experiences increases student comprehension and academic achievement by connecting new information to students' lives.

Teaching strategies that control the meaning of what is learned by relying on specific content and learning processes that ignore the experiences students bring to the classroom deny students the opportunity to learn through more individualized activities

(Lave & Wenger, 1991). Curricula that enlist these instructional strategies increase student difficulty in establishing the meaning and relevance of new information and hinder the transfer of knowledge to other situations, increasing the reliance of students on their instructors to make sense of the information for them (Lave & Wenger, 1991). Relying upon teachers to determine the importance of new information rather than determining this independently does not prepare students for academic success. When someone else determines meaning for learners, engagement is reduced if students do not find the relevance of this information to their lives. Increasing the meaning and relevance of instruction through Authentic Learning experiences also increases student learning and academic achievement, better preparing them for postsecondary success.

   Increasing rigor. The use of Authentic Learning strategies results in an increase of rigor in student performance. Schon (1987) finds that reflection on students' writing process aids in learning and improves the final product. The degree to which teachers have elementary students read and write texts in authentic contexts link to higher growth in reading comprehension and writing abilities (Purcell-Gates, Duke, & Martineau, 2007). In a study of 420 students in 16 second and third grade classrooms, researchers found strong relationship between the degree of authenticity of reading and writing activities during science instruction and growth (Purcell-Gates, Duke, & Martineau, 2007). The degree of authenticity of reading and writing events was a statistically significant positive predictor on growth in grade 2 (Effect Size=.703) and grade 3 (ES=.912), meaning the extent students are involved in authentic literacy events related to their degree of growth in their abilities to both comprehend and produce texts (Purcell-Gates, Duke, & Martineau, 2007). While this effect was not causal due to the

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correlational design of the study, it supports the theory that Authentic Learning experiences positively and predictably impact reading comprehension as well as writing abilities (Purcell-Gates, Duke, & Martineau, 2007).

Similar results were found in a study with 173 adult literacy students from 83 adult literacy classes in 22 states (Purcell-Gates, Degener, Jacobson, & Soler, 2002). There is a positive, statistically significant relationship between the degree of authenticity of texts and the purposes for reading and writing in adult literacy classes and the literacy practices of adult literacy students (Purcell-Gates, Degener, Jacobson, & Soler, 2002). As a result of reading texts that interest them and reading for purposes that connect to their lives outside of class, students increase the frequency of their reading and writing outside of school as well as engage in more complex and linguistically demanding literacy activities (Purcell-Gates, Degener, Jacobson, & Soler, 2002). While a causal relationship cannot be established between the inclusion of Authentic Learning practices and increased frequency and difficulty level of practices, the positive correlation between the two reflect what other researchers have reported: Authentic Learning increases student learning and academic achievement.

Increased motivation and engagement. The use of Authentic Learning increases student motivation and engagement in a variety of ways.

Active learning. Freire (1970) states that students are only interested in education discussions directly related to their needs. Active learning opportunities increase motivation and student participation as students use action and reflection to transform new information in to knowledge (Freire, 1970). Wlodkowski and Ginsberg (1995) found active learning to be a major factor in the success of developmental instruction at the

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post-secondary level, contributing to the motivation of adult students and useful in teaching nontraditional students. Students and faculty alike identify active learning strategies as the most effective for increasing student success as well as engagement (Wlodkowski & Ginsberg, 1995; Boylan, 2002). If these techniques work with postsecondary students to increase student success and engagement, they should also work well with secondary students.

   Relevance and meaning. Situated cognition learning theorists Brown, Collins, and Duguid (1989) assert that while practicing new information is important to the learning process, students should also be participating in activities that are solving real-world problems to maintain motivation and engagement. Connecting new information to real-life situations or problems increases students' understanding of this information by relating it to things the students already understand in their lives (Hart, 1983). As student' understanding of the concepts increase, they are better able to apply the information to other settings and see how all the parts relate and fit together (Hart, 1983). Once students see the connection, increased motivation and achievement results (Hart, 1983).

   Wlodkowski and Ginsberg (1995) show that relevance has the potential to inspire participation & increase engagement. Relating information to students' experience increases motivation and engagement, but this is especially true for female students when instruction is placed within a social and personal context (Webb, 1996). Biancarosa and Snow (2006) show that one strategy to better engage students in literacy activities is to promote relevancy in what students read and learn.

   Choice. Providing students choices in how they engage in their education, such as how they will demonstrate their knowledge and choosing topics of interest for reading or

projects, decreases passive learning (Freire, 1970). Alternately, the absence of choice or connection to student lives outside of school increases student helplessness, decreasing student participation in the process and alienating them from future participation (Lave & Wenger, 1991; Freire, 1970). Traditional education settings that rely on rote tasks without providing relevant instruction connected to students' lives decrease both student motivation as well as academic success (Freire, 1970). Students' abilities to focus or attend to activities chosen for them is less than when they choose the activities themselves (Hart, 1983). Similarly, while programmed or canned instruction produce little gain in learning effectiveness, Hart (1983) find this form of instruction does result in increased student boredom. Traditional classrooms have the potential to produce boredom, conflict, misbehavior, and apathy (Hart, 1983). When Authentic Learning experiences are used, these issues occur less. Choice not only leads to increased motivation, but also to longer attention and increased persistence on academic tasks (Hart, 1983). Giving students choices in how they engage in their education increases motivation and enables students to actively participate in education (Freire, 1970).

One way to provide choice in students' education is through the use of open-ended tasks. In a study of 6 year-olds by Turner and Paris (1995), one of the six major components of a strong open-ended task involves offering students choice in their educational activities. Increased motivation results from offering choice to these students through open-ended tasks, as well as increased positive feelings about their effort, increased ownership, and increased achievement (Turner & Paris, 1995).

Increased comprehension and transfer of knowledge. Authentic Learning practices not only increase learning and academic achievement, but also increase comprehension and transfer of knowledge.

Active and experiential learning. Students are more motivated to learn if take an active part in their learning, resulting in higher comprehension of the concepts (Freire, 1970). Wlodkowski and Ginsberg (1995) find active learning to be a major factor in the success of developmental instruction for postsecondary students. Schon (1987) also shares that students must actively apply concepts and learn by doing for higher comprehension, even though this may result in some student frustration with the learning process. Better learning occurs when content and experience are knit together (Schon, 1983). If students are not able to connect new information to experience or action, the depth of understanding for this knowledge is reduced and limited by the context within which it was originally learned (Schon, 1987). This also results in increased difficulty transferring knowledge to other situations (Schon, 1987). Connecting instruction to real world experiences increases postsecondary learning success in both college and career endeavors (Schon, 1987). Active or experiential Authentic Learning strategies increase student comprehension and knowledge transfer. In AP courses, this may mean that students who do not have access to active or experiential Authentic Learning opportunities may only perform well in the course or on the test, but not be able to transfer this information to postsecondary coursework. This can be especially problematic if students earn college credit for coursework completed and take more difficult courses at the postsecondary level. If students are not able to transfer the

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knowledge learned in their AP courses they will be less prepared for postsecondary success.

The learning theorist Kolb (1984) asserts that a balance of action and reflection is necessary for learning to occur, and that situations where one is used without the other, stifles learning. Reflection helps students think about the reasons for their actions, increasing understanding, comprehension, and transfer of knowledge to similar situations (Schon, 1983). Reflection has the potential to aid in the learning process and for improving the final product. Increasing student opportunities to use reflection in learning activities during their K-12 coursework including AP coursework, would better prepare them to succeed in college (Schon, 1983). As students' comprehension and ability to transfer knowledge increases, they will be better prepared to succeed in postsecondary coursework and increase their success in college (Schon, 1983).

In addition to reflection and action, Kolb (1984) determines that all of the following must occur in balance with each other for learning to be the most powerful: concrete experience, reflective observation, active experimentation, and abstract conceptualization to identify meaning of new concepts and analyze how new concepts change students' world view. Learning that is removed from the real-world experience results in reduced comprehension and ability to transfer knowledge learned to new situations (Kolb, 1984). Schon (1987) emphasizes the importance of having a teacher or expert supervise these experiential activities to help correct the student in the middle of applying new information to allow for reflection on errors and for learning a better way to practice new information before reinforcing an incorrect method of application. Student reflection on their actions as they apply new information helps students hone

their practice and prepares them for solving problems in the real world that they did not

necessarily learn about in their coursework (Schon, 1983). This ability to transfer

information learned to experiential opportunities is good preparation for postsecondary

success, as there are often many obstacles in both college and career that do not exactly

match information learned in the classroom (Schon, 1983).

Kolb (1984) also determines that knowledge is the result of the transaction

between social knowledge and personal knowledge, or the accumulation of previous

cultural experiences and the accumulation of subjective life experiences. Thus,

knowledge is created as individuals interact with the world, and it is action that

transforms new information in to knowledge (Kolb, 1984). Active learning therefore

increases comprehension. Because knowledge results from the combination of experience

and transforming new information in to knowledge, being exposed to new information

alone through readings or lectures is not enough for learning to occur (Kolb, 1984).

Individuals must do something with new information, and active or experiential

Authentic Learning activities allow for this to take place. The creation of knowledge and

meaning occurs by combining ideas and experiences from the external world with

internal reflection about those ideas and experiences (Kolb, 1984). Both are needed for

learning to be successful, and Authentic Learning practices include both of these aspects

needed.

Traditional instructional strategies do not always benefit students as much as

Authentic Learning strategies. Hart (1983) shows that the brain is not designed to learn in

the linear or step-by-step style found in the traditional classroom, but by identifying and

discriminating between patterns that exist from randomly presented material. While the

brain can do it, it is not a natural function. Learning increases when alternative activities are provided, such as those found in active or experiential Authentic Learning practices (Hart, 1983). Instruction that recognizes and is compatible with the natural brain functions will go faster and be more successful than more linear instruction (Hart, 1983). When students' educational options are limited to participation in linear, rote tasks that have little or no connection to their lives or future directions, their active learning opportunities are also limited (Freire, 1970). This limits the likelihood of successful learning, decreasing comprehension and students' ability to transfer new information to other situations. Limiting students' participation in their elementary and secondary education decreases their ability to succeed in postsecondary activities, reducing their opportunities to practice and apply new information to better comprehend and transfer the knowledge to future college or career endeavors. Implementing Authentic Learning increases students' potential for success in these postsecondary opportunities. Reflection can counteract against rote memorization, providing opportunities to analyze experiences and help them make sense of these experiences by connecting them to concepts learned (Schon, 1983). Authentic Learning that provides opportunity for reflection therefore increases comprehension and transfer of knowledge from one situation to a similar one.

    Relevance and meaning. Translating the traditional education system into one that provides more relevance and meaning for students increases comprehension and academic achievement (Freire, 1970). Learning methods embedded in authentic situations are essential for increased knowledge acquisition transfer to other situations (Brown, Collins & Duguid, 1989). When students have the opportunity to choose literary materials and topics for their assignments, they are then better able to construct meaning

from these texts and benefit from increased comprehension of the material and increased transfer of knowledge to other situations (Turner & Paris, 1995). In addition, students are better able to make sense of new information when it is put in to social, historical, and political context (Rothenberg, 1996), because to increase comprehension students need to understand the underlying issues to better grasp concepts (Rothenberg, 1996). Connecting new information to students' lives helps increase comprehension and transfer of knowledge to more permanent form of memory (Webb, 1996). With the new information stored in a more permanent form of memory, these students will be better prepared to transfer this new information to postsecondary college or career endeavors, increasing their likelihood of success.

When instructors provide more linear instruction rather than connecting new information to students' lives outside of school or previous experiences, brain functions occur more slowly and less successfully (Hart, 1983; Davis, 1993). New knowledge cannot be generated if current knowledge is not understood through the merging of everyday knowledge with academic knowledge (Moje & Hinchman, 2004). By focusing on real world questions that are of interest to students and using examples students can understand or relate to, teachers can build a bridge between students' prior knowledge and mainstream education goals (Moje & Hinchman, 2004). In order for learning to take place, teaching needs to have meaning to students so they can use their prior knowledge to make sense of new information (Hart, 1983). This may require teachers to relate new information to what students already know, or find a way to show how new material is relevant to students' lives (Hart, 1983). Utilizing the types of oral or written texts valued in home or community, or identifying ways that skills valued in the schools could be

made meaningful across communities, are examples for using student experiences to connect with academic content knowledge and literary practices to create a more relevant educational opportunity for students (Moje & Hinchman, 2004). As new concepts learned are applied meaning, students are better able to transfer their knowledge to other situations (Freire, 1970). As the new information to be learned connects with students' lives outside of school, students' understanding of the concepts increases, which increases comprehension in the process. As conceptual understanding deepens and comprehension increases, so do students' abilities to transfer this new information to new situations. When students understand these new concepts in depth due to the connection of this information to their prior experiences, students are better able to apply it to situations outside of where or how they originally learned the information.

In addition to connecting new information to students' lives outside of school, Authentic Learning can also help students connect concepts learned in one discipline to another. Connecting new vocabulary words to other content areas by identifying common words, as well as comparing or contrasting the use of these words, can help students connect meaning and understanding across subjects to deepen comprehension and increase academic achievement (Marzano, 2004). Nelson (1996) finds increased student understanding when higher education science instruction made clear connections between new concepts in the current discipline and other fields, including other sciences. Explicitly demonstrating how new information connects with other areas of knowledge resulted in increased comprehension for postsecondary students (Nelson, 1996).

Hart's (1983) brain-based research finds that students' transfer of learning increases as they identified patterns in the information and saw how one pattern helps

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solve another problem. Students may learn a portion of new information in a lesson, but it may not be clear how this connects to the entire unit or big picture (Hart, 1983). Students perceive their learning to be limited to the setting in which it is learned and overlook how it could be applied to a similar situation (Hart, 1983). The connection between concepts needs to be explicit so students can apply the new information to new situations, and using real-life problems helps students integrate new knowledge and apply it more easily (Hart, 1983). This parallels Freire's (1970) belief that education relies upon students' ability to make meaning from themes presented. Hart's (1983) Proster theory defines learning as the process of establishing meaningful patterns out of the mass of information taken in from the world. Once students are able to see how all the parts relate and connect, increased academic achievement results (Hart, 1983).

Increased comprehension and transfer of knowledge is not only possible for students speaking the majority language, but for Non Native English Speakers (NNES) as well. Contextual, cultural connections with cultural relevance and meaningful texts increase comprehension for NNES (Rueda, Velasco, & Lim, 2008). To increase processing and comprehension, instructors must connect new information to NNES students' cultural experiences the same way they would for any other student (Davis, 1993). Because abstraction can occur only when it is situated in the lives of the persons and culture in which knowledge is learned, it is critical that teachers connect new information to students' cultural backgrounds (Lave & Wenger, 1991). This will require a better understanding of students' background and will take time, but the result is higher comprehension. As schools struggle with achievement gaps for students whose home

language differs from school language, the use of Authentic Learning could benefit these students specifically.

For learning to be most beneficial for students, it must relate to learners' real world and be tied to their real life experiences (Lave & Wenger, 1991). In order for students to best transfer new knowledge and skills and apply it to other contexts, the knowledge and skills must relate to the learner's life. If AP courses do not require students to participate in Authentic Learning activities, students may be alienated from participating fully and denied the opportunity for increased knowledge or skill acquisition. This prevents them from receiving the full benefit of their AP coursework, therefore preventing them from being as fully prepared for success in postsecondary college or career opportunities in the future. AP courses offering students the opportunity to participate fully through Authentic Learning activities, the students receive better preparation for post-secondary success.

Collaborative Learning

Collaborative Learning opportunities prepare students for postsecondary success. Rarely do individuals complete their work responsibilities in isolation from others, and having the opportunity to practice the social skills needed to work with peers successfully better prepares students for postsecondary success. While Authentic Learning activities may require students to work together, Collaborative Learning activities require more structure for students to reap additional benefits from the instruction. Combining the structure of Collaborative Learning with Authentic Learning activities increases the potential benefits for students. Situated cognition learning theorists explain that learning is situated in context, which is socially and culturally defined (Brown, Collins & Duguid,

1989). When students are given the opportunity to collaborate through Authentic

Learning experiences that connect new information to students' lives outside of school,

student learning is enhanced. According to situated cognition learning theorists, student

learning is not only enhanced when Authentic Learning and Collaborative Learning is

combined but both these strategies are required for learning to take place at all (Brown,

Collins & Duguid, 1989). Combining Collaborative Learning with Authentic Learning

activities is a necessary condition for student learning, increasing students' potential for

postsecondary success.

Collaborative Learning Defined

The definition of Collaborative Learning may vary from author to author, but

Merriam-Webster's Dictionary ("Collaborate", n.d.) defines the term collaborate as

meaning "to work jointly with others or together especially in an intellectual endeavor".

To learn, students must actively work with new information, ideas, and skills and attach

meaning to this new information or integrate it with something the students already know

(Smith & MacGregor, 1992). Collaborative Learning groups are communities of teacher-

learners that are effective because each student has knowledge to share with other

members that can benefit their group (Freire, 1970). Students collaborate and share their

knowledge through two main roles: Modeling and coaching (Turner & Paris, 1995). In

these roles, students guide each other toward the correct answer but do not merely give

the answers to fellow group members (Turner & Paris, 1995). Students can give each

other clues but independent learning will not take place if students are just given the

solutions (Turner & Paris, 1995). Collaboration involves more than coordination or

cooperation (Grover, 1996). Palincsar and Herrenkohl (2002) clarify that while certain

forms of cooperative learning can occur without collaboration, Collaborative Learning is assumed to include cooperation. Many authors address cooperative learning, which can be assumed to be included under the umbrella of collaboration.

Smith and MacGregor (1992) define Collaborative Learning as groups of two or more students attempting to understand concepts, make meaning of new information, and solve problems together. According to these authors, Collaborative Learning groups also engage in Problem Solving activities. These Collaborative Learning groups focus on students' exploration or application of new information, decreasing the emphasis on lecture material and note-taking and increasing the importance of student discussions and active participation in the group (Smith & MacGregor, 1992). In these groups, students solve problems together with peers, providing an opportunity for deeper learning as students use collaboration to discuss the merits of potential solutions rather than merely reciting an answer (Higgins, Flower, & Petraglia, 1992).

Collaborative Learning groups give students the opportunity to better understand new concepts by discussing them with other group members. Each student must learn the information if they are to benefit from Collaborative Learning. Effective Collaborative Learning occurs when each student plays a role in the Problem Solving process and applies new information learned to some type of activity. Rawlins' (1996) cooperative learning groups in postsecondary education math courses provided opportunities for small group members to bounce questions off peers, gaining a better understanding of challenging concepts in the process. These discussion activities ran more smoothly when the expectations for the process and student roles were clearly described in advance (Rawlins, 1996). Therefore, Collaborative Learning involves more than just students

talking to each other. Often a Problem Solving activity helps focus the discussion, but additional structure must be in place for student learning to benefit.

Guided discussion and questioning. For Collaborative Learning groups to be most beneficial to students, it is helpful to provide a suggested format for guiding group Problem Solving. Collaborative activities are beneficial for students' learning, but King (1994) finds students perform better with more structured discussion and questioning activities. Artzt and Armour-Thomas' (1992) research on mathematical Problem Solving in small groups notes that structuring collaborative activities with questioning, elaboration, explanation, and feedback activities allowed Problem Solving to take place. Other researchers found collaborative Problem Solving groups utilizing strategies for encouraging elaboration and explanation to others were more effective than groups that did not utilize these structures (Veenman, Denessen, van den Akker, & van der Rijt, 2005).

One way to provide this structure in Collaborative Learning groups involves the use of reciprocal teaching. Reciprocal teaching allows students to actively process text read in small groups by questioning, clarifying, predicting, and summarizing (Palincsar & Herrenkohl, 2002). This process allows students to clarify any confusion that emerged in the text, apply the information from the text by predicting what will happen or what will be learned next, and summarize the main ideas from the text as well as the main ideas from the group discussion (Palincsar & Herrenkohl, 2002). This process allows students to practice Problem Solving skills as they interact with each other, gaining a better understanding of the material as their ideas are challenged or not understood by group members. Combining Collaborative Learning with this Problem Solving process helps

students better comprehend the material, resulting in better preparation for postsecondary success.

Another way to structure Problem Solving in Collaborative Learning groups is to organize phases of the group process. Using neuroscience research to structure learning for improved student comprehension, Caine (2008) identifies four group process phases for Collaborative Learning groups. Ordered sharing allows participants to learn deeply and speak their minds individually without interruption by other group members, followed by reflection on the new material by identifying the key elements and connecting it to their own understanding and experience as learners (Caine, 2008). Next, students explore how the application of this new information impacts practice and finally students review their work together to clarify what their next steps will be for putting new knowledge gained in to practice (Caine, 2008). There are many ways to structure Collaborative Learning groups. Researchers may differ on the best way to do so, but as long as there is some sort of structure embedded in the Collaborative Learning activity the student benefits are increased.

Types of Collaborative Learning groups. Collaborative Learning groups can be organized in a variety of ways depending on the purpose of the activity. While there is no one right way to organize the groups, it is helpful to use a combination of the various types of groups when possible (Johnson & Johnson, 1991). Formal learning groups can be organized for a single assignment that students work on for a few weeks, with the purpose of teaching students to rely on peers for assistance (Johnson & Johnson, 1991).

Informal learning groups involve short discussion tasks lasting a few minutes following a lecture or a movie and serve multiple purposes: Focus student attention on

material to be learned; create an attitude conducive to learning; and provide closure to an instructional session (Johnson & Johnson, 1991). This type of group helps students process and apply the information after lectures as they verbally process it with their peers, increasing comprehension as they combine Collaborative Learning with active Authentic Learning strategies.

In a third type of group, called a base group, students may work together for a semester, a year, or even multiple years (Johnson & Johnson, 1991). The purpose of base groups is to provide support and accountability for students (Johnson & Johnson, 1991). As students work together in base groups, they have an increased responsibility to attend school on a daily basis to help their base group peers. These groups help keep their members on-track academically and may hold formal meetings on a regular basis to check-in on each members' academic progress (Johnson & Johnson, 1991). These base groups have been used in a variety of ways to create small learning communities in much larger, more traditional environments in which not every student has been successful.

Required elements for effective collaboration. Collaboration is more than just students working together. Collaboration requires some additional components such as building relationships of respect with well-defined communication processes, and establishing a shared decision-making strategy (Grover, 1996). Student involvement is also necessary in the Collaborative Learning process with students assuming some of the responsibility for defining the group's learning task and the strategies for accomplishing this task (Schlais & Davis, 2001). Despite these differences, collaboration does have much in common with cooperative learning. Students engaged in cooperative learning activities work together to accomplish goals established as a group, working together for

outcomes that benefit the group as well as the individuals involved (Johnson & Johnson, 1991). Cooperative learning groups are used to maximize student learning by assigning students to small groups where they work through assignments until all group members understand and complete them (Johnson & Johnson, 1991). As students work together and develop differing ideas about solving the problem, group members must resolve differences and work together since they rely upon each other for their success (Johnson & Johnson, 1991). Effective collaboration does not automatically occur just by creating a small group. For effective collaboration, five elements must be in place for group members to work well together and for all to benefit from these activities.

One element required for effective collaboration is that of positive interdependence. Positive interdependence means all the group members are needed for the group to succeed (Johnson & Johnson, 1991). Situations where one person does all the work or one person always explains to the others will not attain success. If the group and its members are to benefit from Collaborative Learning, all group members must be participating and adding something to the group. The next element needed for effective cooperation to take place is face-to-face promotive interaction (Johnson & Johnson, 1991). This occurs when students maximize opportunities to promote their individual and group success by not only helping group members, but actively encouraging and praising each other's efforts to learn (Johnson & Johnson, 1991). Face-to-face promotive interaction goes beyond assisting group members for the sake of a student's grade, and moves in to a more supportive role that encourages the learning process for the sake of learning.

Effective cooperation in groups requires more than just helping and encouraging fellow group members. To maximize the benefits of these activities, individual accountability must also be present (Johnson & Johnson, 1991). When measures are in place to ensure each group member understands the concepts involved in the activity, group member are less likely to rely on others to do the work for them (Johnson & Johnson, 1991). Assessing performance for each individual and giving the results back to the student as well as the group is one way to encourage individual accountability (Johnson & Johnson, 1991). This helps identify to the group who needs more help so that they can work together to support the individual's learning, as well as strengthen the group's final product.

The last two elements needed for effective collaboration requires explicit teaching to the group members about how to work together as a team. Students need to learn the social skills necessary to interact with other group members (Johnson & Johnson, 1991). The ability to work well in groups is something that takes practice, and some students do not yet have the skills needed to resolve problems with their peers. Explicitly teaching students the skills they will need to meet expectations for the group work will increase the benefit of the assigned activity. Before any of the social skills are effective, however, the group members must establish trust with each other. True dialogue cannot exist unless trust exists and permission is given to explore all ideas, no matter how far-fetched (Freire, 1970). Establishing trust is essential for true problem-solving to take place, and the application of social skills in the group process can be much more beneficial once group members trust one another.

Once social skills are taught to the students, the students may need to be motivated to utilize these skills (Johnson & Johnson, 1991). One way to do this is asking each group member to rate each other on how well they use these skills. This will provide information to the teacher on areas to better support individual students, and give group members feedback on how their behavior is perceived by others. Teaching students the fifth element of effective collaboration, group processing skills, will show students ways to discuss how well they are achieving group goals, maintaining effective working relationships, identifying behaviors that are helpful or not towards meeting group goals and how to make decisions about what behaviors to continue or change (Johnson & Johnson, 1991). With group processing skills, it may also be useful to have group members rate each other on their individual abilities to implement these skills.

Benefits of Including Collaborative Learning in Curricula

Collaborative Learning can benefit students when used alone, or its benefits can be increased in combination with other teaching strategies such as Authentic Learning or Problem Solving. The use of collaboration has increased in postsecondary education in both professional education and liberal art settings (Smith & MacGregor, 1992). Using Collaborative Learning activities in elementary and secondary education settings can benefit students indirectly by preparing them for postsecondary education, but collaboration can also have direct benefits to performance at the higher education level.

Collaborative Learning has many direct benefits for postsecondary success. Students engaging in these activities benefit from improved social skills, increased motivation, and increased academic achievement.

Social skills. Social skills are important for success in postsecondary career and education endeavors. Group work holds an important function in both settings, and all members of our society must know how to participate effectively in groups and teams in order to be successful (Davis, 1993). Collaborative Learning activities provide opportunities for students to practice and build the social skills needed to work effectively in groups (Malecki & Elliott, 2002; Welsh, Parke, Widaman, & O'Neill, 2001). Bruffee (1992) states that "Collaborative Learning provides a social context in which students can experience and practice the kinds of conversation valued by college teachers" (p. 27). Collaborative Learning activities therefore directly prepare students for success in postsecondary education. Postsecondary students need to be able to talk about the subject content as well as the process of learning (Bruffee, 1992). Collaborative Learning activities help with this and provide a social context to learning. In order for students to find success in life after high school they need to be able to collaborate effectively with others. Having the opportunity to practice these skills in AP allows them to gain the skills needed, increasing the likelihood of their success in college and career.

Collaboration increases student social skills, resulting in higher student achievement (DiPerna, 2006; Malecki & Elliott, 2002; Welsh, Parke, Widaman, & O'Neill, 2001). In longitudinal analyses, researchers found that social skills predict children's future academic functioning (Malecki & Elliott, 2002; Welsh, Parke, Widaman, & O'Neill, 2001). Given the importance of social skills in both college and career success, if social skills predict academic functioning for students in the elementary and secondary levels it is likely that they will also predict academic functioning at the postsecondary level. If social skills are taught and cultivated in Collaborative Learning

activities, it makes sense that these activities should be incorporated in all courses, including AP courses. Having the opportunity to practice these social skills in Collaborative Learning activities directly prepares student for postsecondary success.

Collaboration and team work are crucial for living in almost any community (Smith & MacGregor, 1992), and most positions in society require these skills for success (Hart, 1983). This type of social interaction, learning, and decision making is expected in most workplaces of today, and if Collaborative Learning activities are integrated in elementary and secondary courses our schools would be better aligned with workplace and college expectations (Schlais & Davis, 2001). Better alignment would reduce the problem of employers finding candidates unqualified and unready, and colleges finding freshman unprepared (Hart, 1983). Students could emerge from high school far better prepared for postsecondary success in career or college, with a better grasp on real world expectations of working with others in a group setting. This real-world experience would benefit students and prepare them for success regardless of the path they choose.

Collaborative Learning is especially important as less face-to-face interaction occurs due to globalization (Schlais & Davis, 2001). People need to know how to interact and make decisions when they are not able to communicate in person. In Collaborative Learning groups, students learn to listen to other group members while still actively offering their thoughts related to the activity (Smith & MacGregor, 1992). Peer review in freshman composition courses strengthened group cohesiveness, important in the functioning of most groups (Hafer, 2001). While the skills developed in Collaborative Learning groups are important for success in college and career, these skills are difficult to teach (Schon, 1987). For best results, these skills need to be practiced. Providing

opportunities to practice collaboration in all courses, including AP courses, increases students' post-secondary success.

Increased motivation. Collaborative Learning activities result in increased motivation at the postsecondary education level as well as in K-12 education. Motivation increases at any education level are valued, but those in postsecondary education settings exemplify more directly the importance of Collaborative Learning.

Increased productivity and motivation in postsecondary education. Students participating in Collaborative Learning groups benefit from increased productivity at the postsecondary education level. Higher level ideas result from Collaborative Learning groups (Davis, 1993). This is not just a product of having more heads and therefore more ideas, but the process itself generates more and higher quality ideas than are generated when students work in isolation or competition (Davis, 1993). Thus student productivity is increased as a result of working with peers in Collaborative Learning groups, increasing the potential of increased student achievement. Hafer (2001) finds Collaborative Learning groups in the freshman composition groups at the postsecondary level result in student achievement increases, such as higher grades for students who participate in Collaborative Learning and lower D, F, and withdraw rates (Hafer, 2001). Smith and MacGregor (1992) also found that Collaborative Learning groups resulted in better writing and higher quality of thinking in student writing at the postsecondary education level, producing significantly better results than a lecture method or whole group discussion. In mathematics instruction, peer collaboration rather than traditional competitive models of Calculus instruction is one of the key factors in reversing rates of failure found in Hispanic and Black students (Smith & MacGregor, 1992). Collaborative

Learning not only improves postsecondary success for all students, but specifically benefits students underrepresented in postsecondary education. As more underrepresented students enroll in AP courses, success rates for these students could improve by adding Collaborative Learning strategies to instruction.

Another benefit of working with peers in Collaborative Learning groups is the increased student motivation. Astin's (1993) study of undergraduate students found peers to be the most influential environmental variable on student academic and affective growth. Working collaboratively with peers may be more potent than traditional competitive methods at the postsecondary education level because it motivates student to become more active and involved in their learning process (Astin, 1993; Smith & MacGregor, 1992). The more actively engaged or involved students are in their learning was one of the crucial factors in the educational development of those students (Astin, 1993). The Study Group on the Conditions of Excellence in American Higher Education (1984) suggested using more active modes of teaching to increase student involvement in the learning process, and Collaborative Learning activities were identified as potential strategies for meeting this goal. Collaborative Learning activities can increase student engagement and therefore increase postsecondary student development.

If students already possess the skills needed to work collaboratively with peers due to K-12 Collaborative Learning experiences, they will more likely succeed at the postsecondary education level when they engage in these activities. Providing these opportunities in AP courses will more accurately represent postsecondary course requirements and better prepare students for success in this coursework. Because active learning increases student involvement and improves the learning process, and

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Collaborative Learning activities are strategies that could be used to help with this, using Authentic Learning and Collaborative Learning together improves the effectiveness of postsecondary instruction. Incorporating these strategies in AP courses would directly improve the effectiveness of teaching college level courses offered in high school and better prepare students for postsecondary success.

Increased motivation and engagement in K-12 education. Collaborative Learning activities increase student motivation by increasing curiosity, interest, confidence, engagement, effort, and persistence (Sharan, 1980). Students are able to observe multiple ways of planning and executing tasks, and learn to borrow strategies from peers (Sharan, 1980). Collaborative Learning also provides opportunities for students to gain more refined understandings of tasks and procedures by observing others who have more knowledge or experience (Sharan, 1980). These students with more knowledge and experience can model how to request and give help, and through Collaborative Learning activities students can then assist each other (Sharan, 1980). This Collaborative Learning process "will encourage children to regard literacy as an opportunity for engagement and improvement rather than a search for the correct answer or a race to completion" (Sharan, 1980, p.669). Providing open tasks in a collaborative classroom are more likely to increase student interest in learning through help seeking, help giving, and discussions about ideas and strategies (Sharan, 1980). As interest is increased and students learn the process for seeking help or sharing ideas, student motivation and engagement also increases.

Johnson and Johnson (1991) find cooperative learning results in increased productivity and motivation. While these results are impressive, the authors are clear that

cooperative learning groups are more effective if members already possess strong social skills (Johnson & Johnson, 1991). While cooperative learning may not cause improved social skills, it is in these groups that social skills can be taught to and practiced by students. Regardless of this limitation, cooperative learning produce higher student achievement than individual or competitive work, especially in conceptual learning and Problem Solving tasks (Johnson & Johnson, 1991).

Sharan (1980) also finds similar results from cooperative learning groups, with increased performance on Problem Solving and better achievement in cooperative rather than competitive groups. Increased Problem Solving increases students' chance of success in college and better prepares them for performance on higher education tasks. The more opportunities students have to practice collaborative Problem Solving, the better prepared students will be for meeting postsecondary expectations in postsecondary education or the workplace. Studies also show increased motivation and increased critical thinking related to Collaborative Learning groups (Schlais & Davis, 2001). Combining Collaborative Learning with critical thinking can transform education more effectively by increasing comprehension and transfer of knowledge (Schlais & Davis, 2001). These benefits of Collaborative Learning better prepare students for postsecondary success.

As student motivation and engagement increases, students take a more active role in their learning process. Students who are more involved in their learning process produce more creative work as they share ideas with their peers (Grover, 1996). Collaborative Learning provides the opportunity for students to take more responsibility for their learning, resulting in a deeper understanding of the material which also improves transfer of new knowledge to other settings (Grover, 1996).

Swan (2004) finds that Collaborative Learning activities increase student knowledge by increasing engagement, decision making, Problem Solving, and opportunities to explain understanding of the material to their peers. Students are more motivated to learn if they take an active part in their learning process through activities such as collaborative or Authentic Learning activities (Freire, 1970). Smaller group discussions, as opposed to whole classroom discussions, provide students more opportunities to actively participate in their learning (Hart, 1983). Freire (1970) goes on to state that "when teachers and students work together through dialogue, students become more accountable in their education process" (p.80). Working as a team member rather than a student passively absorbing information alone results in increased motivation as student responsibility is also increased (Freire, 1970). Collaborative Learning is one strategy that can be used to increase student motivation and responsibility in the learning process, increasing comprehension in the process (Freire, 1970). As student comprehension increases, students are better prepared for transferring their knowledge to postsecondary coursework.

Academic achievement. In addition to the direct benefits of collaboration preparing students for postsecondary success, Collaborative Learning also possesses some indirect benefits for such preparation. One of these benefits is increased academic achievement. Gourgey (1992) finds instruction to be more effective when Collaborative Learning activities are used. Students are able to discuss why mathematical procedures make sense, and collaboration can help guide the students through the Problem Solving process (Gourgey, 1992). This not only helps students become better learners and better

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prepared for college (Gourgey, 1992), but it also increases student achievement (Veenman, Denessen, van den Akker, & van der Rijt, 2005).

Specifically, structuring Collaborative Learning groups to use high level elaborations is positively related to student achievement (King, 1994). If new information is to be retained and meaningfully related to previously acquired knowledge, students must elaborate or generate connections between information and representations in memory (Webb et al., 2008). This intersection between Collaborative Learning and Authentic Learning shows how using these strategies together further strengthens instruction. Students who construct explanations that clarify processes and help classmates arrive at their own solutions learn more than those who simply tell classmates solutions (Veenman, Denessen, van den Akker, & van der Rijt, 2005). Increased student achievement corresponds with extent students explain their thinking when working with other students (Webb et al., 2008). Incorporating collaboration in to instruction has a positive relationship with achievement that classrooms relying on one correct, rote answer lack (Webb et al., 2008).

Marzano, Pickering, and Pollock (2001) found that students participating in cooperative learning groups benefited from an average effect size of .73, which translates into 27 percentile gains on achievement tests. This effect size means the average student participating in cooperative learning strategies scored 27 percentile points higher than an average student who did not participate in these strategies (Marzano, Pickering, & Pollock, 2001). These effect sizes varied by .4 standard deviations, and based on Cohen's definition of effect size of .5 being a medium effect size and .8 a large one, cooperative learning strategies have a high probability of enhancing student achievement for all

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students in all subject areas across all grade levels and have a strong effect on student achievement (Marzano, Pickering, & Pollock, 2001).

Johnson and Johnson (1991) and Sharan (1980) also find that cooperative learning produces higher student achievement than individual or competitive work, especially in conceptual learning and Problem Solving tasks. The peer interaction provided in Collaborative Learning promotes critical thinking, higher level reasoning, and metacognitive thought resulting in better preparation for college performance tasks as all of these skills are needed at the postsecondary education level (Johnson & Johnson, 1991). Cooperative learning activities increased performance on problem-solving and increased positive attitudes across grades, ethnicities, and rural or urban locations (Sharan, 1980). With increased Problem Solving skills, students' potential to succeed in higher education tasks also increases, better preparing students for success in their postsecondary coursework (Sharan, 1980).

Increased academic achievement at the elementary and secondary levels improves students' confidence as they enter postsecondary education. As students are able to perform better, students will likely possess the ability to achieve higher scores on college entry exams. This puts them in a better position for college acceptance and on track for college completion within four years. Higher student achievement also translates to better performance in AP courses, potentially resulting in higher AP test scores and postsecondary credit waivers resulting in fewer courses needed for graduation. Collaborative Learning is one strategy for increasing student academic achievement. When used with other strategies such as Authentic Learning and Problem Solving activities these results can be even greater.

Increased comprehension. Utilizing Collaborative Learning activities increases student comprehension in a variety of ways. When collaboration is used as a means to problematize ideas rather than recite them, deeper learning is the result (Higgins, Flower, & Petraglia, 1992). Postsecondary instruction is more effective when collaboration allows students to discuss why procedures make sense and when topics are related to real life applications drawn from students' experiences (Gourgey, 1992). Combining Collaborative Learning with Authentic Learning increases the effectiveness of postsecondary instruction and makes learning more meaningful to students. Collaborative Learning activities allow students to maximize effectiveness and efficiency of mathematical Problem Solving (Artzt & Armour-Thomas, 1992). As students work together in Problem Solving groups, they can explain math concepts misunderstood by group members (Webb et al., 2008). This saves time and streamlines the Problem Solving process as students no longer have to devote time to solving a problem based on incorrect or misunderstood information.

Literacy can also improve through Collaborative Learning activities. Marzano (2004) finds that student comprehension of material covered in vocabulary instruction increased when students are able to discuss their reading and learning, make sense of information in their own words, view the information from multiple perspectives different from their own, and express themselves freely during these interactions. The likelihood of words being stored in permanent memory rather than working or temporary memory also increases, making it more likely that the new information will be transferred to another setting later (Marzano, 2004).

Collaboration and questioning also increase students' comprehension and writing skills (Reznitskaya et al., 2008). When students' main points are developed through discussion with peers, writing can be improved (Reznitskaya et al., 2008). Comprehension of new information can also be enhanced as students discuss how their understanding may differ from their group members' perspectives (Reznitskaya et al., 2008). Increased comprehension enables successful transfer of knowledge to new situations (Reznitskaya et al., 2008), improving students' preparation for postsecondary success. The more students interact with the information through Collaborative Learning activities, the more exposure students have to the concepts in reading which expands their understanding (Marzano, 2004). Students with better comprehension and ability to transfer this knowledge to new situations will be better prepared to meet the expectations of postsecondary coursework. Including Collaborative Learning activities in AP courses will also produce the same result, improving student's likelihood of success at the postsecondary education level.

Problem Solving improvement. Small group Problem Solving increases members' abilities to monitor and regulate the cognitive processes engaged in Problem Solving (Artzt & Armour-Thomas, 1992). Collaboration increases math Problem Solving by creating the conditions necessary for Problem Solving to take place, keeping group members on track by reminding each other of next steps in the process and filling in members' knowledge or understanding gaps (Artzt & Armour-Thomas, 1992). Collaboration allows group members to not only benefit from members' ideas, but also to be inspired by them (Artzt & Armour-Thomas, 1992).

To ensure students feel comfortable sharing any ideas that could be examined critically by the group, trust must be built among group members (Freire, 1970). In addition to trust, groups must be structured carefully to ensure positive interdependence and maximize the benefits to the Problem Solving process (Artzt & Armour-Thomas, 1992). Self-regulation strategies can be built in to the structure of the group process, and students must be taught how to use these strategies (Artzt & Armour-Thomas, 1992). Teaching students to monitor and regulate their cognitive processes during Problem Solving will also be necessary as students who are unable to do so reap fewer benefits from the learning activity (Artzt & Armour-Thomas, 1992). Incorporating reflection in to the Collaborative Learning activity is also important for collaboration to lead to Problem Solving (Artzt & Armour-Thomas, 1992). Collaborative Learning activities increase active participation by students, which increases Problem Solving of the group (Artzt & Armour-Thomas, 1992). The more Collaborative Learning activities are used in Problem Solving groups, the more likely these groups will be successful.

Potential limitations and counter-arguments. Every teaching strategy has some limitations. One concern regarding the limits of collaboration is that it will not automatically produce benefits, such as critical reflection about the learning that occurs through group interaction (Higgins, Flower, & Petraglia, 1992). Students need to communicate with each other to process new information, but in order for groups to fully benefit from Collaborative Learning explicit instructions and coaching is necessary (Hart, 1983; Higgins, Flower, & Petraglia, 1992). Teaching students the skills and the processes they will need for working together collaboratively will be essential to the success of Collaborative Learning work.

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Another concern regarding Collaborative Learning is social loafing. As group size exceeds eight members, Pavitt (1990) explains that individuals do not work as hard in group settings and that individual problem-solving decreases when group sizes increase to more than eight members. Thus, eight members seemed to be the maximum size for a successful group project. Hart (1983) shares that smaller group discussions are better to ensure all students have the opportunity to participate, but the limit for these small groups is a bit higher at 12-15 students. Regardless of the numbers, one way to address this issue is by limiting group size to the number of students best suited for the activity (Davis, 1993; Pavitt, 1990). As instructors monitor group productivity, they can adjust group size when it seems that loafing is taking place. One problem that can occur in Collaborative Learning groups is difficulty with communication structure. Sometimes the communication structure can become centralized, meaning there is an unequal flow of communication between only a few members (Pavitt, 1990). A more diffused communication structure is more beneficial, resulting in more equal positions of the group members (Pavitt, 1990). Diffused communication structure results in higher group member satisfaction and increases productivity (Pavitt, 1990).

An additional concern that Pavitt (1990) reports is that groups do not always work efficiently and may waste time with off-track behavior. This concern can be addressed by providing groups with instructions for budgeting time, staying on task, and organizing discussion (Davis, 1993; Pavitt, 1990). When individual contributions are difficult to distinguish, group performance suffers (Pavitt, 1990). Assigning roles to each member can clarify the task each has to complete, increasing on task behavior and organization (Davis, 1993; Pavitt, 1990). Establishing and modeling a clear collaboration process,

explicitly teaching conflict resolution skills or other social skills as needed, and having each member rate fellow members on their performance as part of their final grade will all help to address this concern (Davis, 1993; Pavitt, 1990).

Additional supports that could strengthen collaboration include providing sample questions or prompts for starting the collaborative process (King, 1994), teach group facilitation skills, show students how to compare and consider alternate paths, and encourage students to justify their plan to group members as well as to themselves through their own reflection (Higgins, Flower, & Petraglia, 1992). Effective, high performance teams consistently set clear goals for themselves that were either challenging to all members or real world goals that would make a difference to someone by solving a real world problem (Davis, 1993; Pavitt, 1990). Effective teams also used a results-driven structure with some sort of incentive or motivation to perform well (Davis, 1993; Pavitt, 1990). Implementing these potential solutions would likely address any concerns regarding potential limitations of Collaborative Learning.

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Examples of Best Practices in Syllabi

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If AP course instructors are using high quality syllabi, the best practices of Problem Solving, Authentic Learning, and Collaborative Learning should be found in those syllabi. Evidence of these best practices can be found in a variety of ways.

Problem Solving in Syllabi

Three major themes of the Problem Solving process emerged in the literature: Process or strategies used, the potential for multiple correct strategies, and the importance of identifying obstacles or barriers to the Problem Solving process. From these themes, the three main forms Problem Solving may take in the syllabus align with the work of

Conley, Lombardi, Seburn, and McGaughy (2009): understanding the problem, hypothesizing, and strategizing.

Understanding the problem. One of the three steps in Polya's (1945 & 1962) Problem Solving process includes understanding the problem. Before students can begin to solve a problem, they need to have a strong understanding of what they are to solve. One way students can better understand the problem is to restate the problem in their own words (Polya, 1945 & 1962). Activities or assignments that require students to restate the problem in their own words, in written form or through paired verbal exchanges with peers, are using Problem Solving in the form of understanding the problem (Conley, Lombardi, Seburn, & McGaughy, 2009; Marzano, 2004). Examples of such assignments could take the form of written responses following reading assignments to address the main conflicts or issues being discussed, writing a summary of readings in the students' own words before beginning to write, or gathering research to support and develop their own opinions rather than just restating opinions found in the literature. Understanding the problem could also be demonstrated through activities requiring students to identify the goal of the Problem Solving process, describe the barriers preventing goal completion, and identify possible solutions for overcoming those barriers (Marzano, Pickering, & Pollock, 2001). If activities described in AP course syllabi include any of these activities or something similar, they will be demonstrating Problem Solving in the form of understanding the problem.

Hypothesizing. Once students have a strong understanding of the problem, they must hypothesize potential solutions. EPIC identifies developing hypotheses for problem solution as an important part of the Problem Solving process (EPIC, n.d.). This could be

demonstrated in syllabi through activities requiring students to hypothesize the likely solution to a problem, then to try the solution, and finally to explain whether their hypotheses are correct (Marzano, Pickering, & Pollock, 2001). Depending on the accuracy of their original hypotheses, students may be required to test another hypothesis using a different solution (Marzano, Pickering, & Pollock, 2001). These assignments would demonstrate the use of Problem Solving activities in syllabi in the form of hypothesizing.

Assignments requiring students to make predictions about what will happen next in literary works or what students could do next in writing assignments also demonstrate Problem Solving in the form of hypothesizing (Marzano, Pickering, & Pollock, 2001). Any activity requiring students to predict potential outcomes in written or verbal interactions with peers, or activities requiring them to explain the thinking behind their writing would also demonstrate hypothesizing in syllabi (Marzano, Pickering, & Pollock, 2001). Similarly, students making predictions about what will happen or what they can do next after each step in Problem Solving processes demonstrates hypothesizing in syllabi for mathematics courses (Marzano, Pickering, & Pollock, 2001). Showing work in assignments, sharing with peers verbally, or completing written mathematical assignments that hypothesize solutions and identifying the best option may also demonstrate this skill (Marzano, Pickering, & Pollock, 2001). Speculating outcomes and justifying student thinking are additional steps that demonstrate hypothesizing in syllabi (Marzano, Pickering, & Pollock, 2001).

Strategizing. The third form of Problem Solving involves students strategizing as they work to solve the problem. This requires students to look at the problem from

various perspectives and plan their approach for solving this problem (Polya 1945 &

1962). Planning the approach for writing assignments is key for developing an improved

product and can include prewriting strategies, proofreading, revisions, and editing of

multiple drafts (Marzano, Pickering, & Pollock, 2001; The College Board, n.d-a; The

College Board, n.d.-b). In AP English courses, it is also required that students not only

receive feedback about their writing from peers and teacher, but they are also expected to

make the suggested changes and review their writing before final assignment submission

(The College Board, n.d-a; The College Board, n.d.-b). Syllabi that identify similar

writing processes to be followed, as well as planning and justifying mathematical

solutions plans, will be demonstrating Problem Solving in the form of strategizing.

Strategizing is identified as one of the key components of problem formulation by

EPIC, requiring students to generate possible solutions to the problem and devise

strategies for solving all parts of the problem (EPIC, n.d.). It is in this strategizing form of

Problem Solving that students must analyze their situation and choose the solution that is

most likely correct and reasonable. The third major phase of Polya's (1945 & 1962)

process involves the student carrying out the plan by checking work completed,

reviewing the work for errors, and discussing the solutions with fellow students. Syllabi

that direct students to check their work for accuracy will also be demonstrating Problem

Solving in the form of strategizing. Within AP syllabi, there may be words that indicate

potential Problem Solving even when the description of the activity may not meet the

criteria for the three different forms. Possible key words that may flag Problem Solving

when the syllabi fail to describe it completely include the following words: Analyze,

apply, approximate, classify, calculate, compute, conduct, construct, demonstrate, design,

describe, determine, differentiate, employ, estimate, evaluate, experiment, explain, express, factor, find, formulate, graph, hypothesize, identify, interpret, investigate, judge, justify, match, model, organize, perform, plan; relate, represent, recognize, simplify, speculate, sketch, solve, understand, use, validate, write, interpret, compare, synthesize, and communicate issues, themes, and conflicts in written and oral presentation assignments. (The College Board, n.d.-b). The presence of these words may or may not indicate Problem Solving is the desired goal for students, but they do indicate the requirement that students perform an activity that requires deeper thought.

Some additional English-specific requirements fall under the category of strategizing that do not apply to Calculus. Critical reading and communication skills may be required in the form of writing in response to a reading assignment. Students may be required to include information about influences or implications of the reading through the use of clear and precise writing (The College Board, n.d-a; The College Board, n.d.-b). Assignments requiring students' to think critically about literary works and communicate this understanding in their own words demonstrate Problem Solving in syllabi. English course syllabi may also demonstrate strategizing when students are required to use specific writing conventions, including the use of appropriate writing mechanics, formatting that meets style guide requirements such as MLA or APA, grammar, sentence construction, and punctuation in writing assignments and oral presentations. (The College Board, n.d-a). Utilizing all of these conventions requires student to strategize the best way to meet requirements and still make their position clear. In addition, writing for English requires the use of a variety of writing styles including argumentative or position essays, expository, narrative, business, persuasive, research

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papers, and reflection papers depending on the written or oral presentation assignment (The College Board, n.d-a; The College Board, n.d.-b). Determining how to meet style expectations that may require students to compare or contrast as well as interpret texts requires much planning and strategizing to meet the demands of the assignment. During this process, students may also be required to analyze issues of audience and determine how best to use tone, formal or informal style, and sentence structure to best to communicate their purpose (The College Board, n.d-a; The College Board, n.d.-b). In these assignments, tone, diction, and sentence structure must be honed as students reinforce writing conventions, style, and audience to communicate their position.

AP English courses also require students to form, articulate, and support opinions or points of view clearly in oral & written forms, and to cite support for these arguments appropriately (The College Board, n.d-a). Students are required to use evidence to defend and support their arguments and positions, which requires strategizing and the willingness to solve such problems through researching potential support and clearly communicating their positions. Writing in AP English courses requires analysis and development of research questions pertaining to reading, and through additional research students then cite this to support their claims. Syllabi that include these aspects of Problem Solving in the form of strategizing demonstrate the inclusion of these best practices.

Authentic Learning in Syllabi

As found in the literature, Authentic Learning opportunities can take the form of active or experiential activities, learning opportunities that connect to student lives outside of school, and opportunities to engage in activities that professionals in the real-

world engage in during their work activities. From these three main types of opportunities identified in the literature, I have identified three main forms Authentic Learning may take in AP course syllabi. These include experiential opportunities or active participation, meaningful connection to students, and relevance to students' lives and opportunities to engage in real-world problems.

Experiential opportunities or active participation. Authentic Learning activities that fall under this category promote active learning through activities such as projects, hands-on activities, simulations and role plays, debates, and field trips (Davis, 1993; Hart, 1983). Projects or homework that allow students to apply, practice, and review their knowledge, including long term projects that involve generating and testing hypotheses, provide students with the opportunity to apply new information learned and interact with this information to gain a better understanding of the content (Marzano, Pickering, & Pollock, 2001). Activities that provide students opportunities to participate actively in their learning process could include discussion activities, labs, simulations, and field experiences (Davis, 1993; Hart, 1983; Schon, 1987). Practicum experiences that require students to reflect on their active learning experiences (Schon 1983, 1987), such as apprenticeships, internships, or field projects (Kolb, 1984) would also be categorized as active or experiential opportunities. Any activity found in the AP syllabi that provides such active or experiential opportunities would fall under this category of Authentic Learning.

Meaningful connection to students. As the literature states, connecting instruction to students' lives outside of school can increase student achievement. This can be found in AP syllabi through assignments designed to solve, address, or make students

aware of current problems within the students' community or relate to current events (Webb, 1996; Hart 1983). Meaningful connections can also be found through assignments or activities dealing with current events (Hart 1983). Connecting lecture topics or activities to cultural or background knowledge students may bring with them, or inviting students to build on the knowledge of the community and a culture already known to students would be other ways to connect with students' lives (Hart, 1983). Assignments requiring students to write mathematical word problems that apply to their lives outside of school would also demonstrate connection to students' lives in syllabi (Kalish & Eastman, 1996).

Making a meaningful connection to students means more than connecting to their experiences outside of school. Meaningful connections can also be made by helping students make connections between concepts learned in different disciplines. Offering cross-disciplinary assignments or activities may help students make sense of the information from another perspective, providing the opportunity to observe how these subject concepts interact with other subject areas. Cross-disciplinary assignments that require writing in math through the use of math journals or reflection papers on students' Problem Solving process also help students make connections in their conceptual learning as they explain their thinking in a different format (Rawlins, 1996). Similarly, assignments requiring students to communicate their mathematics understanding in both verbal and written forms, or through both graphic and numerical formats, help students better understand the content as they demonstrate their knowledge in a variety of ways (The College Board, n.d). Such assignments demonstrate meaningful connection to students in syllabi.

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Another way to increase meaningful connection is to offer students choice in the topics that they read or research, as well as how they demonstrate their knowledge of course concepts. When students are able to choose topics of interest for assignments, increased comprehension and transfer of knowledge to other activities and subjects as well as increased motivation and responsibility is the result (Marzano, 2004; Turner & Paris, 1995). Whether students are able to choose from a variety of options or fixed options, choice results in increased student achievement (Turner & Paris, 1995). Relevance can also be demonstrated in syllabi when instructors take in to consideration their students' diverse learning styles. Assignments that provide a variety of options for completion to address these diverse student learning styles demonstrates relevance (Marzano, 2004). In fact, Marzano (2004) finds that activities requiring students to demonstrate their knowledge through nonlinguistic-based strategies produce higher academic achievement. When both linguistic and nonlinguistic representations of knowledge are accepted, relevance is demonstrated in the syllabi (Marzano, Pickering & Pollock, 2001). Assignments on the syllabi that require uniform demonstrations of knowledge for all students fail to take into account Kolb's (1984) experiential learning theory which states different ways of knowing require different demonstrations of knowledge.

Relevance to students' lives. Relevance can be demonstrated in AP course syllabi in a number of ways. One way to do this is with assignments designed to address actual problems professionals in the field are currently struggling to solve (Brown, Collins & Duguid, 1989). As students see that the problem they are working on is a real problem that professionals are working to solve, they see there is a reason to work

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towards a solution. Assignments that require students to apply their subject knowledge to an activity in a way that directly ties in to the subject content, rather than using worksheets that do not require students apply their knowledge, would also be examples of relevance in syllabi. One example of this is through activities that require students to use mathematical tools to analyze current problems in their world.

Additional examples of relevant activities are those that aid students in course success and help organize student thinking to increase comprehension of subject matter. Creating useful study guides for upcoming exams is one way to demonstrate this in syllabi (Rawlins, 1996). Assignments requiring students to create graphic organizers and other visual mapping activities such as timelines, geographical mapping, change of culture or practice over time representations, or thematic mapping are also activities that can be assigned as homework but also aid students in the process of better understanding the material (Rawlins, 1996). Other activities that improve students' study skills and note-taking, activities that require students to create exam or assignment questions, or those asking students to build a rubric for evaluation of assignments or exams all benefit students and are directly related to their course success as students think more deeply about the material as they organize their thoughts for the assignments (Rawlins, 1996).

Relevance can also be demonstrated in syllabi through activities providing students with experience that will improve their postsecondary success. Assignments that require students to critique each other's work provide real-world experience needed for life after high school where students may be responsible for reviewing others' work (Rawlins, 1996). Activities requiring students to research a potential career, including the academic skills needed for success in that career or in any postsecondary coursework

required, lends relevance to these assignments as they directly relate to students' lives after high school (Rawlins, 1996). This activity can demonstrate the importance of learning the current course content in order succeed in students' potential careers, increasing motivation to succeed in the course in order to meet their goals for the future.

Relevance is also demonstrated in syllabi in activities that require students to understand the "whys" of a process rather than just memorizing the process (Hart, 1983; Marzano, 2004; Powell, 1980). When students are able to understand how they would apply new information to similar problems in the real world, they have a deeper understanding of the information. For Calculus, assignments that require students to extract a problem from a new context, analyze the problem with processes learned in class, and interpret the solution back in to context is one demonstration of relevance. Explaining the results of solutions by providing a written interpretation rather than just a number in a box would be an additional way students can demonstrate their understanding of the process (Hart, 1983; Marzano, 2004; Powell, 1980). In English courses, students' ability to apply critical thinking skills learned in class to new literary works or writing assignments would be another way students could demonstrate understanding a process when applied to a variety of situations. Assignments requiring these skills would demonstrate relevance in syllabi.

Collaborative Learning in Syllabi

From the many forms of collaboration found in the literature, I have identified six main forms collaboration may take in English course syllabi, and five main forms collaboration may take in Calculus syllabi. These include using out of class time effectively for study group learning; group projects or assignments; small-group or whole

class discussions; reciprocal teaching; and for English syllabi only, peer review or editing.

Using out of class time effectively for study group learning. Advanced Placement (AP) courses require more time and work from students than many regular high school courses due to the fact that they are college level courses offered in high school. One demonstration of collaboration in syllabi involves students seeking help sessions outside of class (Schon, 1987). This may take the form of tutoring circles, learning groups with peers, or even learning groups with the instructor (Schon, 1987). Due to the beneficial nature of Collaborative Learning activities as found in the literature, any study group activity that students participate outside of class time demonstrates Collaborative Learning in the syllabus. Students may be required to participate or attendance may be optional, but inclusion of study group opportunities on course syllabi will demonstrate collaboration.

Group projects or assignments. Syllabi for AP courses may demonstrate group projects or assignments in a variety of ways. Demonstration of this category in syllabi may include any work together with peers on assignments or projects (Hart, 1983). This group work may be described on syllabi as activities requiring students to participate in brainstorming activities, triad work, role play activities, dramatizations, games, panels, symposiums, colloquia, or round table discussions (Davis, 1993). Additional demonstrations on syllabi may include table group assignments, or lab work with partner/group (Davis, 1993). These activities may involve listening to others' strategies to evaluate the strengths and weaknesses of each, accepting constructive criticism by respecting differing opinions, or reviewing group work to provide constructive criticism

including positives as well as suggested changes (Davis, 1993). Any of these activities would demonstrate collaboration in syllabi.

Dialogue opportunities: Small-group or whole class discussions. Syllabi for AP courses may demonstrate collaboration through either small-group or whole class dialogue opportunities. Whole class discussions provide opportunities for instructors to ensure all students are clear on task and performance expectations, as well as the course content. Class discussions demonstrate collaboration in the form of dialogue opportunities, providing a time for students to exchange ideas and better understand the course content.

Small-group discussions provide students with additional opportunities to discuss perspectives of reading assignments, ideas about the content covered, as well as to clarify any expectations regarding coursework (Hart, 1983). One example of a small-group discussion is an activity requiring students to pair up and discuss characteristics of literary works or mathematical concepts, then share the information discussed with the whole class (Davis, 1993). Smaller groups can increase student achievement as students have more opportunities to share their thoughts and work through them with peers when there are fewer peers interacting at the same time (Hart, 1983). Small-group dialogue opportunities prevent the social loafing phenomenon that develops as the group size exceeds eight members (Pavitt, 1990). Smaller group sizes also reduce the likelihood that uneven communication structures develop in group interactions, a dynamic that materializes when individual contributions are difficult to distinguish and harms group performance (Pavitt, 1990). While both types of dialogue opportunities are beneficial for

students and demonstrate Collaborative Learning in syllabi, small-group Collaborative Learning activities can often provide more benefit to students.

Reciprocal teaching. As found in the literature, reciprocal teaching allows students to actively process text read in small groups through a systematic process of questioning, clarifying, predicting, and summarizing (Palincsar & Herrenkohl, 2002). Peer interactions demonstrating reciprocal teaching in the syllabi include those requiring each student in a small group to learn specific content and then teach this content to the peers in the group. These jigsaw activities require each person or group to learn one piece of the "big picture", then teach this information to the whole group so all participants learn all pieces (Block & Duffy, 2008). Similar Collaborative Learning activities demonstrate reciprocal teaching in syllabi.

Peer review or editing (English syllabi only). One of the requirements for AP English Language and Composition syllabi to receive approval in the AP audit process is that they require students to review each other's writing as part of their writing process (The College Board, n.d-a). Activities that demonstrate peer review or editing in syllabi include the reviewing peer writing assignments, listening to others' strategies and evaluating the strengths and weaknesses of each, and providing constructive criticism including positive points as well as needed revisions (The College Board, n.d-a). Additionally, syllabi may demonstrate peer review or editing by stating the expectation that students accept constructive criticism by respecting differing opinions and maintaining civility.

To test ideas from the literature about these three learning styles, I will evaluate well-developed syllabi that are sufficiently detailed due to the AP audit process EPIC

created. An AP syllabus is on average 1-2 pages longer than a regular high school syllabus, rich in content and detail, making it more likely That I will be able to identify the learning styles of Problem Solving, Authentic Learning, and Collaborative Learning. Because Math and English courses are core subject areas that many students are required to take in both high school and college, I have chosen to sample syllabi from the AP courses Calculus AB, English Language and Composition, and English Literature and Composition. AP Calculus BC course syllabi will not be evaluated because this AP course content overlaps with Calculus AB content and covers three terms of content over two terms, resulting in fewer courses being offered in this subject area.

CHAPTER III

METHOD

Research Design

To determine to what degree the AP courses Calculus AB, English Language and Composition, and English Literature and Composition incorporate Problem Solving, Authentic Learning, and Collaborative Learning, I conducted a content analysis on AP course syllabi for those courses.

Content Analysis Data Source and Sample

My unit of analysis was authorized AP course syllabi for the 2012 academic year. These syllabi had been submitted for approval through the AP Course Audit process. The AP Course Audit is conducted by the Education Policy Improvement Center (EPIC) for the College Board, and all AP courses must have an approved syllabus through this process before courses receive AP designation on student transcripts. Syllabi are submitted from schools not only around the country but from around the world. Schools that offer AP courses for students globally, including Department of Defense (DOD) schools, submit syllabi for approval providing a rich data set for this study.

Syllabi obtaining approval through the AP Course Audit process have been evaluated by reviewers who are either post-secondary faculty or recently retired faculty who have experience in entry-level post-secondary courses to which the reviewed AP course syllabi should correspond. Reviewers have been recruited because they possess the content knowledge in the subject area sufficient to determine whether the syllabus conforms to the curricular requirements and to make judgments and inferences necessary

for this determination. Reviewers have evaluated syllabi within their subject area of expertise to identify syllabi that meet the established criteria for College Board approval.

Because judgment is an integral part of the review process, reviewers undergo training prior to beginning any syllabi review. First they read and score a series of practice syllabi against the criteria required to obtain approval for AP status. From this practice series they receive feedback to help improve the accuracy of their judgments. Next, they are required to correctly score additional syllabi. Senior reviewers are available throughout the process to assure that all reviewers understand each component on the analytic tool. Senior reviewers are college professors who have been selected based on demonstrated experience and expertise with a specific AP subject. Senior reviewers have expertise in using the scoring guides, resulting from their participation in rubric development and the creation of all training syllabi answer keys. To inform reviewer judgment, decision rules accompany each AP subject to be reviewed. Decision rules are developed by senior reviewers and College Board Advisors and help guide reviewers. College Board Advisors serve as liaisons between the public and the College Board committees that develop the AP curricular requirements. It is because of this extensive review and certification process that these syllabi were chosen for the study.

By using AP syllabi that have been approved using standardized criteria, I had the best opportunity to detect evidence of this project's focus of study. High school syllabi vary greatly in content and detail, but approved AP syllabi must meet the content requirements of the AP Course Audit process. If the requirements are not met, approval is not granted and syllabi are returned to schools with feedback on changes required in order to earn approval. Approved syllabi vary in length but generally range between12

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and 20 pages. Syllabi can be submitted up to three times in order to incorporate feedback and make changes for approval. If syllabi do not meet the requirements within these three opportunities, AP cannot be designated on student transcripts for that course. Even if a syllabus fails to meet approval requirements, students are still eligible to sit for the exam at the end of the course. Approval rates vary across subjects, but in the 2010-11 review cycle 96% of the AP Calculus and English syllabi submitted were approved (K. Aspengren, personal communication, April 22, 2012). Sixty-one per cent of these syllabi were approved in the first submission, with 75% of submitted syllabi approved in the second submission and 86% approved in the third. The number of syllabi submitted across AP Calculus and English courses in the 2010-11 AP Course Audit totaled 160,473. The data set for this study are rich in quality as well as quantity, providing me a large data set from which to sample randomly.

Sampling plan. Syllabi were randomly sampled from the AP Calculus AB, AP English Language and Composition, and English Literature and Composition courses. To ensure enough syllabi were reviewed to determine real differences between subject areas and learning styles, 125 syllabi each of AP Calculus AB, English Language and Composition, and English Literature and Composition were randomly sampled from the authorized AP syllabi for the 2012 academic year. Syllabi were randomly sampled using customary randomization sampling methods by means of the AP Course Audit's MySQL database. Each approved AP syllabus was assigned an identification number, and MySQL has a built-in function called "RAND()" that assigns random values to each row returned in a query. This makes it easy to retrieve a random list of AP English or Calculus syllabi.

Sampling error. During the scoring process, one of the 125 randomly selected AP English Language and Composition syllabi was not a syllabus but a letter to a school about the syllabus submitted. Requests were made for an additional, randomly selected syllabus. Each syllabus selected, however, was a syllabus already in my sample. Instead of continuing with this process, I instead randomly selected a syllabus from the sample of non-randomly selected syllabi to be used for training. The data from this syllabus was used instead of the letter that had erroneously been included in my random sample.

Measurements/Instrument development (construct validity). To ensure constructs were defined consistently, I constructed definitions from the literature to define Problem Solving, Authentic Learning, and Collaborative Learning for this study. The presence of these constructs in AP course syllabi was evidenced by the presence of words or phrases that represent Problem Solving, Authentic Learning, and Collaborative Learning) in the syllabi, which are defined in detail in the following pages. Because the syllabi were being evaluated against well-defined constructs and criteria, the construct validity was expected to be high.

Problem Solving. As identified in the Literature Review, Problem Solving was found in syllabi through activities involving understanding the problem, hypothesizing, and strategizing.

Understanding the problem. Any activity that requires students to restate the problem in their own words was considered a demonstration of understanding the problem in the syllabi and counted on the rubric for this category (see Appendix A). Additional examples of activities that counted as a form of understanding the problem in AP English syllabi included assignments requiring students to use their own words to

identify the main conflicts or issues in their reading, writing a summary of readings in their own words before beginning a writing assignment, or gathering research to support and develop student opinions rather than just restating opinions found in the literature. Requests to include students' own insights along with rephrasing others' opinions also fell under this category. Reading journal assignments requiring students to reflect on a piece of writing and document their perception of the work provided another example of using their own words to demonstrate understanding. If students were asked to describe how the author organized writing as opposed to merely summarizing the plot, or if rather than listing items found in writing students were asked to share how all of those items fit together, these were also counted as examples of understanding the problem.

In AP Calculus syllabi, understanding the problem was demonstrated through activities requiring students to identify the goal of the Problem Solving process of a math problem or assignment, describing the barriers preventing goal completion, and identifying possible solutions for overcoming those barriers (see Appendix A). If students were asked to keep a Calculus journal within which they reflected on their understanding of concepts in their own words, not just repeating definitions and explanations rote from the textbook or lecture, this was also an example of evidence for this subcomponent. Active reading assignments that required text annotation for texts by highlighting new information and summarizing this new information in their own words, adding the material that was new and writing out any questions they had in a journal were also examples of evidence. Assignments requiring students to create their own math problems also demonstrated their understanding of concepts learned. Any of the above activities

that qualify as examples of understanding the problem could have taken the form of a written assignment or required verbal interaction with peers (see Appendix A).

Hypothesizing. Hypothesizing was demonstrated in AP English syllabi by writing assignments requiring students to make predictions about what might happen in literary works, or what students could do next in their writing assignments (See Appendix A). Any assignment that presented students with pieces of literature that had gaps within the story line, requiring students to guess what happened despite this missing information, were also a demonstration of hypothesizing in syllabi. If students were asked to speculate about potential outcomes in their reading, predicting not only what might happen next but also how the story might end also counted as evidence. In addition to reading assignments, if students were asked to predict exam questions based on material covered in class this also counted as evidence of hypothesizing.

Hypothesizing was found in similar ways in AP Calculus syllabi. Assignments that asked students to predict what might happen next after choosing an approach to solving the problem, or requiring students to think about what they might do next after each step in the Problem Solving process were some ways hypothesizing was demonstrated in the syllabi (see Appendix A). Any assignment that required students to speculate the outcomes of choosing a particular path for solving a problem, and requiring students to explain the thinking behind this choice, demonstrated hypothesizing in syllabi. Assignments that required students to hypothesize solutions and the likely best option for solving their problem also demonstrated hypothesizing. Common words that could be used in syllabi to encourage hypothesizing were words or phrases like predict, estimate, approximate, or the make projections. Any of these activities in English or

Calculus syllabi could take the form of written assignments or paired peer verbal exchanges (see Appendix A).

Strategizing. The third form of Problem Solving that was searched for in AP syllabi was strategizing. Solving a problem requires the use of multiple steps or multiple strategies. In AP English courses, this was demonstrated through a multiple step writing process (see Appendix A). These steps were called different names by different instructors, but they often involved a planning or pre-writing phase, followed by multiple drafts that required proofreading, editing, and revising that incorporated feedback from peers and instructors. Syllabi that include assignments requiring students to participate in a multiple step writing process demonstrated strategizing. Quizzes and exams also required students to strategize in order to demonstrate their knowledge learned through class by responding to questions in a limited amount of time (see Appendix A). If students were required to provide specific information in a particular format in order to receive full credit, they were required to strategize in order to meet those expectations.

Strategizing was also demonstrated in syllabi through assignments requiring critical reading and writing (see Appendix A). Writing assignments that required careful reading and writing about literary work demonstrated strategizing. Any writing assignment that required students to explain and evaluate a position or claim also fit in this category. Essays requiring students to identify the main ideas or claims of a literary work, and create questions about that work that could be answered through additional research, were additional examples of strategizing through critical reading and writing. Assignments that required constructing arguments in support or opposition of the key claim, using research to support those arguments, also demonstrated strategizing.

Activities requiring students to evaluate the influences or implications of literary work could take the form of essays, critical reading journals, or formal and informal debates with peers. Any activity, whether written or oral, that required students to select the best way to construct a logical argument that also met instructor requirements fit under the strategizing category. Assignments that required students to analyze and develop their own research questions pertaining to reading or content covered in the course, requiring students use research to support their claims, also fit under the category of strategizing (see Appendix A).

Strategizing was also found in syllabi when requirements for writing conventions, writing styles, and analysis of audience issues were present (see Appendix A). Requirements for writing conventions included the appropriate use of writing mechanics, use of formatting guides such as MLA or APA, as well as grammar, sentence construction and punctuation in both writing assignments and oral presentations. The presence of these and similar writing convention requirements in syllabi demonstrated strategizing as students decided how best to meet instructor expectations. Writing assignments and oral presentations that required the use of a variety of writing styles such as argumentative or position essays, expository, narrative, business, persuasive, research or reflection papers demonstrated strategizing as well. These assignments required students to compare or contrast as well as interpret texts. Writing assignments that required students to analyze issues of audience by focusing on use of tone, whether to use a formal or informal style, and choosing the appropriate sentence structure for their purposes all demonstrated strategizing in AP English syllabi. Key words or phrases in syllabi that indicated strategizing could be present included describe; evaluate; analyze;

understand; compare; contrast; synthesize; explain; interpret; and communicate issues, themes, and conflicts.

In AP Calculus syllabi, strategizing was identified in a number of ways. Similar to the AP English syllabi, activities requiring students to use multiple strategies or to solve the problem using multiple steps demonstrated strategizing (see Appendix A). One step in this process involved planning the approach for solving the problem (see Appendix A). Any mention of this requirement in the syllabi demonstrated strategizing. Examples of using multiple steps for solving the problem included estimating possible solutions and strategies prior to attempts to solve the problem, writing assignments that required showing and explaining the choices taken in the Problem Solving process, and through verbal exchanges with peers requiring students to justify their reasoning behind chosen steps (see Appendix A). Once students hypothesized a possible solution, in the strategizing portion of the Problem Solving process students attempted their hypothesized solutions and explained why they were or were not the correct choices. If necessary, students then tested other hypotheses until the correct solution was found. Examples such as these in the syllabi all demonstrated strategizing. Activities requiring students to analyze the mathematical situation and choose the interpretation that was most likely correct and reasonable, justifying this choice, then retracing their steps when they selected an incorrect one were all additional demonstrations of strategizing in the syllabi (see Appendix A). After students completed a math problem, syllabi requirements to check their work for accuracy provided another source of strategizing in the syllabus (see Appendix A).

Similar to the use of quizzes and exams in AP English syllabi, in AP Calculus these activities also required students to strategize in order to demonstrate their knowledge learned through class by responding to questions in a limited amount of time (see Appendix A). Students were required to provide specific information in a particular format in order to receive full credit, requiring students to strategize in order to meet these expectations. Key words or phrases in the syllabi that indicated strategizing may be present included the use of verbs referring to Problem Solving such as analyze, apply, approximate, classify, calculate, compute, conduct, construct, demonstrate, design, describe, determine, differentiate, employ, estimate, evaluate, experiment, explain, express, factor, find, formulate, graph, hypothesize, identify, interpret, investigate, judge, justify, match, model, organize, perform, plan, relate, represent, recognize, simplify, speculate, sketch, solve, understand, validate, and write about.

Authentic Learning. As identified in the Literature Review, Authentic Learning was found in syllabi through activities involving experiential opportunities or active participation, meaningful connection to students, and relevance to students' lives and opportunities to engage in real-world problems.

Experiential opportunities or active participation. Any activity in the syllabi that promoted active learning such as projects, hands-on activities, simulations, role plays, debates, or field trips demonstrated experiential opportunities or active participation on the rubric for this category (see Appendix B). Projects or homework that allowed students to apply, practice, and review their knowledge, including long term projects that involved generating and testing hypotheses, also demonstrated this category in the rubric. Additional activities that qualified in this category included labs, discussions, or field

experiences that provided experiential opportunities for students to actively participate in their learning such as practicum experiences, apprenticeships, internships, or projects in the field (see Appendix B). This also took the form of more creative demonstrations in syllabi, such as requiring students to create an art project to demonstrate knowledge of a concept, write a song synthesizing the main points of a literary work, participate in a service learning project in the community, develop a six-minute walk through the major events of a literary work, or producing a scavenger hunt requiring students to find and document key themes from a literary work after being given items to find. Other activities that could be found in syllabi and demonstrated experiential opportunities or active participation included an activity called document shuffle, requiring small groups to review 12-15 documents to determine theme, chronological order, and which documents don't fit in with others. Assignments requiring students to take on roles of major characters in literary works and prepare for a debate between them, or public address on a current issue demonstrated experiential opportunities or active participation in syllabi.

Many of the above examples were found in both English and Calculus syllabi with minor adjustments. Additional examples of experiential opportunities or active participation that could more likely be found in Calculus syllabi included labs or projects used to demonstrate concepts learned in the textbook and lectures, as well as building models of something described in writing to transform a concept in to a physical entity. Activities that introduced students to new topics through group work using discovery-learning, or that provided opportunities for students to engage in explorations or games using graphing calculators all demonstrated experiential opportunities or active

participation in the syllabi. Homework assignments also may have required students to graph a mathematical problem, therefore demonstrating an experiential opportunities or active participation in the syllabi (see Appendix B).

Meaningful connection to students. Meaningful connection to students was found in AP syllabi through assignments designed to solve, address, or make students aware of current problems within the students' community (see Appendix B). This took the form of participation in service learning projects in the community, activities requiring students follow current events in newspapers or other media to integrate addressing actual problems in the students' community, or engaging in projects to apply concept knowledge and help the students' community (see Appendix B). Assignments requiring students to write mathematical word problems that applied to their lives outside of school also demonstrated connection to students' lives in syllabi. Connecting lecture topics or activities to cultural or background knowledge students may bring with them, or inviting students to build on the knowledge of the community and a culture already known to students were other ways to connect with students' lives in the syllabi (see Appendix B).

Field trips to museums that required students to compare and contrast what they just viewed to their own lives or activities such as a scavenger hunt that required students to find items in the museum that connect to their lives in some way were examples in the syllabi of a meaningful connection to students. Starting the year using concepts students were more familiar with, and then using those ideas to connect to more challenging concepts in the course was another example of an activity or strategy that helped connect the course content to students' lives. Choosing to use a variety of authentic and current texts to expand knowledge and understanding current diverse perspectives also

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demonstrated meaningful connection to students in syllabi. Additional creative demonstrations of this category in syllabi included creating a family tree history that connects a students' family history with the story line in literary works, creating a bumper sticker that could be used in the time period of the literary work being studied that required students to visually represent a concept from the course and relate it to a modern slogan or bumper sticker currently seen in circulation, or an assignment requiring students to write a newspaper article connecting the literary work with current events. While any of the above examples could also be altered for Calculus, one additional Calculus-specific example included assignments requiring students to apply the programming tools they have learned to real-life examples of problems.

Offering cross-disciplinary assignments or activities was an additional example in syllabi of the meaningful connection to students construct (see Appendix B). Cross-disciplinary assignments that required writing in math through the use of math journals or reflection papers on students' Problem Solving process, as well as assignments requiring students to communicate their mathematics understanding in both verbal and written forms demonstrated meaningful connection to students. Similarly, assignments requiring students to represent problems through both graphic and numerical formats demonstrated this construct.

Offering students choice in the topics they read or researched as well as choice of how they demonstrated their knowledge of the concepts learned also demonstrated meaningful connection to students in syllabi. For example, students may have been asked to select a topic for a writing assignment, and then choose from a variety of different formats such as a research essay, document analysis, annotated bibliography, film

analysis, cartoon or visual analysis, or PowerPoint presentation to demonstrate their knowledge of the material learned in the course. In English or Calculus courses, syllabi that required students to participate in poster presentation assignments requiring students to review current research in the field related to class that was of interest to each student, display that information in poster form, and present this information to the class demonstrated evidence of this construct. Additionally, students required to research and critique articles in the field that were most interesting to each student would also count as evidence.

Relevance to students' lives and opportunities to engage in real-world problems. Relevance to students' lives and opportunities to engage in real-world problems was demonstrated in AP course syllabi in a number of ways. Assignments designed to address actual problems professionals in the field were currently struggling to solve was one way to do this (see Appendix B). This was done through activities requiring students to follow and examine current trends in the subject area, and complete assignments requiring students to address issues or solve problems that exist. Another example in syllabi was the requirement that each student completes a research project and submits this into a high school research competition, present the new information to the public in a poster presentation, or share the new information in some other way.

Assignments that required students to apply their subject knowledge to an activity in a way that directly tied in to the subject content, rather than using worksheets that did not require students to apply their knowledge, were also examples of relevance in syllabi (see Appendix B). Journals were also used to keep track of a variety of student thoughts including reflection journals for literary works or math textbook reading assignments

requiring documentation of initial questions and impressions. Assignments that required using these journal entries later when students developed essays or engaged in group discussions made the journal activity more relevant for later success in the course. Activities where students were given the opportunity to correct writing and exam errors with an analysis of their errors, written responses to former AP exam prompts providing opportunities for students to discover weaknesses in conceptual understanding or in their communication skills, or where in-class opportunities provided background information that improved comprehension of literary work in AP English or mathematical concepts in AP Calculus, also demonstrated relevance. Assignments that provided college entry essay practice, matching activities requiring students to pair main characters in literature with quotes from those characters and writing a paper describing why they belong together, and opportunities to grade peers' exams to better understand instructor expectations all demonstrated relevance in syllabi.

Some specific examples of relevance in AP Calculus syllabi that helped students understand and apply subject knowledge included activities offering the use of graphing computer programs to make graphing assignments more understandable, written responses to former AP exam prompts providing opportunities for students to discover weaknesses in conceptual understanding or in their communication skills, and reflection journal activities explaining how concepts in AP Calculus tied together throughout the year. Text annotation activities requiring students highlight new information in reading assignments and put the material in their own words, organize the concepts into a logical and hierarchical order, and apply or react to the material also demonstrated relevance in

syllabi. Another example of relevance in Calculus syllabi is through activities requiring students to use mathematical tools to analyze current problems in their world.

Additional examples of relevant activities are those that aid students in course success and help organize student thinking to increase comprehension of subject matter (see Appendix B). Creating useful study guides for upcoming exams and writing chapter summaries were examples of relevance found in syllabi. Assignments requiring students to create graphic organizers and other visual mapping activities such as timelines, geographical mapping, change of culture or practice over time representations, or thematic mapping also demonstrated relevancy in syllabi. Additional activities that improved students' study skills and note-taking, activities that required students to create exam or assignment questions, or activities asking students to build a rubric for evaluation of assignments or exams all demonstrated relevance in syllabi by organizing students' thinking. Developing flash cards for exam reviews, and summarizing class information on notecards to use during quizzes, both helped students learn to organize their ideas concisely and assist students in applying their knowledge to their exams. Additional examples of study aids demonstrating relevance in syllabi included highlighting unfamiliar vocabulary to later define, and compiling student-developed questions at the beginning of each major section to be covered on the exam for the class members to focus their exam review.

Relevance was also demonstrated in syllabi through activities providing students with experience that would likely improve their postsecondary success (see Appendix B). Assignments demonstrating relevance in this way included those that required students to critique each other's work, or assignments requiring students research a potential career

and the academic skills needed for success in that career or in any postsecondary coursework required. Relevance was also demonstrated in syllabi in activities that required students to understand the "whys" of a process rather than just memorizing the process (see Appendix B). In AP English courses, students' ability to apply critical thinking skills learned in class to new literary works or writing assignments was one way students demonstrated understanding a process when applied to a variety of situations. Assignments that required students to show how their argument helps us understand and deal with problems in the real world, and activities requiring students to critically evaluate all sources of information both recent and historical, were additional ways relevance was demonstrated in this form.

In AP Calculus syllabi, assignments that required students to extract a problem from a new context, analyze the problem with processes learned in class, and interpret the solution back in to context was one demonstration of relevance. Explaining the results of solutions by providing a written interpretation rather than just a number in a box was an additional way students demonstrated their understanding of the process. Assignments requiring these skills demonstrated relevance in syllabi.

Collaborative Learning. As identified in the Literature Review, Collaborative Learning was found in syllabi through activities involving using out of class time effectively for study group learning; group projects or assignments; small-group or whole class discussions; reciprocal teaching; and for English syllabi only, peer review or editing.

Using out of class time effectively for study group learning. Any activity in the syllabi that promoted using out of class time effectively for study group learning

demonstrated collaboration (see Appendix C). Seeking help sessions outside of class in the form of tutoring circles, learning groups with peers, or even learning groups with the instructor demonstrates this form of collaboration. Activities such as regularly scheduled study groups, optional after-school study sessions to read and analyze supplemental texts, and student-formed study or tutoring groups relying on peer support demonstrated using out of class time effectively for study group learning. Exam review sessions, encouragement by instructors for students to regularly attend office hours, and participation in the school's Writing Center all demonstrated collaborative activities outside of class. Additionally, test preparation and study skill sessions, as well as extra credit opportunities for participation in any of the above out-of-class Collaborative Learning opportunities, demonstrated Collaborative Learning in this form.

Group projects or assignments. Syllabi for AP courses demonstrated group projects or assignments in syllabi through any work together with peers on assignments or projects (see Appendix C). Demonstrations of group projects or assignments in syllabi involved brainstorming activities, triad work, role play activities, dramatizations, games, panels, symposiums, colloquia, or round table discussions. Activities demonstrating group projects or assignments in syllabi included listening to others' strategies to evaluate the strengths and weaknesses of each, accepting constructive criticism by respecting differing opinions, and reviewing group work to provide constructive criticism including positives as well as suggested changes. Group projects that required class presentations, in-class activities requiring collaboration and short written responses, small group work or paired activities interpreting literary works or mathematical concepts together all demonstrated additional examples of group projects or assignments in syllabi. Group

jigsaw presentations, group debates, and group writing activities also demonstrated this form of collaboration. Additional demonstrations in syllabi included table group assignments as well as lab work with a partner or small group. In Calculus syllabi, group projects or assignments were demonstrated in discovery-learning activities as students were introduced to new topics through group work. Having the opportunity to work cooperatively on in-class work, graded AP problems, and take-home exams also demonstrated group projects or assignments in syllabi.

Small-group or whole class dialogue opportunities. Syllabi for AP courses demonstrated collaboration through either small-group or whole class dialogue opportunities (see Appendix C). Whole class discussions provided opportunities for instructors to ensure all students were clear on task and performance expectations, as well as the course content. Class discussions demonstrated collaboration in the form of dialogue opportunities, providing a time for students to exchange ideas and better understand the course content through graded discussion activities, class debates, electronic discussion boards on which all students were required to participate, and development of their own questions about course content based on the Socratic seminar models.

Games involving whole class participation included Jeopardy for review, vocabulary Bingo, and literary work Charades also demonstrated whole class dialogue opportunities in the syllabi. Syllabi requiring a minimum amount of student participation within a particular amount of time also demonstrated whole class dialogue opportunities. If students were required to discuss homework questions in small groups, while unresolved questions are saved for discussion with the entire class, this demonstrated

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whole class dialogue opportunities in the syllabi. Creating a role of "homework boss" in the classroom required individual students to serve for several days or weeks leading the homework reviews for the entire class and soliciting volunteers to share their work, ensuring that all students were keeping up with assignments completion and understanding the content requirements. Inclusion of a "homework boss" demonstrated whole class dialogue opportunities in the syllabi. An additional example of whole class dialogue opportunities in the syllabi was the use of text annotations as a basis for class discussions, allowing students the opportunity to add to and correct these annotations as the class progressed. All of the above activities demonstrated whole class dialogue opportunities in the syllabi.

Small-group dialogue opportunities provided students with additional opportunities to discuss perspectives of reading assignments, ideas about the content covered, as well as to clarify any expectations regarding coursework (see Appendix C). Activities requiring students to pair up and ask their partner challenging questions about their writing ideas or arguments, small-group online discussions of reading assignments, round table discussions on individual or group research projects, and developing study circles to address questions and concerns in both reading and other course assignments were all demonstrations of small-group dialogue opportunities in the syllabi. Assignments requiring students to create questions for sharing with a partner after summarizing an article that was different from the partner's article, and providing opportunities for each student to answer clarifying questions, also demonstrated small-group dialogue opportunities in the syllabi. Pre-reading activities requiring collaboration with a partner to tell a story about a book or chapter based on a picture, diagram, or

bolded key words throughout the text were additional examples demonstrating this form of collaboration. Assignments requiring students to pair up and discuss characteristics of literary works or mathematical concepts, then share the information discussed with the whole class, would demonstrated a think/pair/share activity as a small-group dialogue opportunity in the syllabi.

Reciprocal teaching. Peer interactions demonstrating reciprocal teaching in the syllabi included those requiring each student in a small group to learn specific content and then teach this content to their peers in the group (see Appendix C). Those jigsaw activities required each person or group to learn one piece of the "big picture", then teach this information to the whole group so all participants learned all pieces. Inner/outer circle discussions where students from two groups read different articles on the same topic, one group discussing the issues with the other group taking notes, and then finally reversing this process was another demonstration of reciprocal teaching in the syllabi. Assignments requiring students to create questions for sharing with a partner after summarizing an article different from the partner's article, and providing opportunities for each student to answer clarifying questions, also demonstrated reciprocal teaching in the syllabi. Jigsaw activities often incorporated learning and teaching about a reading assignment, but sometimes they involved sharing research with fellow students in a symposium or sharing some other item related to course content thematically but not incorporated in the instruction. Demonstrations in syllabi that indicated students were learning and teaching content to each other in a jigsaw manner were examples of reciprocal teaching.

Peer review or editing. Activities that demonstrated peer review or editing in AP English syllabi included the review of peer writing assignments, listening to others' strategies and evaluating the strengths and weaknesses of each, and providing constructive criticism including positive points as well as needed revisions (see Appendix C). Syllabi demonstrated peer review or editing when stating the expectation that students accept constructive criticism by respecting differing opinions and maintaining civility. Activities such as face-to-face or online discussion boards to provide peers feedback on writing assignments, developing rebuttals to feedback encouraging writing or argument changes, and group development of a rubric for evaluating writing assignments all demonstrated peer review or editing in AP English syllabi.

Rubric Scoring Process

Rubric development. I worked closely with the Director of the AP Course Audit who has expertise in building scoring guides to analyze syllabi. The scoring guides shared by the Director of the AP Course Audit were adapted to reflect the new constructs being measured that represent the constructs of interest in this study: Problem Solving, Authentic Learning, and Collaborative Learning. Therefore, the rubric that will be used to determine if Calculus and English AP syllabi contain evidence for Problem Solving, Authentic Learning, and Collaborative Learning has been adapted from an already constructed analytic tool used by EPIC. The rubric was reviewed and revised with the help of staff familiar with criterion-based scoring systems.

Similar tools have been used to analyze AP course syllabi for evidence of syllabus requirements needed to obtain AP status from the College Board. As the College Board develops scoring guides and training materials for use by reviewers in the AP Course

Audit, rubrics similar to mine undergo a calibration process informed by decisions made by the reviewers (K.Aspengren, personal communication, May 16, 2014). Once scoring guides and training materials are developed, reviewers score 5 syllabi with the 5th syllabus serving as a benchmark to ensure scoring is consistent (K.Aspengren, personal communication, May 16, 2014). This process was mirrored in my study, but since fewer syllabi were being reviewed, I chose to set the 4th syllabus to be the benchmark to check for agreement between myself and the other rater. Also, training materials were reviewed thoroughly before any sample scoring took place. Review of the Training Manual, Codebook, Decision Rules (see Appendix D), and scored/annotated syllabi took place in the Initial Training Session prior to scoring of sample syllabi. The structure of these materials were also modeled from the materials used by the College Board. The College Board aims for a minimum of 84% to 88% agreement, depending on the subject (K.Aspengren, personal communication, May 16, 2014). If this goal is not met reviewers score another benchmark syllabus and if the minimum agreement is not met, reviewers must meet participate in additional training and review of decisions made that were in disagreement. For my study, our goal was 80% agreement. If this was not met we reviewed the scoring decisions in disagreement and retrained on additional syllabi outside the random sample until the minimum agreement threshold was met. This process has been found to yield strong products for the College Board and has been used numerous times.

Rubric piloting. To verify that the rubrics could be used to evaluate syllabi and that the constructs can be found in syllabi, I scored sample syllabi across a variety of AP course subjects using each of the two rubrics for this study: Calculus and English. The

Director of the AP Course Audit thought I might be better able to explore examples of the three learning styles in syllabi by evaluating this variety of subject areas, and in total 116 syllabi chosen by convenience were evaluated for this pilot.

Using the Calculus rubric, 41 syllabi were evaluated across the following AP subject areas: Calculus AB (8), Calculus BC (6), Biology (17), and Computer Science (10). More syllabi were evaluated using the English because of larger perceived differences in the structure of courses sampled. With the English rubric, 75 sample syllabi were evaluated from the following AP subject areas: US History (8), World History (14), US Government and Politics (10), English Language and Composition (8), English Literature and Composition (8), Spanish Language (7), Art History (12), and Studio Art (8).

From the 41 syllabi reviewed using the Calculus rubric I found 51 examples of Problem Solving, 48 examples of Authentic Learning, and 31 examples of Collaborative Learning (see Tables 1, 2, and 3). From those frequency counts, 17 examples of Problem Solving came from the Calculus syllabi specifically, as well as 15 examples of Authentic Learning and 13 examples of Collaborative Learning. From the 75 syllabi reviewed using the English rubric, 239 examples of Problem Solving were found with 98 examples from the English syllabi specifically (see Tables 4, 5, and 6). Ninety-five examples of Authentic Learning were found with 11 from the English courses, and 114 examples of Collaborative Learning were found with 26 from English syllabi.

Table 1. Frequency counts for rubric pilot scoring Calculus-related subjects: Problem Solving subcomponents

Subject (# syllabi scored)	Overall Problem Solving	Understanding the Problem	Hypothesizing	Strategizing
Calculus AB (8)	15	3	2	12
Calculus BC (6)	12	2	2	8
Biology (17)	18	1	0	17
Computer Science (10)	6	0	0	6

Table 2. Frequency counts for rubric pilot scoring Calculus-related subjects: Authentic Learning subcomponents

Subject (# syllabi scored)	Overall Authentic Learning	Experiential Opportunities or Active Learning	Meaning	Relevance
Calculus AB (8)	10	5	0	5
Calculus BC (6)	5	2	0	3
Biology (17)	24	13	2	9
Computer Science (10)	9	6	2	1

Table 3. Frequency counts for rubric pilot scoring Calculus-related subjects: Collaborative Learning subcomponents

Subject (# syllabi scored)	Overall Collabora-tive Learning	Using out of Class Time for Study Groups	Group Projects or Assign-ments	Dialogue (Whole Class/ Small Groups)	Reciprocal Teaching	Peer Review
Calculus AB (8)	8	1	5	2	0	0
Calculus BC (6)	5	0	4	1	0	0
Biology (17)	14	3	4	7	0	0
Computer Science (10)	4	2	2	0	0	0

Examples were found of each construct used in the rubrics with a few exceptions. From the area of Problem Solving strategizing, no evidence of "Use multiple strategies/Solve problem using multiple steps" was found in either the English or the Calculus rubrics. Also missing from the strategizing area of the Calculus rubric were examples of "Plan your approach for solving the problem", "Analyze mathematical

situation and choose interpretation more likely correct and reasonable: Retrace steps

when select incorrect one", and "After completion of math problem, check your work for

accuracy". Because all of these constructs are evidence of higher level Problem Solving

required of students and less likely to be found frequently in the syllabi, I decided to

leave them in the rubric to assess whether examples can be found after analyzing a larger

number of Calculus syllabi.

Table 4. Frequency counts for rubric pilot scoring English-related subjects: Problem Solving subcomponents

Subject (# syllabi scored)	Overall Problem Solving	Understanding the Problem	Hypothesizing	Strategizing
US History (8)	26	1	1	32
World History (14)	34	1	1	32
US Govt and Politics (10)	13	0	0	13
English Lang & Composition (8)	37	2	0	35
English Lit & Composition (8)	61	33	1	27
Spanish Language (7)	16	0	2	14
Art History(12)	49	4	1	44
Studio Art (8)	3	2	0	1

Table 5. Frequency counts for rubric pilot scoring English-related subjects: Authentic Learning subcomponents

Subject (# syllabi scored)	Overall Authentic Learning	Experiential Opportunities or Active Learning	Meaning	Relevance
US History (8)	15	4	5	6
World History (14)	25	7	10	8
US Govt and Politics (10)	11	3	4	4
English Lang & Composition (8)	5	1	2	2
English Lit & Composition (8)	6	0	2	4
Spanish Language (7)	5	1	3	1
Art History(12)	21	12	6	3
Studio Art (8)	7	7	0	0

Table 6. Frequency counts for rubric pilot scoring English-related subjects: Collaborative Learning subcomponents

Subject (# syllabi scored)	Overall Collaborative Learning	Using out of Class Time for Study Groups	Group Projects or Assignments	Dialogue (Whole Class/ Small Groups)	Reciprocal Teaching	Peer Review
US History (8)	15	4	4	4	1	2
World History (14)	26	6	7	7	3	3
US Govt and Politics (10)	13	1	4	7	0	1
English Lang & Composition (8)	14	1	2	7	0	4
English Lit & Composition (8)	12	1	3	5	0	3
Spanish Language (7)	8	0	0	6	0	2
Art History(12)	22	4	4	12	2	0
Studio Art (8)	4	0	0	2	0	2

From the Collaborative Learning section, no examples of Reciprocal Teaching were found using the Calculus rubric. Since no other subcomponent is similar to Reciprocal Teaching, I am leaving this construct in the rubric so I can measure it's inclusion in the syllabi and be able to directly compare the frequency of the same construct across subjects. However, no evidence of Peer Review was found in the Calculus syllabi. Peer Review was defined as reviewing peer writing assignments, listening to others' strategies to evaluate strengths and weaknesses of each, providing constructive criticism by including positive points as well as needed revisions, and accepting constructive criticism by respecting differing opinions while maintaining civility. The College Board requires English syllabi to include some aspect of peer review in order for AP approval. Since a peer review activity can take different forms (review a

peer's assignment and provide only written feedback, dialogue in a small group about suggested revisions, etc.), I wanted to differentiate my findings and collect data on all three subcomponents (Group projects, Dialogue, and Peer Review) for English syllabi. But because no evidence of these same activities was found in the Calculus syllabi during the pilot scoring, and the Peer Review activities were easily combined with Group projects, I chose not to collect Peer Review data for Calculus anticipating the Chi Square analysis would likely be skewed between subjects due to this discrepancy in College Board syllabus subject requirements.

Examples from the Authentic Learning construct Relevant could not be found for "Use mathematical tools to analyze the student's world" nor "Able to extract a problem from context, use mathematical knowledge to solve the problem, and interpret solution back in to context". Because these constructs both seem important for assessing the presence of Authentic Learning in Calculus syllabi, I have chosen to keep them in the rubric to assess whether a larger pool of Calculus syllabi will yield a different result.

From this pilot of the rubric, I demonstrated that the rubrics work to identify the constructs of Problem Solving, Authentic Learning, and Collaborative Learning in AP syllabi. Having found evidence for the constructs in the rubric through my evaluation of sample syllabi, and explaining my reasoning for keeping constructs for which evidence was not found, I verified that these rubrics worked to detect the components and subcomponents of this study.

Inter-Rater Agreement

Adjustments to the rubric. After piloting the rubric and preparing scored syllabi for training, the subcomponents for Authentic Learning seemed to overlap too much. In

addition, the initial presentation of the rubric and my project to the rater left the rater requesting fewer variables to score. Due to these issues, adjustments to the categories were made, combining Meaningful connection to students and Relevance to students' lives/Opportunities to engage in real-world problems into one subcomponent for Authentic Learning: Connection to students' lives outside of school. Additionally, the original Codebook which took the form of the rubrics in Appendices A, B, and C was reformatted for ease of rater understanding (see Appendix D).

Training process overview. To ensure reliability in rating the syllabi, I recruited and trained another graduate student to score a random sample of 10% from the total syllabi evaluated for this study. When a minimum of 80% agreement was found between the rater and myself, this established inter-rater agreement. Training materials were reviewed with the rater (see Appendix D) that included examples of how each component and subcomponent could be found in the syllabi, as well as directions on how to score each syllabus. Once agreement on scoring was met, we scored four syllabi independently and compared our scores after the independent review. Whenever score agreement was lower than 80%, I retrained the rater until a minimum of 80% agreement was achieved. A detailed description of this process follows.

Initial training: Calculus (Step 1). I met with the rater before any scoring took place to train the rater and help familiarize her with the codebook and scoring process. During the initial training session, I went through the Training Manual and Codebook with the rater (see Appendix D). Once the Training Manual and Codebook were reviewed, I went through two sample syllabi from Calculus that had already been scored by I to show the rater how evidence was found, or not found, for each component and

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subcomponent. Decision rules for scoring of these Initial Training syllabi were discussed at this time (see Appendix D) focusing on examples in the syllabus that did and did not count as evidence of Problem Solving, Authentic Learning, or Collaborative Learning. The rater had the opportunity to ask clarifying questions throughout the process. All Initial Training and Training syllabi were taken outside of the random sample for this study.

Next, the rater reviewed a third syllabus and verbally shared her scoring process with I as the syllabus was reviewed. Differences between how I scored the syllabus and how the rater scored the syllabus were discussed as the scoring took place to reduce errors in thinking later in the scoring process. Decision rules for these Initial Training syllabi were discussed throughout this phase of the training process (see Appendix D), especially when any discrepancies between scoring occurred. Finally, the rater scored a fourth sample syllabus alone and compared her final scoring with I scores. This Initial Training process gave me an opportunity to determine how closely the rater's scores matched my own and identify any areas where retraining needed to occur. At this point in the training process, the rater and I had obtained 100% agreement.

Decision rules for the Initial Training syllabi were again discussed and any further questions the rater had about the process were addressed. Additional, general decision rules were also developed at this time. One new decision rule regarded the phrase "students will be able to" in the syllabi. This phrase alone was not enough evidence for a Problem Solving, Authentic Learning, or Collaborative Learning opportunity. Instead, an explicit description of the activity rather than listing of an objective or learning goal for the course was needed for an activity to count as evidence of a component. Similarly, a

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decision rule was created for Collaborative Learning specifically regarding assumptions of what happened during group activities. While Group activities counted as evidence of Collaborative Learning, these activities needed to be explicitly described and scorers should not assume that Dialogue also occurred during these activities. Unless specifically indicated, activities were to be explicitly described in order to count as evidence for both subcomponents of Collaborative Learning. This leads to another decision rule made, which was that one activity could count as evidence for multiple subcomponents if described in enough detail to meet criteria for these subcomponents.

Scoring procedures. Initially, electronic versions of the syllabi were viewed by rater and I in pdf format. After reliability issues occurred (as described in the next section), the scoring process was revised to the following procedure. Two copies of each syllabus was printed so that the rater and trainer each had a paper copy for scoring. Scorers reviewed each section or paragraph for evidence of Problem Solving, Authentic Learning, or Collaborative Learning. As syllabi were evaluated for the presence of Problem Solving, Authentic Learning, or Collaborative Learning, frequency counts were used to determine how often these learning styles were included in the syllabi. When evidence of one or more of the components and subcomponents was found in each syllabus, scorers wrote abbreviations corresponding with the Concept Overview (see Appendix D) in the left margins. When a scorer was uncertain about whether or not an activity demonstrated Problem Solving, Authentic Learning, or Collaborative Learning, they wrote a question mark on either side of the component/subcomponent written in the margins. After completing their first review of the syllabus, scorers reviewed the syllabus one more time to make a final decision on any uncertainties.

A paper copy of the Excel sheet used for scoring (see Appendix E) was provided for each scorer to help keep track of evidence as they reviewed each syllabus. When evidence for components and subcomponents were found, a 'Yes' or 'Y' was entered in the appropriate column. Each 'Yes' counted as one point. If any subcomponents of Problem Solving, Authentic Learning or Collaborative Learning were marked as being present ('Y' or 'Yes'), scorers also marked the larger component as being present. Any empty columns at the end of the reviews were filled with a 'No' or 'N' on the paper scoring sheet. Total frequency counts were calculated by subject area to determine to what degree each learning style was included in each subject area.

After the final review of the syllabus, scorers completed the Excel sheet electronically by selecting "Yes" if there is any evidence for each component (Problem Solving, Authentic Learning, and Collaborative Learning) and which subcomponent there was evidence found for each component. Either 'Yes' or 'No' was required for each component and each subcomponent.

General questions about whether evidence of a component (Problem Solving, Authentic Learning, Collaborative Learning), or any of the subcomponents within each component were present in the syllabi were available in the Decision Rules in the Training Manual (see Appendix D). Definitions and examples of each component and subcomponent were available in the Codebook, as well as in the Training Manual.

Independent syllabus rating: Training session 1 (Step 2). Once the initial training session was completed and scoring agreement met, the rater and I reviewed and scored four additional training syllabi independently. After completing these syllabi I compared our scores and whenever score agreement was lower than 80% I retrained the

rater with more syllabi outside of the random sample. After Training Session 1, only 73%

inter-rater agreement was obtained (see Table 7). Since this number was below the

desired 80% inter-rater agreement, I reviewed the scoring of all four syllabi with the rater

and retrained around areas that had lower reliability, including Problem Solving

(Hypothesizing and Strategizing both at 50%) and Authentic Learning

(Experiential/Active Learning and Connection to students lives both at 75%).

Collaborative Learning scores were in agreement 100% of the time, with the exception of

the subcomponent Dialogue through Whole Class or Small Group Discussions where

scores aligned 75% of the time. Revisions were made to the Problem Solving

subcomponent Strategizing and the Authentic Learning subcomponent

Experiential/Active Learning in the Codebook (see Appendix F) to alleviate some of

these agreement differences and clarify the scoring process for these subcomponents.

Table 7. Inter-Rater agreement rates in percentages: Calculus training

Scoring Session	Problem Solving	Authentic Learning	Collaborative Learning	Total Reliability
Training Session 1	62	75	100	73
Training Session 2	75	100	80	83
Benchmark 1	68	83	65	73
Training Session 3	69	92	80	79
Training Session 4	93	92	75	85
Benchmark 2	81	83	90	85
Benchmark 3	85	100	96	92

At this point in the scoring, the rater suggested that she would prefer a hard copy

of each syllabus to review. Since we had reviewed paper copies of the syllabi during the

Initial Training and our agreement seemed higher, the next round of scoring used paper

copies to determine if reliability increased with a hard copy versus the digital version

used in Training Session 1.

Independent syllabus rating: Training session 2 (Step 3). After revising the
Strategizing and Experiential/Active Learning subcomponents, and reviewing low-
agreement areas from Training Session 2, we scored four more syllabi independently and
obtained 83% agreement (see Table 7). Although disagreement in Strategizing still
occurred, we examined our independent scoring decisions and reviewed the
subcomponents of Reciprocal Teaching (Collaborative Learning) and Group Projects or
Assignments. Since the 80% inter-rater agreement minimum was met, we moved on to
score four syllabi from the random sample of syllabi for this study. Because inter-rater
agreement did increase with the paper copies of the syllabi, hard copies for the rater and I
were printed for the remainder of the scoring process.

Independent syllabus rating: Benchmark 1 from random sample (Step 4). Once
we met the minimum inter-rater agreement score of 80%, the rater was given a random
sample of 13 syllabi from I random sample of 125 Calculus syllabi.

Benchmarking process. The rater independently reviewed the syllabi in numerical
order, with every fourth syllabus serving as a benchmark to be compared with my
scoring. Whenever the rater's benchmarked syllabus scores did not agree with my
benchmarked scores at least 80% of the time, the trainer reviewed the scoring process
with the rater on syllabi outside of this random sample and retrained the rater on any
scoring that did not match the criteria in the Codebook. This process was adapted from
the training/retraining process used for the AP Audit syllabi scoring (K. Aspengren
personal communication, April 30, 2013). Adjustments to the Codebook were made as
needed in order to increase clarity and reliability.

Benchmark 1 agreement. In this first benchmark of four syllabi, the overall rate of inter-rater agreement declined back to 73% (see Table 7). Inter-rater agreement for Problem Solving was 68%, with subcomponents Understanding the problem and Hypothesizing being much lower (25% and 75% respectively). However, the inter-rater agreement for Strategizing increased to 100% after the retraining and revision of the Codebook. Review of Understanding the problem and Hypothesizing criteria occurred, as well as reviews for the Authentic Learning subcomponent Experiential/Active Learning (50%) and the Collaborative Learning subcomponents Group Projects (75%) and Dialogue (25%). A revision to the Concept Overview for Group Projects was necessary to clarify the criteria for this subcomponent, expanding "Any work together with peers" to include the turning in of a product of students' work together or a formal presentation to the class or instructor (see Appendix G). Since the inter-rater agreement rate was below 80%, however, retraining with four additional syllabi was the required next step.

Changes to Hypothesizing definition. As the scorers reviewed syllabi, it soon became clear that some of the key words for the Problem Solving subcomponent Hypothesizing were not useful. After collaborating with math faculty at the University of Oregon it was confirmed that terms such as "approximate" and "estimate" held different definitions in the Calculus content area than I had initially intended for the subcomponent definition (A. Hampton personal communication, September 26, 2013; S. Libeskind personal communication, September 15, 2013; D. Sinha personal communication, September 23, 2013). At this point in the training, a correction was made to the Codebook and the key words "approximate" and "estimate" were replaced with "make a

good guess" (see Appendix H). Additional Decision Rules specifically for Hypothesizing were also reviewed with the rater and printed for her later reference (see Appendix I).

Training session 3 (Step 5). After reviewing four additional syllabi, the inter-agreement rate increased from 73% to 79% (see Table 7). Still below the 80% desired rate. Retraining with four more syllabi was required, after reviewing all Problem Solving criteria (69% overall), Authentic Learning Experiential/Active Learning criteria, and Collaborative Learning Dialogue criteria, even though the overall agreement for Collaborative Learning was at 80%. The low agreement for Dialogue (25%) required more clarification between it and Group Projects.

Training session 4 (Step 6). Reviewing four more syllabi resulted in an inter-rater agreement rate of 85% (see Table 7). This increase over the 80% threshold meant that we could score the next benchmark group of syllabi. While some of the subcomponents continued to result in disagreement (Hypothesizing, Experiential/Active Learning, Dialogue), reviewing our scores together resulted in agreement of how to score these subcomponents in the next rounds. Revisions to Group projects and Dialogue criteria in the Codebook (see Appendix J) helped us keep track of these clarifications in the upcoming scoring rounds.

Benchmark 2 from random sample (Step 7). Benchmark 2 scores resulted in maintaining the 85% inter-rater agreement rate. Dialogue agreement increased from 25% to 100% (see Table 7), while other subcomponents continued to cause problems with agreement (Understanding the problem, Strategizing, Experiential/Active Learning). To help reduce confusion regarding Experiential/Active Learning criteria, revisions were made to the Codebook (see Appendix K).

Benchmark 3 from random sample (Step 8). In the third benchmark round of the final four syllabi, we reached 92% agreement between raters (see Table 7). As a result of retraining, reviewing criteria, and revising the Codebook, a score of 80% inter-rater agreement was earned for each subcomponent. Dialogue continued to have 100% agreement across raters, and Experiential/Active Learning increased to 100% agreement as well. Understanding the problem and Strategizing reached 80% inter-rater agreement this round, while Hypothesizing reached 100% agreement. Overall inter-rater agreement for the AP Calculus syllabi sample was 84%.

Initial training: English Literature and Composition (Step 1). After completing the scoring for the Calculus sample, training began for English Literature and Composition with the same process as used for Calculus. Most of the Codebook subcomponent from the Calculus section translated to the English courses, so revisions to these subcomponents (Collaborative Learning Group and Dialogue, Authentic Learning Experiential/Active Learning) in the Codebook took place before Initial Training began.

As with the Initial Training for scoring Calculus syllabi, I met with the rater before any scoring took place to train the rater and help familiarize her with the codebook for the new subject area. Once the new Codebook criteria were reviewed, I went through two sample syllabi from English Literature and Composition that had already been scored by I to show the rater how evidence was found, or not found, for each component and subcomponent. Decision rules for scoring of these Initial Training syllabi were discussed at this time (see Appendix D) focusing on examples in the syllabus that did or did not count as evidence of Problem Solving, Authentic Learning, or Collaborative Learning. The rater had the opportunity to ask clarifying questions throughout the process. All

Initial Training and Training syllabi were again taken outside of the random sample for this study.

Next, the rater reviewed a third syllabus and verbally shared her scoring process with I as the syllabus was reviewed. Differences between how I scored the syllabus and how the rater scored the syllabus were discussed as the scoring took place to reduce errors in thinking later in the scoring process. Decision rules for these Initial Training syllabi were discussed throughout this phase of the training process (see Appendix D), especially when any discrepancies between scoring occurred. Finally, the rater scored a fourth sample syllabus independently and compared her final scoring with I scores. This Initial Training process gave me an opportunity to determine how closely the rater's scores matched my own and identify any areas where retraining needed to occur. Decision rules for the fourth Initial Training syllabus were discussed and any further questions the rater had about the process were addressed.

Training session 1 (Step 2). After scoring four English Literature and Composition syllabi independently, an inter-rater agreement rate of 90% was obtained (see Table 8). While many of the Collaborative Learning subcomponents and the Authentic Learning subcomponent Experiential/Active Learning scored at 75% agreement, the overall rate of agreement met the minimum of 80%. Review of these subcomponents (Collaborative Learning Group and Dialogue, Authentic Learning Experiential/Active Learning) took place before moving on to the first benchmark.

Benchmarks from random sample (Steps 3,4, and 5). An inter-rater agreement rate of 87% was obtained after the first benchmark of four syllabi (see Table 8). Because this rate was higher than the minimum 80% threshold, we reviewed all areas of scoring

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disagreement and moved on to the next benchmark. At benchmark 2 a 94% inter-rater

agreement was obtained, still higher than the minimum threshold. Again after reviewing

areas of scoring disagreement we moved on to the third and final benchmark for English

Literature and Composition. Inter-rater agreement declined to 89% after scoring the final

syllabi, but as this rate was still above 80% we moved on to English Language and

Composition after reviewing scoring disagreements and reviewing the Authentic

Learning subcomponent Experiential/Active Learning and the Collaborative Learning

subcomponent Using out of class time for study group learning. The Codebook for this

Collaborative Learning subcomponent was also revised at this time (see Appendix L).

The overall inter-rater agreement rate for the AP English Literature and Composition

syllabi was 90%.

Table 8. Inter-Rater agreement rates in percentages: English Literature & Composition training

Scoring Session	Problem Solving	Authentic Learning	Collaborative Learning	Total Reliability
Training Session 1	100	92	79	90
Benchmark 1	94	100	79	87
Benchmark 2	100	75	100	94
Benchmark 3	100	100	87	89

Initial training for English Language and Composition (Step 1). As with the

Initial Training for scoring the Calculus and English Literature and Composition syllabi, I

met with the rater before any scoring took place to train and help familiarize her with the

syllabi in the new subject area. The Codebook criteria remained the same. I went through

two sample syllabi from English Language and Composition that had already been scored

by I to show the rater how evidence was found, or not found, for each component and

subcomponent in this new subject area. Decision rules for scoring of these Initial

Training syllabi were discussed at this time (see Appendix D) focusing on examples in

the syllabus that did and did not count as evidence of Problem Solving, Authentic Learning, or Collaborative Learning. The rater had the opportunity to ask clarifying questions throughout the process. All Initial Training and Training syllabi were again taken outside of the random sample for this study.

Next, the rater reviewed a third syllabus and verbally shared her scoring process with I as the syllabus was reviewed. Differences between how I scored the syllabus and how the rater scored the syllabus were discussed as the scoring took place to reduce errors in thinking later in the scoring process. Decision rules for these Initial Training syllabi were discussed throughout this phase of the training process (see Appendix D), especially when any discrepancies between scoring occurred. Finally, the rater scored a fourth sample syllabus independently and compared her final scoring with I scores. This Initial Training process gave me an opportunity to determine how closely the rater's scores matched my own and identify any areas where retraining needed to occur. Decision rules for the fourth Initial Training syllabus were discussed and any further questions the rater had about the process were addressed.

Because the English courses used the same Codebook and reliability had already been established for English Literature and Composition, after completing the scoring for the English Literature and Composition Initial Training sample, we transitioned on to scoring the first benchmark for English Language and Composition.

Benchmark 1 and 2 (Steps 2 and 3). After an inter-rater agreement rate of 98% was obtained at the first benchmark (see Table 9), we moved on to benchmark 2 after reviewing the Collaborative Learning subcomponent Dialogue. However, the inter-rater agreement decreased to 79% at Benchmark 2 (see Table 9) requiring me to re-train the

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rater after reviewing our scoring disagreements. Reviewing subcomponents in all three

components was necessary, but once we reviewed these (Problem Solving

subcomponents Understanding the problem and Hypothesizing; Authentic Learning

subcomponents Experiential/Active Learning and Connection to students' lives; and

Collaborative Learning Using out of class time for study group learning and Dialogue)

we moved on to score four more syllabi to determine if our rate of agreement increased.

Table 9. Inter-Rater agreement rates in percentages: English Language & Composition
training

Scoring Session	Problem Solving	Authentic Learning	Collaborative Learning	Total Reliability
Benchmark 1	100	100	96	98
Benchmark 2	75	75	83	79
Training Session1	100	92	92	94
Benchmark 3	95	87	97	92

Training session 1 (Step 4). Scoring our training sample brought the inter-rater

agreement rate back up to 94% (see Table 9). We agreed 100% on scoring for the

Dialogue subcomponent but continued to disagree on the scoring of the

Experiential/Active Learning subcomponent. Due to our inter-rater agreement score

meeting the 80% threshold, after reviewing the few disagreements in scoring (Group

Projects, Experiential/Active Learning) we moved on to the final benchmark.

Benchmark 3 (Step 5). In our final benchmark, we obtained a 92% inter-rater

agreement rate (see Table 9). We continued to agree 100% on the scoring for Dialogue

and increased our scoring agreement for Experiential/Active Learning up to 100% as

well. Scoring agreement declined for Understanding the problem, Peer review, and

Connection to students' lives, but the overall rate of 92% marked the end of inter-rater

scoring for AP English Language and Composition. The inter-rater agreement for this

subject overall was 90%.

Statistical Analyses

Chi-Square (χ^2) tests of independence were used to determine whether the presence of the components of interest (inclusion of Problem Solving, Collaborative Learning, and Authentic Learning) were differentially observed between the three subject areas. A statistically significant chi-square indicates that any observed differences between the subject areas were not simply due to chance. When significant results were found in the presence of components or subcomponents present in the syllabi from different subject areas, additional follow-up Chi-Square (χ^2) tests were conducted in order to interpret the omnibus effect. Specifically, the omnibus effect was broken down by comparing frequencies of sub/components in Calculus courses to frequencies in the combined English courses. Next, another Chi-Square (χ^2) test was conducted comparing the two AP English courses to each other.

CHAPTER IV

RESULTS

On average, the length of an AP Calculus syllabus was 8.7 pages. In comparison, the average length of an ELC syllabus was 15.2 pages and an ELA syllabus 13.6 pages.

Problem Solving in AP Calculus and English Syllabi

To determine the degree AP Calculus and English courses showed evidence of Problem Solving in the syllabi (Research questions 1 and 2), frequency counts were calculated. From the Calculus subject area (see Table 10), 108 syllabi contained examples of Problem Solving (86.4% of the Calculus syllabi). From these syllabi, 21 contained examples of Understanding the Problem (16.8%), 4 contained examples of Hypothesizing (3.2%) and 105 contained examples of Strategizing (84%).

All English Literature and Composition (ELC) and English Language and Composition syllabi contained examples of Problem Solving (see Table 10). One hundred five ELC syllabi contained examples of Understanding the Problem (84%), 11 contained examples of Hypothesizing (8.8%), and 125 contained examples of Strategizing (100%). Ninety-seven ELA syllabi contained examples of Understanding the Problem (77.6%), 3 contained examples of Hypothesizing (2.4%), and 125 contained examples of Strategizing (100%).

Table 10. Presence of Problem Solving in the syllabi across subjects: Percentage of syllabi and frequency counts

Sub/Components	Calculus	ELC	ELA
Problem Solving	86.4% (108)	100% (125)	100% (125)
Understanding the Problem	16.8% (21)	84% (105)	77.6% (97)
Hypothesizing	3.2% (4)	8.8% (11)	2.4% (3)
Strategizing	84% (105)	100% (125)	100% (125)

Authentic Learning in AP Calculus and English Syllabi

To determine the degree AP Calculus and English courses showed evidence of Authentic Learning in the syllabi (Research questions 3 and 4), frequency counts were calculated. From the Calculus subject area (see Table 11), 124 syllabi contained examples of Authentic Learning (99.2% of the Calculus syllabi). From these syllabi, 65 contained examples of Experiential/Active Learning (52%) and 123 contained examples of Connection to Students' Lives (98.4%).

Table 11. Presence of Authentic Learning in the syllabi across subjects: Percentage of syllabi and frequency counts

Sub/Components	Calculus	ELC	ELA
Authentic Learning	99.2% (124)	100% (125)	100% (125)
Experiential/ Active Learning	52% (65)	48% (60)	57.6% (72)
Connection to Students' Lives	98.4% (123)	100% (125)	100% (125)

All English Literature and Composition (ELC) and English Language and Composition syllabi contained examples of Authentic Learning (see Table 11). From these syllabi, 60 contained examples of Experiential/Active Learning (48%) and all ELC syllabi contained examples of Connection to Students' Lives (100%). Seventy-two ELA syllabi contained examples of Experiential/Active Learning (57.6%) and all ELA syllabi contained examples of Connection to Students' Lives (100%).

Collaborative Learning in AP Calculus and English Syllabi

To determine the degree AP Calculus and English courses showed evidence of Collaborative Learning in the syllabi (Research questions 5 and 6), frequency counts were calculated. From the Calculus subject area (see Table 12), 94 syllabi contained examples of Collaborative Learning (75.2% of the Calculus syllabi). From these syllabi, 16 contained examples of Using out of Class Time for Study Group Learning (12.8%), 67

contained examples of Group Projects (53.6%), 65 contained examples of Dialogue

(52%), and 10 contained examples of Reciprocal Teaching (8%). Peer Review data were

not collected for Calculus.

Table 12. Presence of Collaborative Learning in the syllabi across subjects: Percentage of syllabi and frequency counts

Sub/Components	Calculus	ELC	ELA
Collaborative Learning	75.2% (94)	94.4% (118)	95.2% (119)
Using out of Class Time for Study Groups	12.8% (16)	17.6% (22)	15.2% (19)
Group Projects	53.6% (67)	49.6% (62)	59.2% (74)
Dialogue	52% (65)	90.4% (113)	88% (110)
Reciprocal Teaching	8% (10)	22.4% (28)	8% (10)
Peer Review	-	66.4% (83)	83.2% (104)

In the English Literature and Composition (ELC) syllabi, 118 (94.4%) syllabi

contained examples of Collaborative Learning (see Table 12). From these syllabi, 22

contained examples of Using out of Class Time for Study Group Learning (17.6%), 62

contained examples of Group Projects (49.6%), 113 contained examples of Dialogue

(90.4%), 28 contained examples of Reciprocal Teaching (22.4%), and 83 contained

examples of Peer Review (66.4%). Similar data was collected for the English Language

and Composition (ELA) syllabi. One hundred nineteen (92.5%) syllabi contained

examples of Collaborative Learning (see Table 12). From these syllabi, 19 contained

examples of Using out of Class Time for Study Group Learning (15.2%), 74 contained

examples of Group Projects (59.2%), 110 contained examples of Dialogue (88%), 10

contained examples of Reciprocal Teaching (8%), and 104 contained examples of Peer

Review (83.2%).

Component and Subcomponent Frequency Differences

To determine the degree of frequency for the three learning types (Problem

Solving, Authentic Learning, and Collaborative Learning) and their subcomponents and

how they differ between AP English and AP Calculus course syllabi (Research questions 7 and 8), chi-square tests of independence were conducted.

Results for Problem Solving and Subcomponents

A chi-square test of independence indicated that presence of Problem Solving in course syllabi was related to subject area (χ^2 (2) = 35.62, p<.001). This suggests that the presence of this subcomponent was not distributed evenly among the subject areas (Calculus, ELC, and ELA). To better determine whether meaningful differences are represented by this result, I next looked for any significant differences between Calculus courses and English courses combined and also whether the two types of English courses differed from one another to understand if an omnibus effect was present. When comparing the distribution of presence of Problem Solving between Calculus courses and both English courses together, the chi-square test was significant (χ^2 (1) = 35.62, p<.001). However, the distribution did not differ at all between the two English courses since Problem Solving was found in 100% of the syllabi in both English courses. Examination of the observed frequencies (see Tables10 and 13) suggests that the presence of Problem Solving occurs more often in the AP English syllabi compared to Calculus syllabi, but the frequencies are not different between the two English courses.

A chi-square test of independence indicated that presence of Understanding the Problem in course syllabi was related to subject area (χ^2 (2) = 142.68, p<.001). This suggests that the presence of this subcomponent was not distributed evenly among the subject areas (Calculus, ELC, and ELA). To better understand this omnibus effect, I next tested whether there were differences between Calculus courses and English courses overall and also whether the two types of English courses differed from one another.

When comparing the distribution of presence of Understanding the Problem between

Calculus courses and both English courses together, the chi-square test was significant (χ^2

(1) = 141.61, p<.001). However, the distribution did not differ between the two English

courses (χ^2 (1) = 1.65, p =0.20). Examination of the observed frequencies (see Tables 10

and 13) suggests that the presence of Understanding the Problem occurs more often in the

AP English syllabi compared to Calculus syllabi, but the frequencies are not different

between the two English courses.

Table 13. χ^2 tests of independence: Significance of results

Sub/Components	Significant χ^2	Significant Difference in Omnibus Test	
		Calculus v. English	ELC v. ELA
Problem Solving	Yes	Yes	No
Understanding the Problem	Yes	Yes	No
Hypothesizing	No	-	-
Strategizing	Yes	Yes	No
Authentic Learning	No	-	-
Experiential/Active Learning	No	-	-
Connection to Students' Lives	No	-	-
Collaborative Learning	Yes	Yes	No
Using out of Class Time	No	-	-
Group Projects	No	-	-
Dialogue	Yes	Yes	No
Reciprocal Teaching	Yes	[a]Yes	Yes
Peer Review	-	-	Yes

[a] Values for the presence of Reciprocal Teaching in Calculus and ELA were equal.

A chi-square test of independence indicated that presence of Hypothesizing in AP

course syllabi was not related to subject area ($\chi2$ (2) = 6.65, p = .036). This suggests that

the infrequent presence of this subcomponent appeared to be distributed evenly among

the subject areas (Calculus, ELC, and ELA). Because no significant difference was found

across subject areas, no further tests were run regarding Hypothesizing.

A chi-square test of independence indicated that presence of Strategizing in course syllabi was related to subject area (χ^2 (2) = 42.25, p<.001). This suggests that the presence of this subcomponent was not distributed evenly among the subject areas (Calculus, ELC, and ELA). To better understand this omnibus effect, I next tested whether there were differences between Calculus courses and English courses overall and also whether the two types of English courses differed from one another. When comparing the distribution of presence of Strategizing between Calculus courses and both English courses together, the chi-square test was significant (χ^2 (1) = 42.25, p<.001). However, the distribution did not differ at all between the two English courses since Strategizing was found in 100% of the syllabi in both English courses. Examination of the observed frequencies (see Tables 10 and 13) suggests that the presence of Strategizing occurs more often in the AP English syllabi compared to Calculus syllabi, but the frequencies are not different between the two English courses.

In summary, Problem Solving was found in the English syllabi more than in the Calculus syllabi (see Tables 10 and 13), as were the subcomponents Understanding the Problem and Strategizing. No significant differences were found of Hypothesizing between subjects.

Results for Authentic Learning and Subcomponents

A chi-square test of independence indicated that presence of Authentic Learning and both of its subcomponents in course syllabi was not related to subject area (see Table 13). Results for Authentic Learning (χ^2 (2) = 2.0, p = .367), the subcomponent Experiential/Active Learning (χ^2 (2) = 2.0, p = .367), and Connection to Students' Lives (χ^2 (2) = 2.02, p = .365) all suggested that the presence of this component and its

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subcomponents appeared to be distributed evenly among the subject areas (Calculus, ELC, and ELA). Because no significant difference was found across subject areas, no further tests were run regarding the component of Authentic Learning. However, it was noted that although Experiential/Active Learning was evenly distributed across subjects, it was found less frequently in the syllabi than either Authentic Learning or Connection to Students' Lives.

Results for Collaborative Learning and Subcomponents

A chi-square test of independence indicated that presence of Collaborative Learning in course syllabi was related to subject area (χ^2 (2) = 30.95, p<.001). This suggests that the presence of this subcomponent was not distributed evenly among the subject areas (Calculus, ELC, and ELA). To better understand this omnibus effect, I next tested whether there were differences between Calculus courses and English courses overall and also whether the two types of English courses differed from one another. When comparing the distribution of presence of Collaborative Learning between Calculus courses and both English courses together, the chi-square test was significant (χ^2 (1) = 30.91, p<.001). However, the distribution did not differ between the two English courses (χ^2(1) = .081, p =0.776). Examination of the observed frequencies (see Tables 12 and 13) suggests that the presence of Collaborative Learning occurs more often in the AP English syllabi compared to Calculus syllabi, but the frequencies are not different between the two English courses.

A chi-square test of independence (see Table 13) indicated that presence of Using out of Class Time for Study Group Learning (χ^2 (2) = 1.12, p = .572) and Group Projects (χ^2 (2) = 2.341, p = .310) in course syllabi was not related to subject area. This suggests

that the presence of these subcomponents appeared to be distributed evenly among the subject areas (Calculus, ELC, and ELA). Because no significant difference was found across subject areas, no further tests were run regarding Using out of Class Time for Study Group Learning or Group Projects.

A chi-square test of independence indicated that presence of Dialogue in course syllabi was related to subject area (χ^2 (2) = 64.93, p<.001). This suggests that the presence of this subcomponent was not distributed evenly among the subject areas (Calculus, ELC, and ELA). To better understand this omnibus effect, I next tested whether there were differences between Calculus courses and English courses overall and also whether the two types of English courses differed from one another. When comparing the distribution of presence of Dialogue between Calculus courses and both English courses together, the chi-square test was significant (χ^2 (1) = 64.72, p<.001). However, the distribution did not differ between the two English courses (χ^2(1) = .081, p =0.776). Examination of the observed frequencies (see Tables 12 and 13) suggests that the presence of Dialogue occurs more often in the AP English syllabi compared to Calculus syllabi, but the frequencies are not different between the two English courses.

A chi-square test of independence indicated that presence of Reciprocal Teaching in course syllabi was related to subject area (χ^2 (2) = 15.48, p<.001). This suggests that the presence of this subcomponent was not distributed evenly among the subject areas (Calculus, ELC, and ELA). To better understand this omnibus effect, I next tested whether there were differences between Calculus courses and English courses overall and also whether the two types of English courses differed from one another. When comparing the distribution of presence of Reciprocal Teaching between Calculus courses

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and both English courses together, the chi-square test was significant (χ^2 (1) = 3.87, p=.049). It is important to note that despite a significant difference between subjects in this test, that the values for the presence of Reciprocal Teaching in Calculus and ELA courses were equal. However, the distribution differed significantly between the two English courses (χ^2(1) = 10.06, p =.002). Examination of the observed frequencies (see Tables 12 and 13) suggests that the presence of Reciprocal Teaching occurs more often in the AP Literature and Composition English syllabi compared to Calculus and English Language and Composition syllabi, which were found at equal frequencies.

The final Collaborative Learning subcomponent Peer Review was different from the others in that no data was collected for the Calculus syllabi (see Table 13). Therefore, the only chi-square test of independence run was between the two English courses. This indicated the presence of Peer Review in course syllabi was related to subject area (χ^2 (1) = 9.36, p=.002). Examination of the observed frequencies (see Tables 12 and 13) suggests that the presence of Peer Review occurs more often in the AP Language and Composition compared to the Literature and Composition English syllabi.

In summary, Collaborative Learning and the subcomponent Dialogue were found in the English syllabi more than in the Calculus (see Tables 10 and 13). No significant differences were found between subjects for Using out of Class Time for Study Group Learning or Group Projects (see Table 13). Reciprocal Teaching was found most in the English Literature and Composition syllabi with equal frequencies in Calculus and ELA, while Peer Review was found most often in English Language and Composition syllabi (see Tables 12 and 13).

CHAPTER V

DISCUSSION

Two main aspects of significance surfaced in this study. First, the rubric developed to find evidence of Problem Solving, Authentic Learning, and Collaborative Learning in AP Calculus and English syllabi was found to be a reliable tool for identifying activities representing these three components. By obtaining inter-rater reliability results above the 80% minimum threshold established for this study (Calculus 84%, ELC & ELA 90%), this tool was shown to be useful in identifying these three college readiness practices in future syllabus reviews. Individuals, schools, districts, or universities wanting to evaluate the presence of these or similar practices in their syllabi or possibly courses could use this tool as a starting point of their review. Additionally, they could incorporate the practices from the rubric in to their syllabi/courses to increase their students' college readiness, academic achievement, and post-secondary success in general. This rubric can help teachers, schools, districts, faculty, and universities improve not only how they prepare their students for success in their courses, but also use it to help improve instruction.

Second, significant differences were found through the use of the rubric between AP Calculus and English syllabi, and in some cases between ELC and ELA syllabi. Aside from Authentic Learning and the subcomponent Hypothesizing, significant differences in the presence of Problem Solving, Authentic Learning, and Collaborative Learning were found between AP Calculus and English syllabi. Evidence of the best practices of Problem Solving, Authentic Learning, and Collaborative Learning were found more often in the English syllabi than in the Calculus syllabi. Problem Solving and its

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subcomponents Understanding the Problem and Strategizing were found in the English syllabi more than in the Calculus syllabi, while no significant differences were found between subjects for Hypothesizing. Nor were significant differences found across subject areas for Authentic Learning or either of its subcomponents Experiential/Active Learning and Connection to Students' Lives. Yet despite the even distribution across subjects, Experiential/Active Learning was found less frequently in the syllabi than either Authentic Learning or Connection to Students' Lives. Collaborative Learning and the subcomponent Dialogue were found in the English syllabi more than in the Calculus syllabi, but no significant differences were found between subject areas for Using out of Class Time for Study Group Learning or Group Projects. Reciprocal Teaching was found most in the English Literature and Composition syllabi with equal frequencies in Calculus and ELA, while Peer Review was found most often in English Language and Composition syllabi and not analyzed for its presence in the Calculus syllabi.

Significance of Results

While differences in frequency counts exist between many of the components and subcomponents found within the different subject areas, there may be explanations for these findings.

Subject Syllabus Style

The style of the Calculus syllabi differed from that of the English syllabi. For Calculus, many of the syllabi were very brief. While activities were described in the Calculus syllabi, less detail was provided on average for each activity than in the English syllabi. This could account for some of the differences found between the presence of the components and subcomponents within Calculus and English syllabi. With less

description of activities, it would be less likely for an activity to be defined in enough detail to have met criteria for the presence of one or more subcomponents.

Additionally, the Problem Solving subcomponent Understanding the Problem was found more often in the English syllabi, but most evidence for this subcomponent came from former AP exam prompts. These AP exam prompts were often included in the English syllabi, and more evidence of this subcomponent may have been found if such Calculus AP exam prompts were included in the syllabi. Often Calculus problems were included on the syllabus, but description meeting criteria for Understanding the Problem was absent. Changing the wording of the expectations for completing the problem or re-wording how these problems were presented could have resulted in a change to the frequency counts found for this subcomponent.

Average Length of Syllabi

Similarly, the average length of an AP Calculus syllabus was 8.7 pages. In comparison, the average length of an ELC syllabus was 15.2 pages and an ELA syllabus 13.6 pages. This discrepancy in length, on average 5 to 7 fewer pages for the Calculus syllabi than the English, could account for some of the differences in frequency counts for the components and subcomponents of this study. A shorter syllabus means there are fewer pages available for the inclusion of full descriptions for all the activities that may or may not take place during the actual class, meaning the syllabus may be less likely to include enough detail to meet criteria for the presence of one or more subcomponents.

College Board Requirements

The College Board requires the inclusion of different content for the syllabi from different subject areas. The ELA curricular requirements include analyzing visual and/or graphic text. This requirement resulted in more variety in the learning activities and more presence of Authentic Learning's subcomponent Experiential/Active Learning. If this curricular requirement was not present, then a lower frequency of these activities may have resulted in a more skewed distribution of this subcomponent across subject areas.

Practical Significance of Study/Recommendations

The differences found in the inclusion of Problem Solving, Authentic Learning, and Collaborative Learning across the subject areas of AP Calculus and English courses indicate possibilities for syllabus and curricular changes that could be implemented to promote the inclusion of these practices both in AP courses and high school courses in general.

Recommendations for the College Board

Now that differences in the presence of activities promoting college readiness have been found between the subject areas of AP Calculus and English courses, changes could be implemented to promote increased inclusion of these practices. To better align AP courses with Common Core standards and the new SAT changes, the College Board may want to make changes.

Curricular Requirements and syllabus development. Currently most of the requirements for AP syllabi focus around specific content for each subject area. The College Board could require syllabus changes to increase student readiness for college by requiring the presence of Problem Solving, Authentic Learning, and Collaborative

Learning activities. This could be done by requiring the presence of activities in the syllabi to obtain approval through the AP Audit procedures. While traditionally the College Board has focused on articulating course content and leaving pedagogical choices to the AP instructors (T. Matts, personal communication, May 14, 2014), making a move to change this could improve student success in their AP courses, exams, and postsecondary education.

Course and exam redesign. Current redesign efforts are focused on increasing students' college readiness, critical thinking, inquiry, and communication skills (The College Board, 2012). Because Problem Solving, Authentic Learning, and Collaborative Learning activities are strategies that have been found to increase these skills, including them in the AP course Curricular Requirements and syllabus development would be one way the College Board could meet their redesign goals. Authentic Learning activities benefit student learning by increasing critical thinking skills and preparing them for postsecondary success. Collaborative Learning activities help students practice and improve their communication skills, as well as improve their problem solving skills. This is true especially when Problem Solving activities are used together with the Collaborative Learning activities, including activities that require students to Understand the Problem, Hypothesize, and Strategize. As the College Board seeks to increase the breadth and depth of AP courses, Authentic Learning activities specifically could be used to increase student comprehension and transfer of knowledge to not only the AP exam, but also subsequent college coursework.

Validation. As revised Curricular Requirements are developed, Problem Solving, Authentic Learning, and Collaborative Learning activities could be included prior to the

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validation phase. Over 50 college department chairs, along with over 50 AP teachers, could then review and verify if the presence of these concepts are important and necessary for student success (The College Board, 2012). If validated, these components of college readiness could be included in Enduring Understandings for each subject, which are the core concepts students need to retain for success at the postsecondary education level. Because Problem Solving, Authentic Learning, and Collaborative Learning activities have all been shown to increase comprehension, and Authentic Learning activities increase transfer of knowledge, inclusion of these activities here in the Enduring Understandings seems useful. Examples for any or all of the practices the College Board wishes to increase the presence of in the syllabi could be included with the rest of the course subject Curricular Requirements, and also included in other support materials provided by the College Board.

    Including activities in syllabus development materials. Once Curricular Requirements are set for each subject, scoring guides and training documents are created for the reviewers in the AP Course Audit process (K.Aspengren, personal communication, May 16, 2014). A scoring guide development team makes sure that these new resources align with the framework for the exams (K.Aspengren, personal communication, May 16, 2014). If Problem Solving, Authentic Learning, and Collaborative Learning are included in the Curricular Requirements, these activities could also be included as examples for scoring components in the scoring guides, in the training materials for reviewers, and may be more likely to appear in the sample syllabi published for teachers to use as resources. These sample syllabi would then be annotated to demonstrate how activities meet the Curricular Requirements. If these activities were

included in AP teacher resources such as these, the presence of Problem Solving, Authentic Learning, and Collaborative Learning would likely increase in AP course syllabi.

Including activities earlier in course. One observation made about the timing of some of the most exemplary activities documented during data collection was that they seemed likely to take place after the AP test for the course. While the inclusion of these activities were likely helpful for students' transfer of knowledge to college and life after high school, the activities were not likely helpful for AP exam success. The focus of this study was on college readiness, but if the results of this content analysis could also impact students' success on the AP exams, this would be important information for AP teachers to have. Planning Problem Solving, Authentic Learning, and Collaborative Learning activities after the AP exam may be too late for the activity to be useful for students' application of new knowledge to the exam, but the activities are still helpful for transfer of knowledge to postsecondary opportunities.

Requiring minimum amounts of lab work in AP Calculus courses. As part of the Course and Exam Redesign in the AP science courses, a minimum requirement of class time to be spent on lab work was set (T. Matts, personal communication, May 14, 2014). To increase Active/Experiential Learning in Calculus, and to increase students' ability to transfer their knowledge to the AP exam and postsecondary Calculus coursework, the College Board could set a similar minimum requirement for labs and other active learning opportunities for this and other math subject courses. While this is not a likely decision to be made by the College Board (T. Matts, personal communication, May 14, 2014), the current effort of the Course and Exam Redesign

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effort to increase critical thinking and inquiry skills could be met with this change. Inclusion of lab examples in support materials could assist AP Calculus teachers in increasing their active learning opportunities to minimize difficulties in making this transition.

Inclusion of examples in AP course Teacher's Guides. Including descriptions and examples of Problem Solving, Authentic Learning, and Collaborative Learning in support materials, as well as mandating the review and use of these material, is one recommendation to the College Board for improving AP Calculus and English courses. In order for teachers to have a clear understanding of how to include Problem Solving, Authentic Learning, and Collaborative Learning in their syllabi, the College Board would need to provide examples exemplary practices in the support materials provided for AP teachers. For example, Teacher's Guides are materials provided by the College Board through the AP Central website, demonstrating how teachers can structure their courses and include activities that are helpful preparing students to succeed on the AP exams. Description of Problem Solving, Authentic Learning, and Collaborative Learning activities and their benefits could be included in these materials to encourage their use in AP course structures.

For example, Problem Solving and most of its subcomponents were found more frequently in the AP English courses than in the AP Calculus syllabi. Specifically, the subcomponent Understanding the Problem was found more often in the English syllabi, often in the form of former AP English exam prompts. If similar Calculus AP exam prompts were included in the Calculus syllabi, and if mathematical problems were re-worded in a way that required students to demonstrate their understanding of the problem

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rather than merely solving the problem, more evidence of this subcomponent would be found. If the College Board wanted to increase the Problem Solving content in the AP Calculus syllabi approved through the AP Audit, making these changes could be encouraged by including the above information in support materials for AP teachers. Including some of the possible sentence stems from the original Rubric for this study (see Appendices A through F) and the inter-rater Training Manual Codebook (see Appendix D) in Teacher's Guides, Course Descriptions, and other support materials could help support instructors in making these changes to their syllabi, and in turn their courses.

Inclusion of examples in AP Course Planning and Pacing guides. Course Planning and Pacing guides have been developed by the College Board. Through the compilation of pedagogical practices used by "master AP teachers", these guides were developed to support AP teachers in course improvement for maximizing student success (T. Matts, personal communication, May 14, 2014). Some of these activities are described in detail within AP Course Planning and Pacing guides designed to help AP teachers plan their courses, but they do not explicitly describe why certain aspects of the activities (Problem Solving, Authentic Learning, Collaborative Learning) are helpful for students (help them transfer knowledge to AP exam, college, life after high school, etc.). More explicit description of these activities for AP instructors could increase the likelihood of inclusion of these best practices in AP courses and the corresponding syllabi. Additionally, review and use of these guides are not currently mandated by the College Board (T. Matts, personal communication, May 14, 2014). One recommendation for the College Board is to require the review and use of Course Planning and Pacing guides for course preparation.

Continuing to provide AP Curriculum Modules. The College Board currently develops Curriculum Modules for units of instruction in AP course units (T. Matts, personal communication, May 14, 2014). These modules provide step by step teaching strategies for units of study within different courses, but are resource intensive to produce and not likely to be provided in the future. My recommendation to the College Board is to continue providing this resource, and include more examples of Problem Solving, Authentic Learning, and Collaborative Learning within these modules. Continuing to provide this resource could increase the frequency of these best practices included in AP courses and by using these practices, increase students' postsecondary success.

Including examples through professional development opportunities. The College Board offers their AP instructors training and professional development opportunities for improving their courses and maximizing student success. Including strategies for including Problem Solving, Authentic Learning, and Collaborative Learning activities throughout the course could be included within these opportunities. Currently, the College Board focuses professional development on content and the AP exam scoring processes (D. Roe, personal communication, May 16, 2014). However, these structured professional development modules do allow room for the consultants facilitating the workshop to assess the needs of the participants and make changes as needed (D. Roe, personal communication, May 16, 2014). This flexibility within the professional develop modules is new to those courses and exams that have already undergone the redesign process (D. Roe, personal communication, May 16, 2014). Infusing strategies for AP teachers to increase their use of Problem Solving, Authentic Learning, and Collaborative Learning activities could be encouraged by the consultants

leading these professional development opportunities. For Calculus, providing descriptions of potential labs to be included in the coursework could take place during these professional development opportunities and support any potential College Board requirement to increase the frequency of active learning opportunities within the course.

Expanding the professional development topics past content and AP exam structure to suggesting strategies that have been shown to increase student success and transfer of knowledge is another recommendation for the College Board. Currently, topics for AP professional development are determined by reviewing AP exam responses to identify content areas that resulted in lower scores and student confusion (D. Roe, personal communication, May 16, 2014). Using professional development opportunities to share strategies such as Problem Solving, Authentic Learning, and Collaborative Learning that could aid in teaching those confusing content areas may be one way the College Board could increase the frequency of these practices in their syllabi. With the inclusion of these practices, the likely result is an increase in student success with AP exams as well as postsecondary education coursework.

Recommendations for the Field

Changes to high school course requirements. Problem Solving, Authentic Learning, and Collaborative Learning activities could be included in regular (non-AP) courses to better prepare students for postsecondary education success. If the literature shows that these practices result in increased student achievement and preparedness for postsecondary success, and the majority of AP English and Calculus syllabi studied already include these practices, then high school courses could also look at strategies for including these practices more often. If high school courses contain similar amounts of

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the components and subcomponents found in AP syllabi, then increasing the presence of Hypothesizing, Experiential/Active Learning, Using out of class time for study group learning, Group Projects, and Reciprocal Teaching which were all found infrequently in the syllabi would be one place to start. For Calculus courses specifically, increasing the presence of Understanding the Problem and Dialogue would also be useful for improving college readiness and student success. Examples of activities that could be included can be taken from the Codebook in Appendix D. In order for this to happen, however, AP and high school teachers alike will need support through this transition.

Professional development and support for instructors. To help instructors make the above suggested changes, they will need a variety of supports. Not only will they need assistance as to which activities to include in their courses, but they will also need assistance with student engagement strategies. The information from this study, specifically the original Rubric (see Appendices A, B, and C) and the inter-rater Training Manual Codebook (see Appendix D), could help support instructors in making these changes to their syllabi and later their courses. Instructors needing suggestions about activities to include in their syllabi and lessons can be found in this dissertation, but they may need additional support in how to engage students in these activities in a way that most benefits students' learning.

For example, to implement Collaborative and Authentic Learning, teachers will need additional support to move students from passive role in their education to more active role (Webb et al., 2008). Teacher training on collaboration is not always enough. Teachers need additional support to not only move students from passive role in their education to more active, but to also move their teacher role to a less active role (Webb et

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al, 2008). This course/activity structure results in increased student participation, increasing active learning (Authentic Learning) in the process. Including aspects of Problem Solving can increase student benefits even more, but teachers will need support implementing such additions to their courses. Schools, districts, and the College Board will need to think about the support needed for their instructors if they decide to move forward with such changes. Preparing for the support needs of those affected beforehand will help make these changes easier for the instructors. Workshops to provide training and ideas, as well as help setting up professional learning communities within same schools or subjects areas would be useful in supporting these changes.

Limitations of Study

The results of my study were significant, but there are a few limitations that are important to mention.

Variable Over-Sensitivity

During the analysis of the syllabi, it was apparent that two subcomponents seemed too sensitive and may not have measured exactly what was intended.

Problem Solving, Strategizing. Initially, I included "Tests/quizzes" in the Strategizing category because taking exams required students to answer questions within a given time frame, strategizing how much time was needed to answer the question at hand as well as the best way to support their answer given the question prompt. However, as I analyzed each syllabus it seemed that often the only evidence for Strategizing was the inclusion of a test or quiz. This seemed to make the variable definition too sensitive, and evidence for Strategizing seemed present too often and didn't seem to capture what I was looking for.

Revising this variable would likely require splitting apart some of the components of Strategizing. At the very least, I would have counted Tests/Quizzes as a separate variable outside of the other Strategizing examples. This would give me a Strategizing subcomponent, and a Strategizing, Test/Quiz Only subcomponent which would allow me to keep track if additional examples of Strategizing existed outside of tests and quizzes. This would help measure the other aspects of Strategizing I was hoping to capture, separate from the frequency of tests and quizzes. Similarly, I would also require additional description of the tests and quizzes in order for them to count as evidence of Strategizing. Often, little description of the expectations or questions was provided on the syllabus. Requiring more explanation might increase the likelihood that I am capturing the targeted information for Strategizing, and ensuring I am not skewing my frequency counts for the subcomponent or Problem Solving in general.

Authentic Learning, Connection to Students' Lives. At the beginning of data collection, I collapsed several subcomponents of Authentic Learning in to one subcomponent: Connection to Students' Lives. Because my earlier definitions of the original variables were too vague and overlapped, I had combined them in to one variable. This action, however, also seemed to make this subcomponent too sensitive. To measure whether or not a syllabus contained evidence of Connection to Students' Lives, I would continue to combine the activity definitions for "Relevance" and "Meaningful" that are broken out in the Concept Overviews (see Appendix D) under Authentic Learning, Connection to Students' Lives.

To decrease the sensitivity of this subcomponent, however, I would break out the activity definitions for "Choice". Many syllabi included "Choice", one aspect of

Authentic Learning. Because these activities were included in Connection to Students'
Lives, this subcomponent was found more frequently and possibly skewed the results.
Creating an additional subcomponent for Authentic Learning, Choice would allow me to
keep track of this information specifically and make Connection to Students' Lives less
sensitive.

Additionally, I would split out the definition of "Opportunities to Engage in Real-
World Problems/Solve Problems of Professionals in the Field". This occurred so
infrequently in the syllabi that I originally thought collapsing the variables together
would work well. However, the collapse made Connecting to Students' Lives even more
sensitive and difficult to define. To make the subcomponents clearer, and to measure
what I had originally intended at the start of this study, I would use the following
subcomponents for Authentic Learning: Experiential/Active Learning, Connection to
Students' Lives, Choice, and Opportunities to Engage in Real-World Problems/Solve
Problems of Professionals in the Field. These subcomponent updates would not likely
change the resulting frequency counts for Authentic Learning over all, but would provide
a more accurate description of what types of activities are being included in the syllabi.

Using the Syllabus as a Measure of Best Practices Inclusion

One limitation of this study involves using the syllabi to be an accurate
representation of what really happens within the classroom. It is a mistake to assert that
the absence of Problem Solving, Authentic Learning, and Collaborative Learning from
the syllabus translates to the absence of these activities in the classroom. Just because
sub/components aren't found in syllabus does not mean activities are not taking place in
the corresponding classes. Instructors may not include all activities on the syllabus. The

College Board requires many content-related items to be present in the syllabi for approval through the AP Audit process, but currently these sub/components measured in this study are not required items. Even though these activities are not required on the syllabus and may not be present, they may be occurring despite their absence in the syllabi.

Data Source

AP syllabi were chosen for this study of college readiness because the AP courses offer college level content in high school and the syllabi are generally longer than the typical high school syllabus. While the AP syllabi are good for detail, as the instructors submitting them must meet specific requirements for AP Audit approval, they were originally created for a different purpose.

Originally the AP syllabi requirements were designed to standardize AP courses and ensure courses offer college level difficulty and content at the high school level. Colleges offering credit for scores of 3 or higher on AP exams wanted to make sure there was some consistency across courses. So while this study measured the inclusion of best practices as would be expected in high quality syllabi, these AP syllabi were never designed to meet this expectation. Regardless, this study measured the frequency of Problem Solving, Authentic Learning, and Collaborative Learning activities. These practices have been found in the literature to support college readiness, and despite not being required by the College Board, a majority of the AP English and Calculus syllabi analyzed contained evidence of these practices.

Directions for Further Study

Now that I have analyzed AP Calculus and English courses for the presence of Problem Solving, Authentic Learning, and Collaborative Learning and found a majority of these syllabi contain evidence of these practices, I have several recommendations for further study in this area.

First, I would suggest an additional analysis with changes to the over-sensitive variables. While this study provided valuable information about the inclusion of Problem Solving, Authentic Learning, and Collaborative Learning in AP Calculus and English syllabi, one recommendation for further study is to run the same analysis with the adjusted variables of Strategizing and Connection to Students' Lives. It would be interesting to compare the results and see how they differ between analyses after adjusting for the over-sensitivity found in this study.

Next, I recommend classroom observations. Conducting classroom observations in addition to analyses of the syllabi would help determine whether Problem Solving, Authentic Learning, and/or Collaborative Learning activities are really taking place in the classroom. Since activities may be present in the classroom even if absent from the syllabus, classroom observations would be another way to provide a more holistic assessment not the presence of these three college readiness best practices.

Third, while this study measured the frequency of three college readiness best practices, the presence of one or more of these sub/components did not guarantee the syllabus was a high quality syllabus. Many examples found in the syllabi were lacking explanation of the activity that would have increased the quality of the syllabus. Yet the activity was described in sufficient detail to count as evidence for the corresponding

subcomponent. Use of a different scoring frame may be more revealing of the quality of the syllabus. Some sort of scoring method measuring the degree of presence in the syllabus (1= present, 3=details of the activity, 5=exemplary, full example provided) may provide more information than a single frequency count for evidence of a subcomponent. This change in scoring method may help measure whether a syllabus is a high quality syllabus, rather than this study which merely focused on whether Problem Solving, Authentic Learning, and Collaborative Learning were present.

Finally, now that I have analyzed AP English and Calculus syllabi, I recommend looking at additional AP subjects as well as high school and college level courses. Since AP courses offer college level content in high school, it would be interesting to compare the inclusion of Problem Solving, Authentic Learning, and Collaborative Learning activities in AP syllabi to college syllabi. Also, comparing high school course syllabi to college level syllabi would show more explicitly where high schools could change curriculum activities to better prepare students to meet the expectations of college activities. Having determined the extent Problem Solving, Authentic Learning, and Collaborative Learning activities are present in the AP Calculus and English syllabi analyzed, it would be interesting to compare these results to similar courses at both the high school and college levels to determine differences in occurrence.

APPENDIX A

PROBLEM SOLVING SCORING RUBRIC

Syllabus Scoring Rubric: Problem Solving AP English				
Construct	Common examples within scored syllabi	Explicit example from one syllabus	English Literature and Composition	English Language and Composition
Understanding the problem	Activities or assignments that require restating the problem in your own words. This may be in the form of written work or paired verbal exchange with peer. Examples: required reading responses following reading assignments to address the main conflicts or issues being discussed; write a summary of readings in your own words before beginning to write; gather research to support and develop your own opinions rather than just restating opinions in literature.	<Best examples from individual scored syllabi>	Frequency counts for each syllabus	Frequency counts for each syllabus
Hypothesizing	Make predictions about what will happen/what you can do next in writing assignments or peer verbal exchange regarding potential outcomes Speculate outcomes and explain your thinking This may be in the form of written work or paired verbal exchange with peer.	<Best examples from individual scored syllabi>	Frequency counts for each syllabus	Frequency counts for each syllabus
Strategizing	Use multiple strategies/Solve problems using multiple steps.	<Best examples from individual scored syllabi>	Frequency counts for each syllabus	Frequency counts for each syllabus
	Plan your approach for writing. Use Pre-Writing Strategies before beginning assignments; Proofread, revise, and edit multiple drafts. After receiving feedback of writing and making changes, review writing before final submission			
	Quizzes and Exams: Require students to problem solve by responding to questions based on knowledge learned through class in a limited amount of time.			
	Critical reading and communication/writing: Written reading response assignments or other writing assignments that require careful reading and writing about literary works. May include information about influences or implications of reading/writing assignments. Requires clear and precise written expression as students form, articulate, and support opinions/points of view clearly in oral & written forms and citing support for these arguments appropriately Use evidence to defend and support basic arguments and positions			

	Requires analysis and development of research questions pertaining to reading. Research is used to support students' claims.			
	Writing conventions: Requires use of appropriate writing mechanics, formatting such as MLA or APA, grammar, sentence construction and punctuation in writing assignments and oral presentations.			
	Requires use of a variety of writing styles (argumentative/position essays, expository, narrative, business, persuasive, research papers, reflection) depending on the written/oral presentation assignment. May require student to compare/contrast, interpret texts, etc.			
	Analyze issues of audience through use of tone, formal vs. informal style, choosing appropriate sentence structure for purpose in writing assignments.			
	Use of verbs referring to Problem Solving such as describe, evaluate, analyze, understand, compare, synthesize, explain, interpret and phrases such as communicate issues, themes, and conflicts			

Syllabus Scoring Rubric: Problem Solving AP Calculus			
Construct	Common examples within scored syllabi	Explicit example from one syllabus	Calculus AB
Understanding the problem	Activities or assignments that require restating the problem in your own words. This may be in the form of written work or paired verbal exchange with peer.	<Best examples from individual scored syllabi>	Frequency counts for each syllabus
	1. Identify the goal; 2. Describe barriers preventing goal completion; 3. Identify possible solutions for overcoming barriers		
Hypothesizing	Make predictions about what will happen/what do next after each step in Problem Solving process. Speculate outcomes and explain your thinking. Hypothesize solutions and which will likely be best option This may be in the form of written work or paired verbal exchange with peer.	<Best examples from individual scored syllabi>	Frequency counts for each syllabus
Strategizing	Use multiple strategies/Solve problems using multiple steps, estimating possible solutions and strategies by showing work, writing assignments, or verbal exchange with peers.	<Best examples from individual scored syllabi>	Frequency counts for each syllabus
	Plan approach for solving the problem.		
	Justify steps in work by explaining why choosing each step to solve the problem. Clearly communicate each step by showing work on assignments, writing assignment, or peer collaboration. (Move back to hypothesizing?)		
	Analyze mathematical situation and choose interpretation more likely correct and reasonable: Retrace steps when select incorrect one.		
	Quizzes and Exams: Require students to problem solve by responding to questions based on knowledge learned through class in a limited amount of time.		
	Use of verbs referring to Problem Solving such as Analyze; Apply; Approximate; Classify; Calculate; Compute; Conduct; Construct; Demonstrate; Design; Describe; Determine; Differentiate; Employ; Estimate; Evaluate; Experiment; Explain; Express; Factor; Find; Formulate; Graph; Hypothesize; Identify; Interpret; Investigate; Judge; Justify; Match; Model; Organize; Perform; Plan; Relate; Represent; Recognize; Simplify; Speculate; Sketch; Solve; Understand; Validate; Write		

APPENDIX B

AUTHENTIC LEARNING SCORING RUBRIC

Syllabus Scoring Rubric: Authentic Learning AP English				
Construct	Common examples within scored syllabi	Explicit example from one syllabus	English Literature and Composition	English Language and Composition
Experiential opportunities or active participation	Activities that promote active learning: Projects, hands-on activities, labs, discussions, simulations, field experiences that are experiential, students actively participate in learning, role plays, and debates.	<Best examples from individual scored syllabi>	Frequency counts for each syllabus	Frequency counts for each syllabus
	Projects that allow students to apply, practice, and review their knowledge, such as long term projects that involve generating and testing hypotheses.			
	Experiential education such as practicum. apprenticeships, internships, work/study programs, cooperative education, field projects			
Meaningful connection to students	Connection to life outside of school such as through assignments designed to solve current problems within the students' community: Participation in a service learning project in the community, activities requiring students follow current events in newspapers or other media to integrate addressing actual problem in the students' community, projects to apply concept knowledge and help the students' community.	<Best examples from individual scored syllabi>	Frequency counts for each syllabus	Frequency counts for each syllabus
	Connecting lecture topics or activities to cultural or background knowledge students may bring with them.			
	Assignments or activities dealing with current events, or linking academic and real-world problems.			
	Cross-disciplinary assignments or activities that help make sense of a subject outside this course (science, social, or computer science problem).			
	Choice in the topics students read or research.			
	Choose from a variety of options to demonstrate knowledge: linguistic or nonlinguistic.			
Relevance to students' lives/opportunities to engage in real-world problems	Assignments designed to address actual problems professionals in the field are currently struggling to solve: Follow and examine current trends in the subject area, assignments requiring students to address issues or solve problems that exist, complete a research project and submit this into a high school research competition, present the new information to the public in a poster presentation, or share the new information in some other way.	<Best examples from individual scored syllabi>	Frequency counts for each syllabus	Frequency counts for each syllabus

	Activities requiring application of subject knowledge: Reflection journals for literary works or math textbook reading assignments requiring documentation of initial questions and impressions; Assignments that require using these journal entries later when students develop essays and engage in group discussions; correct writing and exam errors with an analysis of their errors; written responses to former AP exam prompts providing opportunities for students to discover weaknesses in conceptual understanding or in their communication skills; in-class opportunities provide background information that improves comprehension of literary work; college entry essay practice; matching activities requiring students to pair main characters in literature with quotes from those characters and writing a paper describing why they belong together; opportunities to grade peers' exams to better understand instructor expectations.			
	Activities that aid students in course success and help organize thinking: Study guides, graphic organizers and other visual mapping activities such as timelines, geographical mapping, change of culture/practice over time representations, or thematic mapping.			
	Activities that improve students' study skills and note-taking, activities that require students to create exam or assignment questions, or those asking students to build a rubric for evaluation.			
	Activities providing students with experience that will improve their postsecondary success: Critique peers' work, career research, etc.			
	Activities requiring students understand how they would apply new information to similar problems in the real world: understand the process not just memorize; ability to apply critical thinking skills learned in class to new literary works or writing assignments; Assignments that require students show how their argument helps us understand and deal with problems in the real world; activities requiring students to critically evaluate all sources of information both recent and historical.			

Syllabus Scoring Rubric: Authentic Learning AP Calculus			
Construct	Common examples within scored syllabi	Explicit example from one syllabus	Calculus AB
Experiential opportunities or active participation	Activities that promote active learning: Projects, hands-on activities, labs, discussions, simulations, field experiences that are experiential, students actively participate in learning, role plays, debates.	\<Best examples from individual scored syllabi\>	Frequency counts for each syllabus
	Projects that allow students to apply, practice, and review their knowledge, such as long term projects that involve generating and testing hypotheses.		
	Experiential education such as practicum, apprenticeships, internships, work/study programs, cooperative education, field projects.		
	May be demonstrated through homework activities.		
Meaningful connection to students	Connection to life outside of school such as through assignments designed to solve current problems within the students' community: Participation in a service learning project in the community, activities requiring students follow current events in newspapers or other media to integrate addressing actual problem in the students' community, projects to apply concept knowledge and help the students' community, writing mathematical word problems that apply to their lives outside of school, etc.	\<Best examples from individual scored syllabi\>	Frequency counts for each syllabus
	Connecting lecture topics or activities to cultural or background knowledge students may bring with them.		
	Assignments or activities dealing with current events, or linking academic and real-world problems.		
	Cross-disciplinary assignments or activities that help make sense of a subject outside this course (science, social, or computer science problem): Assignments requiring writing in math through the use of math journals or reflection papers, assignments requiring students to communicate their mathematics understanding in multiple formats such as verbal, written, graphic, and numerical.		
	Choice in the topics students read or research.		
	Choose from a variety of options to demonstrate knowledge: linguistic or nonlinguistic.		
Relevance to students' lives/opportunities to engage in real-world problems	Assignments designed to address actual problems professionals in the field are currently struggling to solve: Follow and examine current trends in the subject area, assignments requiring students to address issues or solve problems that exist; complete a research project and submit this into a high school research competition; present the new information to the public in a poster presentation, or share the new information in some other way.	\<Best examples from individual scored syllabi\>	Frequency counts for each syllabus
	Activities requiring application of subject knowledge: Reflection journals for literary works or math textbook reading assignments requiring documentation of initial questions and impressions; Assignments that require using these journal entries later when students develop essays and engage in group discussions; correct writing and exam errors with an analysis of their errors; written responses to former AP exam prompts providing opportunities for students to discover weaknesses in conceptual understanding or in their communication skills; in-class opportunities provide background information that improves comprehension of mathematical concepts;		

	opportunities to grade peers' exams to better understand instructor expectations; use mathematical tools to analyze current problems in their world; use of graphing computer programs to make graphing assignments more understandable; reflection journal activities explaining how concepts tie together throughout the year; text annotation activities requiring students highlight new information in reading assignments and put the material in their own words, organize the concepts into a logical and hierarchical order, and apply or react to the material.		
	Activities that aid students in course success and help organize thinking: Study guides, graphic organizers and other visual mapping activities such as timelines, geographical mapping, change of culture/practice over time representations, or thematic mapping. .		
	Activities that improve students' study skills and note-taking, activities that require students to create exam or assignment questions, or those asking students to build a rubric for evaluation.		
	Activities providing students with experience that will improve their postsecondary success: Critique peers' work, career research, etc.		
	Activities requiring students understand how they would apply new information to similar problems in the real world; understand the process not just memorize; written interpretation rather than just a number in a box		

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APPENDIX C

COLLABORATIVE LEARNING SCORING RUBRIC

Syllabus Scoring Rubric: Collaborative Learning AP English				
Construct	Common examples within scored syllabi	Explicit example from one syllabus	English Literature and Composition	English Language and Composition
Using out of class time effectively for study group learning	Seeking help sessions outside of class in the form of tutoring circles, learning groups with peers, or even learning groups with the instructor: Activities such as regularly scheduled study groups; optional after-school study sessions to read and analyze supplemental texts; student-formed study or tutoring groups relying on peer support; exam review sessions; encouragement of instructors for students to regularly attend office hours; participation in the school's Writing Center; test preparation and study skill sessions Extra credit opportunities for participation in any of the above opportunities	<Best examples from individual scored syllabi>	Frequency counts for each syllabus	Frequency counts for each syllabus
Group projects or assignments	Brainstorming activities; triad work; role play activities; dramatizations; games; panels; symposiums; colloquia; round table discussions; activities involving listening to others' strategies to evaluate the strengths and weaknesses of each, accepting constructive criticism by respecting differing opinions, or reviewing group work to provide constructive criticism including positives as well as suggested changes; group projects requiring class presentations; in-class activities requiring collaboration and short written responses; small group work or paired activities interpreting literary works or mathematical concepts; group jigsaw presentations; group debates; group writing activities; table group assignments	<Best examples from individual scored syllabi>	Frequency counts for each syllabus	Frequency counts for each syllabus
Dialogue through whole class or small-group discussions	Whole class discussions to ensure all students are clear on task and performance expectations, and course content Activities providing a time for students to exchange ideas and better understand the course content; graded discussion activities; class debates; electronic discussion boards on which all students are required to participate; and development of their own questions about course content based on the Socratic seminar models. Games such as Jeopardy for review; vocabulary Bingo; and literary work Charades. Requiring a minimum amount of student participation within a particular amount of time. Students may discuss homework questions in small groups, while unresolved questions are saved for discussion with the entire class. Creating a role of "homework boss" in the classroom requires individual students to serve for several days weeks leading the homework reviews for the entire class and soliciting volunteers to share their work, ensuring that all students are keeping up with assignments completion and understanding the content requirements. Using text annotations as a basis	<Best examples from individual scored syllabi>	Frequency counts for each syllabus	Frequency counts for each syllabus

	for class discussions, allowing students the opportunity to add to and correct these annotations as the class progresses.			
	Small-group dialogue opportunities provide students with additional opportunities to discuss perspectives of reading assignments, ideas about the content covered, as well as to clarify any expectations regarding coursework: Pair up and ask partner challenging questions about writing ideas or arguments; small-group online discussions of reading assignments; round table discussions on individual or group research projects; developing study circles to address questions and concerns in both reading and other course assignments; create questions for sharing with a partner after summarizing an article that is different from partner's article and providing opportunities for each student to answer clarifying questions; pre-reading activities requiring collaboration with partner to tell a story about book or chapter based on a picture, diagram, or bolded key words throughout the text; pair up and discuss characteristics of literary works or mathematical concepts, then share the information discussed with the whole class demonstrating a think/pair/share activity.	\<Best examples from individual scored syllabi\>	Frequency counts for each syllabus	Frequency counts for each syllabus
Reciprocal teaching	Peer interactions requiring each student in a small group to learn specific content and then teach this content to the peers in the group, jigsaw activities requiring each person or group to learn one piece of the "big picture", then teach this information to the whole group so all participants learn all pieces. Inner/outer circle discussions where students from 2 groups read different articles on the same topic, then one group discusses issues while the other group takes notes and then reversing this process; create questions for sharing with a partner after summarizing an article that is different from partner's article, and providing opportunities for each student to answer clarifying questions. Jigsaw activities often incorporate learning and teaching about a reading assignment, but sometimes they may involve sharing research with fellow students in a symposium, or sharing some other item related to course content thematically but not incorporated in the instruction	\<Best examples from individual scored syllabi\>	Frequency counts for each syllabus	Frequency counts for each syllabus
Peer review or editing	Reviewing peer writing assignments; listening to others' strategies, evaluating the strengths and weaknesses of each, and providing constructive criticism including positive points as well as needed revisions; expectation that students accept constructive criticism by respecting differing opinions and maintaining civility; face-to-face or online discussion boards to provide peers feedback on writing assignments; developing rebuttals to feedback encouraging writing or argument changes; and group development of a rubric for evaluating writing assignments	\<Best examples from individual scored syllabi\>	Frequency counts for each syllabus	Frequency counts for each syllabus

Syllabus Scoring Rubric: Collaborative Learning AP Calculus			
Construct	Common examples within scored syllabi	Explicit example from one syllabus	Calculus AB
Using out of class time effectively for study group learning	Seeking help sessions outside of class in the form of tutoring circles, learning groups with peers, or even learning groups with the instructor: Activities such as regularly scheduled study groups; optional after-school study sessions to read and analyze supplemental texts; student-formed study or tutoring groups relying on peer support; exam review sessions; encouragement of instructors for students to regularly attend office hours; test preparation and study skill sessions Extra credit opportunities for participation in any of the above opportunities	\<Best examples from individual scored syllabi\>	Frequency counts for each syllabus
Group projects or assignments	Brainstorming activities; triad work; role play activities; dramatizations; games; panels; symposiums; colloquia; round table discussions; activities involving listening to others' strategies to evaluate the strengths and weaknesses of each, accepting constructive criticism by respecting differing opinions, or reviewing group work to provide constructive criticism including positives as well as suggested changes; group projects requiring class presentations; in-class activities requiring collaboration and short written responses; small group work or paired activities interpreting literary works or mathematical concepts; group jigsaw presentations; group debates; group writing activities; table group assignments; lab work with a partner or small group; discovery-learning activities as students are introduced to new topics through group work; opportunity to work cooperatively on in-class work, graded AP problems, and take-home exams	\<Best examples from individual scored syllabi\>	Frequency counts for each syllabus
Dialogue through whole class or small-group discussions	Whole class discussions to ensure all students are clear on task and performance expectations, and course content Activities providing a time for students to exchange ideas and better understand the course content; graded discussion activities; class debates; electronic discussion boards on which all students are required to participate; and development of their own questions about course content based on the Socratic seminar models. Games such as Jeopardy for review; vocabulary Bingo; and literary work Charades. Requiring a minimum amount of student participation within a particular amount of time. Students may discuss homework questions in small groups, while unresolved questions are saved for discussion with the entire class. Creating a role of "homework boss" in the classroom requires individual students to serve for several days weeks leading the homework reviews for the entire class and soliciting volunteers to share their work, ensuring that all students are keeping up with assignments completion and understanding the content requirements. Using text annotations as a basis for class discussions, allowing students the opportunity to add to and correct these annotations as the class progresses.	\<Best examples from individual scored syllabi\>	Frequency counts for each syllabus
	Small-group dialogue opportunities provide students with additional opportunities to discuss perspectives of reading assignments, ideas about the content covered, as well as to clarify any expectations regarding coursework: Pair up and ask partner challenging questions about writing ideas or arguments; small-group online discussions of reading assignments; round table discussions on individual or group research projects; developing study circles to address questions	\<Best examples from individual scored syllabi\>	Frequency counts for each syllabus

	and concerns in both reading and other course assignments; create questions for sharing with a partner after summarizing an article that is different from partner's article and providing opportunities for each student to answer clarifying questions; pre-reading activities requiring collaboration with partner to tell a story about book or chapter based on a picture, diagram, or bolded key words throughout the text; pair up and discuss characteristics of literary works or mathematical concepts, then share the information discussed with the whole class demonstrating a think/pair/share activity.		
Reciprocal teaching	Peer interactions requiring each student in a small group to learn specific content and then teach this content to the peers in the group, jigsaw activities requiring each person or group to learn one piece of the "big picture", then teach this information to the whole group so all participants learn all pieces. Inner/outer circle discussions where students from 2 groups read different articles on the same topic, then one group discusses issues while the other group takes notes and then reversing this process; create questions for sharing with a partner after summarizing an article that is different from partner's article, and providing opportunities for each student to answer clarifying questions. Jigsaw activities often incorporate learning and teaching about a reading assignment, but sometimes they may involve sharing research with fellow students in a symposium, or sharing some other item related to course content thematically but not incorporated in the instruction	\<Best examples from individual scored syllabi\>	Frequency counts for each syllabus

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APPENDIX D

INTER-RATER TRAINING MANUAL (GENERAL DECISION

RULES, CODEBOOK, CONCEPT OVERVIEWS)

Training Manual

Table of Contents

Statement of the Problem

Secondary schools around the country have come under attack for their inability to prepare students adequately for life after high school. A study by Achieve (2004) found no state prepared their high school students adequately for life after graduation. High School diplomas no longer provide all the skills necessary to land jobs offering upward mobility (Achieve, 2007). In 1950 73% of jobs were classified as unskilled. In 2002 only 30% were labeled so. The remaining 70% of the jobs were skilled or professional jobs requiring higher levels of education and training (Achieve, 2007), demonstrating the importance of preparing students to meet postsecondary expectations regardless of whether students pursue educational or work goals following graduation. Wendler et al. (2012) report that "between 2010 and 2020, about 2.6 million new and replacement jobs are expected to require an advanced degree" (p. 2). Studies indicate that the same skills are needed by high school graduates to succeed in both college and the workplace, and what was once considered college preparation is now needed for all (Achieve, 2007; Carnevale & Desrochers, 2003).

A nationwide study conducted by the National Center of Education Statistics (NCES, 2003) found remediation rates at the postsecondary level in the year 2000 reached 28%, proving secondary institutions were not preparing 28% of the students for postsecondary coursework. Although not all students may choose to attend college, college graduates will earn higher annual incomes than those of workers who have only a high school diploma (Carnevale & Desrochers, 2003). "Advanced education levels continue to be associated with lower unemployment rates and higher salaries" (Wendler et al., 2012, p. 2), so students who receive better preparation for meeting post-secondary education requirements may be more likely to complete their undergraduate degrees and earn the higher income needed to support themselves and their families. Thus students must have the skills needed to succeed in such post-high school training to compete for available jobs. In order for secondary schools to improve postsecondary outcomes for students, however, secondary school instruction must change.

The better prepared students are to meet post-secondary education requirements, the more likely they will be to complete their undergraduate degrees and increase their competitiveness in the job market. Implementing Advanced Placement (AP) programs is one method for high schools to increase curricular rigor and improve postsecondary outcome for their students. AP courses better prepare students for college academic work requirements by offering college level courses to high school students.

Attention has also been turned to the effectiveness of using high quality syllabi as a tool for improving student success in secondary and postsecondary coursework (Bottoms, Pucel, & Phillips, 1997; O'Brien, Millis, & Cohen , 2008). High quality syllabi provide students with explicit information describing the skills and outcomes they will need to succeed in their courses. Along with key learning objectives, detailed schedules of activities to be conducted throughout the course are also present in high quality syllabi. Clarifying the activities students will be expected to participate in while they work towards meeting the learning objectives improves the likelihood of their success. The more information students have at the beginning of a course, the more likely they will be able to meet instructor expectations. Students may be expected to engage in Problem Solving activities, including participation in assignments that require them to actively engage with the material or collaborate with peers (Bottoms, Pucel, & Phillips, 1997;

O'Brien, Millis, & Cohen, 2008). Knowing this information at the start of a new course will help students prepare to meet instructor expectations.

If high quality syllabi include detailed description of activities required for students, best practices that support student success should be found on the syllabi. Researchers have identified many teaching and learning strategies that promote student success. Three learning activities that show up in the research together are those of Problem Solving, Collaborative Learning, and Authentic Learning. When each of these learning activities are described in the literature, examples of best practices for each one often include descriptions of all three styles. King (1994) describes Problem Solving groups that incorporate peer collaboration while using experience based questioning (Authentic Learning) as a best practice for increasing student comprehension and student success. Situated cognition learning theorists state that all learning is situated in context, which is socially and culturally defined (Brown, Collins & Duguid, 1989). Using ordinary practices of culture to teach new concepts (Authentic Learning), especially within collaborative Problem Solving groups that require students to reflect on and evaluate new information, results in better understanding of this new information (Brown, Collins & Duguid, 1989). Freire (1970) also describes problem-posing education that incorporates collaboration and connects to students' lives outside of school (Authentic Learning) as being the most successful strategy for teaching.

If high quality syllabi include detailed description of activities required for students, evidence should be present in the syllabi describing Problem Solving, Authentic Learning, and Collaborative Learning activities. Research shows incorporating Problem Solving activities in to instruction improves students' postsecondary success (Hiebert et al., 1996; Higgins, Flower, & Petraglia, 1992; Kolb, 1984; Webb et al., 2008). Chaffee (1992) highlights the need for students entering college to possess critical thinking skills, with Problem Solving skills described as one of those essential skills. Both Chaffee (1992) and Boylan (2002) encourage teaching students these skills prior to postsecondary education experiences to better prepare students for success. When Authentic Learning and Collaborative Learning activities are combined with these Problem Solving activities, success increases still further (Brown, Collins & Duguid, 1989; Kolb, 1984; Lave & Wenger, 1991; Newmann & Wehlage, 1993; Webb et al., 2008).

Definitions and descriptions of Collaborative Learning vary, but usually include some aspect of Problem Solving within a group of peers (Boylan, 2002; Chaffee, 1992; Gross & Kientz, 1999). Authentic Learning definitions also may vary by author, but common components include the use of Problem Solving strategies to resolve real-world problems (Boylan, 2002; Chaffee, 1992; Freire, 1970; Gross & Kientz, 1999; Newmann & Wehlage, 1993; Stein, Isaacs, & Andrews, 2004; Tochon, 2000). Both Authentic Learning and Collaborative Learning strategies incorporate Problem Solving. While each of these learning styles increase student success on their own, when used together these best practices become even more effective.

If postsecondary instructors are encouraged to create high quality syllabi for their courses, then AP teachers offering courses that offer college-level in a high school setting should also be encouraged to create high quality syllabi. If AP courses use high quality syllabi, evidence of best practices such as Problem Solving, Collaborative Learning, and Authentic Learning should be found in the syllabi even though students will not be evaluated on these learning styles on the AP exam at the end of the course. Examining

AP syllabi for evidence of Problem Solving, Authentic Learning, and Collaborative Learning may illuminate how these best practices are being implemented in AP courses.

Research Questions

To test ideas from the literature about these three learning styles, I will evaluate well-developed syllabi that are sufficiently detailed due to the AP audit process EPIC created. An AP syllabus is on average 1-2 pages longer than a regular high school syllabus, rich in content and detail, making it more likely to be able to identify the learning styles of Problem Solving, Authentic Learning, and Collaborative Learning. Because Math and English courses are core subject areas that many students are required to take in both high school and college, I have chosen to sample syllabi from the AP courses English Language and Composition, English Literature and Composition, and Calculus AB.

In my review of AP syllabi for evidence of Problem Solving, Authentic Learning, and Collaborative Learning, I plan to focus my research on the following questions:

9. To what degree will entry-level college curricula taught in the College Board's Advanced Placement courses in Calculus AB show evidence of Problem Solving (as demonstrated in the syllabi authored by teachers of the courses).

10. To what degree will entry-level college curricula taught in the College Board's Advanced Placement courses English Language and Composition and English Literature and Composition show evidence of Problem Solving (as demonstrated in the syllabi authored by teachers of the courses).

11. To what degree will entry-level college curricula taught in the College Board's Advanced Placement courses in Calculus AB show evidence of Authentic Learning (as demonstrated in the syllabi authored by teachers of the courses).

12. To what degree will entry-level college curricula taught in the College Board's Advanced Placement courses English Language and Composition and English Literature and Composition show evidence of Authentic Learning (as demonstrated in the syllabi authored by teachers of the courses).

13. To what degree will entry-level college curricula taught in the College Board's Advanced Placement courses in Calculus AB show evidence of Collaborative Learning (as demonstrated in the syllabi authored by teachers of the courses).

14. To what degree will entry-level college curricula taught in the College Board's Advanced Placement courses English Language and Composition and English Literature and Composition show evidence of Collaborative Learning (as demonstrated in the syllabi authored by teachers of the courses).

15. To what degree will the frequency of the three learning types (Problem Solving, Collaborative Learning, Authentic Learning) differ between AP Calculus and AP English.

16. To what degree are there differences in how evident these practices are in either subject area (Calculus or English).

Research Design

To determine to what degree the AP courses Calculus AB, English Language and Composition, and English Literature and Composition incorporate Problem Solving, Authentic Learning, and Collaborative Learning, I will conduct a content analysis on AP course syllabi for those courses.

Content Analysis Data Source and Sample

The unit of analysis will be authorized AP course syllabi for the 2012 academic year. These syllabi have been submitted for approval through the AP Course Audit process. The AP Course Audit is conducted by the Education Policy Improvement Center (EPIC) for the College Board, and all AP courses must have an approved syllabus through this process before courses receive AP designation on student transcripts.

Sampling plan. Syllabi will be randomly sampled from the AP English Language and Composition, English Literature and Composition, and AP Calculus AB courses. To ensure enough syllabi are reviewed to determine real differences between subject areas and learning styles, 125 syllabi each of AP Calculus AB , English Language and Composition, and English Literature and Composition will be randomly sampled from the authorized AP syllabi for the 2012 academic year. Syllabi will be randomly sampled using customary randomization sampling methods by means of the AP Course Audit's MySQL database. Each approved AP syllabus has been assigned an identification number, and MySQL has a built-in function called "RAND()" that assigns random values to each row returned in a query. This makes it easy to retrieve a random list of AP English or Calculus syllabi.

Scoring procedure.

As syllabi are evaluated for the presence of Problem Solving, Collaborative Learning, and Authentic Learning, frequency counts will be used to determine how often these learning styles are included in the syllabi. If an example of Problem Solving, Authentic Learning, or Collaborative Learning is documented in a syllabus, that syllabus will be awarded one point for the relevant construct. Total frequency counts will be calculated by syllabus and by subject area to determine to what degree each learning style is included in each subject area.

Interrater Agreement.

To ensure that I am rating the syllabi consistently, I will recruit and train another graduate student to score a random sample of 10% from the total syllabi I will evaluate for this study. This will establish inter-rater agreement. I will compile training materials that include examples of each construct that could be found in the syllabi, as well as directions on how to score each syllabus. I will meet with this student before any scoring takes place to train the student and score syllabi together that will not be included in the random sample for this study. This will give me an opportunity to see how closely the student's scores are to my own. Once agreement on scoring has been met, then we can score our syllabi independently and compare our scores. If agreement is lower than 80%, I will plan to retrain the student with syllabi outside of the random sample and then try another random 10% from my study sample and compare our ratings again. I will repeat this process until a minimum of 80% agreement is achieved.

Statistical Analyses

To determine whether any frequency differences found between subject areas on the inclusion of Problem Solving, Collaborative Learning, and Authentic Learning are

significant, I will conduct a Chi-Square (χ^2) test. Statistically significant results would mean it is highly unlikely I would see observed differences by chance. This analysis will help me determine to what degree there are differences in how evident the practices of Problem Solving, Collaborative Learning, and Authentic Learning are in either subject area selected for this study.

Concept Overview

To ensure constructs are defined consistently by both raters, I have constructed definitions from the literature to define the Problem Solving, Authentic Learning, and Collaborative Learning defined in detail in the following pages. Raters will keep a running tally of each example found of the major constructs underneath Problem Solving, Authentic Learning, and Collaborative Learning.

Problem Solving.

As identified in the literature, Problem Solving can be found in syllabi through activities involving *understanding the problem, hypothesizing,* and *strategizing*.

Understanding the problem. Any activity that requires students to restate the problem in their own words could be considered a demonstration of understanding the problem in the syllabus and count on the rubric for this subcomponent. Additional examples of activities that would count as a form of understanding the problem in AP English syllabi include assignments requiring students to use their own words to identify the main conflicts or issues in their reading, writing a summary of readings in their own words before beginning a writing assignment, or gathering research to support and develop student opinions rather than just restating opinions found in the literature. Requests to include students' own insights along with rephrasing others' opinions could also fall under this subcomponent. Reading journal assignments requiring students to reflect on a piece of writing and document their perception of the work provides another example of using their own words to demonstrate understanding. Students may also be asked to describe how the author organizes writing as opposed to merely summarizing the plot. Rather than listing items found in writing, students may be asked to share how all of those items fit together.

In AP Calculus syllabi, understanding the problem could be demonstrated through activities requiring students to identify the goal of the Problem Solving process of a math problem or assignment, describing the barriers preventing goal completion, and identifying possible solutions for overcoming those barriers. Students may be asked to keep a Calculus journal within which they may reflect on their understanding of concepts in their own words, not just repeating definitions and explanations rote from the textbook or lecture. Active reading assignments requiring text annotation for texts may require students to highlight new information and summarize this new information in their own words, adding the material that is new and writing out any questions they may have in a journal. Assignments requiring students to create their own math problems also demonstrate their understanding of concepts learned. Any of the above activities that qualify as examples of understanding the problem could take the form of a written assignment or required verbal interactions with peers.

Hypothesizing. Hypothesizing can be demonstrated in AP English syllabi by writing assignments requiring students to make predictions about what will happen in literary works, or what students could do next in their writing assignments. Any

assignment that presents students with pieces of literature that have gaps within the story line, requiring students to guess what happened despite this missing information, would also be a demonstration of hypothesizing in syllabi. Students may also be asked to speculate about potential outcomes in their reading, predicting not only what may happen next but also how the story may end. In addition to reading assignments, students may be asked to predict exam questions based on material covered in class.

Hypothesizing can be found in similar ways in AP Calculus syllabi. Assignments that ask students to predict what will happen next after choosing an approach to solving the problem, or requiring students to think about what they can do next after each step in Problem Solving process are some ways to demonstrate hypothesizing in syllabi. Any assignment that requires students to speculate the outcomes of choosing a particular path for solving a problem, and requiring students to explain the thinking behind this choice, would demonstrate hypothesizing in syllabi. Assignments that require students to hypothesize solutions and which will likely be best option for solving their problem would also demonstrate hypothesizing. Common words that may be used in syllabi to encourage hypothesizing are words or phrases like predict, estimate, approximate, or make projections. Any of these activities in English or Calculus syllabi could take the form of written assignments or paired peer verbal exchanges.

Strategizing. The third form of Problem Solving that can be found in AP syllabi is strategizing. Solving a problem requires the use of multiple steps or multiple strategies. In AP English courses, this can be demonstrated through a multiple step writing process. These steps may be called different names by different instructors, but they often involve a planning or pre-writing phase, followed by multiple drafts that require proofreading, editing, and revising that incorporates feedback from peers and instructors. Syllabi that include assignments requiring students to participate in a multiple step writing process demonstrate strategizing. Quizzes and exams also require students to strategize in order to demonstrate their knowledge learned through class by responding to questions in a limited amount of time. Students are required to provide specific information in a particular format in order to receive full credit, requiring students to strategize in order to meet these expectations.

Strategizing can also be demonstrated in syllabi through assignments requiring critical reading and writing. Writing assignments that require careful reading and writing about literary work would demonstrate strategizing. Any writing assignment that requires students to explain and evaluate a position or claim would also fit in this subcomponent. Essays requiring students to identify the main ideas or claims of a literary work, and create questions about that work that may be answered through additional research, are additional examples of strategizing through critical reading and writing. Assignments that require constructing arguments in support or opposition of the key claim, using research to support these arguments, would also demonstrate strategizing. Activities requiring students to evaluate the influences or implications of literary work could take the form of essays, critical reading journals, or formal and informal debates with peers. Any activity, whether written or oral, that requires students to select the best way to construct a logical argument that also meets instructor requirements fits under the strategizing subcomponent. Assignments that require students to analyze and develop their own research questions pertaining to reading or content covered in the course, requiring

students use research to support their claims, would also fit under the subcomponent of strategizing.

Strategizing can also be found in syllabi when requirements for writing conventions, writing styles, and analysis of audience issues are present. Requirements for writing conventions can include the appropriate use of writing mechanics, use of formatting guides such as MLA or APA, as well as grammar, sentence construction and punctuation in both writing assignments and oral presentations. The presence of these and similar writing convention requirements in syllabi demonstrate strategizing as students decide how best to meet instructor expectations. Writing assignments and oral presentations that require the use of a variety of writing styles such as argumentative or position essays, expository, narrative, business, persuasive, research or reflection papers demonstrate strategizing as well. These assignments may require students to compare or contrast as well as interpret texts. Writing assignments that require students to analyze issues of audience by focusing on use of tone, whether to use a formal or informal style, and choosing the appropriate sentence structure for their purposes, all demonstrate strategizing in AP English syllabi. Key words or phrases in syllabi that may indicate strategizing include describe; evaluate; analyze; understand; compare; contrast; synthesize; explain; interpret; and communicate issues, themes, and conflicts.

In AP Calculus syllabi, strategizing can also be identified in a number of ways. Similar to the AP English syllabi, activities requiring students to use multiple strategies or to solve the problem using multiple steps demonstrates strategizing. One step in this process involves planning the approach for solving the problem. Any mention of this requirement in the syllabi would demonstrate strategizing. Examples of using multiple steps for solving the problem include estimating possible solutions and strategies prior to attempts to solve the problem, writing assignments that require showing and explaining the choices taken in the Problem Solving process, and through verbal exchanges with peers requiring students to justify their reasoning behind chosen step. Once students have hypothesized a possible solution, in the strategizing portion of the Problem Solving process students with try their hypothesized solutions and explain why they are or are not the correct choices. If necessary, students would then test other hypotheses until the correct solution was found. Examples such as these in the syllabi would all demonstrate strategizing. Activities requiring students to analyze the mathematical situation and choosing the interpretation that is more likely correct and reasonable, justifying this choice, then retracing their steps when they select an incorrect one are all addition demonstrations of strategizing in the syllabi. After students complete a math problem, syllabi requirements to check their work for accuracy provides another source of strategizing in the syllabus.

Similar to the use of quizzes and exams in AP English syllabi, in AP Calculus these activities also require students to strategize in order to demonstrate their knowledge learned through class by responding to questions in a limited amount of time. Students are required to provide specific information in a particular format in order to receive full credit, requiring students to strategize in order to meet these expectations. Key words or phrases in the syllabi that may indicate strategizing include the use of verbs referring to Problem Solving such as analyze, apply, approximate, classify, calculate, compute, conduct, construct, demonstrate, design, describe, determine, differentiate, employ,

estimate, evaluate, experiment, explain, express, factor, find, formulate, graph, hypothesize, identify, interpret, investigate, judge, justify, match, model, organize, perform, plan, relate, represent, recognize, simplify, speculate, sketch, solve, understand, validate, and write about.

Authentic Learning.

As identified in the Literature Review, Authentic Learning can be found in syllabi through activities involving *experiential opportunities or active participation*, and *connection to students' lives.* These constructs will be further defined in the following pages.

Experiential opportunities or active participation. Any activity in the syllabi that promotes active learning such as projects, hands-on activities, simulations, role plays, debates, or field trips provide students to would demonstrate experiential opportunities or active participation on the rubric for this subcomponent. Projects or homework that allow students to apply, practice, and review their knowledge, including long term projects that involve generating and testing hypotheses, would also demonstrate this subcomponent in the rubric. Additional activities that would qualify in this subcomponent include labs, discussions, or field experiences that provide experiential opportunities for students to actively participate in their learning such as practicum experiences, apprenticeships, internships, or projects in the field. This could also take the form of more creative demonstrations in syllabi, such as requiring students to create an art project to demonstrate knowledge of a concept, write a song synthesizing the main points of a literary work, participate in a service learning project in the community, develop a six-minute walk through the major events of a literary work, or producing a scavenger hunt requiring students to find and document key themes from a literary work after being given items to find. Other activities that could be found in syllabi and demonstrate experiential opportunities or active participation include an activity called document shuffle, requiring small groups to review 12-15 documents to determine theme, chronological order, and which documents don't fit in with others. Assignments requiring students to take on roles of major characters in literary works and prepare for a debate between them, or public address on a current issue, would demonstrate experiential opportunities or active participation in syllabi.

Many of the above examples could be used in both English and Calculus syllabi with minor adjustments. Additional examples of experiential opportunities or active participation that could more likely be found in Calculus syllabi include labs or projects used to demonstrate concepts learned in the textbook and lectures, as well as building models of something described in writing to transform a concept in to a physical entity. Activities that introduce students to new topics through group work using discovery-learning, or that provide opportunities for students to engage in explorations or games using graphing calculators, would all demonstrate experiential opportunities or active participation in the syllabi. Homework assignments may require students to graph a mathematical problem, therefore demonstrating an experiential opportunities or active participation in the syllabi.

Connection to students' lives. Connecting instruction to students' lives outside of school can be found in AP syllabi through assignments designed to solve, address, or make students aware of current problems within the students' community or relate to current events. There are many ways education can connect with students' lives.

Creating meaningful connections. Meaningful connection to students can be found in AP syllabi through assignments designed to solve, address, or make students aware of current problems within the students' community. This could take the form of participation in a service learning project in the community, activities requiring students follow current events in newspapers or other media to integrate addressing actual problem in the students' community, or engaging in projects to apply concept knowledge and help the students' community. Assignments requiring students to write mathematical word problems that apply to their lives outside of school would also demonstrate connection to students' lives in syllabi. Connecting lecture topics or activities to cultural or background knowledge students may bring with them, or inviting students to build on the knowledge of the community and a culture already known to students would be other ways to connect with students' lives in the syllabi.

Field trips to museums that require students to compare and contrast what they just viewed to their own lives, or activities such as a scavenger hunt that require students to find items in the museum that connect to their lives in some way are examples in the syllabi of a meaningful connection to students. Starting the year using concepts students are more familiar with it, and then using these ideas to connect to more challenging concepts in the course is another example of an activity or strategy that helps connect the course content to students' lives. Choosing to use a variety of authentic and current texts to expand knowledge and understanding current diverse perspectives also demonstrates meaningful connection to students in syllabi. Additional creative demonstrations of this subcomponent in syllabi include creating a family tree history that connects a students' family history with the story line in literary works, creating a bumper sticker that could be used in the time period of the literary work being studied that requires students to visually represent a concept from the course and relate it to a modern slogan or bumper sticker in currently seen in circulation, or an assignment requiring students to write a newspaper article connecting the literary work with current events. While any of the above examples could also be altered for Calculus, one additional Calculus-specific example includes assignments requiring students to apply the programming tools they have learned to real-life examples of problems.

Offering cross-disciplinary assignments or activities is an additional example in syllabi of the meaningful connection to students construct. Cross-disciplinary assignments that require writing in math through the use of math journals or reflection papers on students' Problem Solving process, as well as assignments requiring students to communicate their mathematics understanding in both verbal and written forms demonstrate meaningful connection to students. Similarly, assignments requiring students to represent problems through both graphic and numerical formats would demonstrate this construct.

Relevance. Relevance to students' lives can be demonstrated in AP course syllabi in a number of ways. Assignments that require students to apply their subject knowledge to an activity in a way that directly ties in to the subject content, rather than using worksheets that do not require students apply their knowledge, would be examples of relevance in syllabi. Journals could also be used to keep track of a variety of student thoughts including reflection journals for literary works or math textbook reading assignments requiring documentation of initial questions and impressions. Assignments that require using these journal entries later when students develop essays and engage in

group discussions makes the journal activity more relevant for later success in the course. Activities where students are given the opportunity to correct writing and exam errors with an analysis of their errors, written responses to former AP exam prompts providing opportunities for students to discover weaknesses in conceptual understanding or in their communication skills, or where in-class opportunities provide background information that improves comprehension of literary work in AP English or mathematical concepts in AP Calculus, would also demonstrate relevance. Assignments that provide college entry essay practice, matching activities requiring students to pair main characters in literature with quotes from those characters and writing a paper describing why they belong together, and opportunities to grade peers' exams to better understand instructor expectations all demonstrate relevance in syllabi.

      Some specific examples of relevance in AP Calculus syllabi that help students understand and apply subject knowledge include activities offering the use of graphing computer programs to make graphing assignments more understandable, written responses to former AP exam prompts providing opportunities for students to discover weaknesses in conceptual understanding or in their communication skills, and reflection journal activities explaining how concepts in AP Calculus tie together throughout the year. Text annotation activities requiring students highlight new information in reading assignments and put the material in their own words, organize the concepts into a logical and hierarchical order, and apply or react to the material would also demonstrate relevance in syllabi. Another example of relevance in Calculus syllabi is through activities requiring students to use mathematical tools to analyze current problems in their world.

      Additional examples of relevant activities are those that aid students in course success and help organize student thinking to increase comprehension of subject matter. Creating useful study guides for upcoming exams and writing chapter summaries are examples of relevance found in syllabi. Assignments requiring students to create graphic organizers and other visual mapping activities such as timelines, geographical mapping, change of culture or practice over time representations, or thematic mapping also demonstrate relevancy in syllabi. Additional activities that improve students' study skills and note-taking, activities that require students to create exam or assignment questions, or activities asking students to build a rubric for evaluation of assignments or exams all demonstrate relevance in syllabi by organizing students' thinking. Developing flash cards for exam reviews, and summarizing class information on notecards to use during quizzes, both help students learn to organize their ideas concisely and assist students in applying their knowledge to their exams. Additional examples of study aids demonstrating relevance in syllabi include highlighting unfamiliar vocabulary to later define, and compiling student-developed questions at the beginning of each major section to be covered on the exam for the class members to focus their exam review.

      Relevance can also be demonstrated in syllabi through activities providing students with experience that will improve their postsecondary success. Assignments demonstrating relevance in this way include those that require students to critique each other's work, or assignments requiring students research a potential career and the academic skills needed for success in that career or in any postsecondary coursework required. Relevance is also demonstrated in syllabi in activities that require students to understand the "whys" of a process rather than just memorizing the process. In AP

English courses, students' ability to apply critical thinking skills learned in class to new literary works or writing assignments would be one way students could demonstrate understanding a process when applied to a variety of situations. Assignments that require students show how their argument helps us understand and deal with problems in the real world, and activities requiring students to critically evaluate all sources of information both recent and historical, are additional ways to demonstrate relevance in this form. In AP Calculus syllabi, assignments that require students to extract a problem from a new context, analyze the problem with processes learned in class, and interpret the solution back in to context is one demonstration of relevance. Explaining the results of solutions by providing a written interpretation rather than just a number in a box would be an additional way students can demonstrate their understanding of the process. Assignments requiring these skills would demonstrate relevance in syllabi.

Opportunities to engage in real-world problems. Assignments designed to address actual problems professionals in the field are currently struggling to solve is one way to do this. This could be done through activities requiring students to follow and examine current trends in the subject area, and complete assignments requiring students to address issues or solve problems that exist. Another example in syllabi could be a requirement that each student complete a research project and submit this into a high school research competition, present the new information to the public in a poster presentation, or share the new information in some other way.

Choice. Offering students choice in the topics they read or research as well as choice of how they will demonstrate their knowledge of the concepts learned also demonstrates meaningful connection to students in syllabi. For example, students may be asked to select a topic for a writing assignment, and then choose from a variety of different formats such as a research essay, document analysis, annotated bibliography, film analysis, cartoon or visual analysis, or PowerPoint presentation to demonstrate their knowledge of the material learned in the course. In either English or Calculus courses, students could also be asked to participate in poster presentation assignments requiring students to review current research in the field related to class that is of interest to each student, display this information in poster form, and present this information to the class. Additionally, students could be required to research and critique articles in the field that are most interesting to each student.

Collaborative Learning.

As identified in the literature, Collaborative Learning can be found in syllabi through activities involving *using out of class time effectively for study group learning; group projects or assignments; small-group or whole class discussions; reciprocal teaching; and for English syllabi only, peer review or editing*.

Using out of class time effectively for study group learning. Any activity in the syllabi that promotes using out of class time effectively for study group learning demonstrates collaboration**.** Seeking help sessions outside of class in the form of tutoring circles, learning groups with peers, or even learning groups with the instructor demonstrates this form of collaboration. Activities such as regularly scheduled study groups, optional after-school study sessions to read and analyze supplemental texts, and student-formed study or tutoring groups relying on peer support all demonstrate using out of class time effectively for study group learning. Exam review sessions, encouragement of instructors for students to regularly attend office hours, and participation in the

school's Writing Center all demonstrate collaborative activities outside of class. Additionally, test preparation and study skill sessions, as well as extra credit opportunities for participation in any of the above out-of-class Collaborative Learning opportunities, all demonstrate Collaborative Learning in this form.

Group projects or assignments. Syllabi for AP courses may demonstrate group projects or assignments in syllabi through any work together with peers on assignments or projects. Demonstrations of group projects or assignments in syllabi may involve brainstorming activities, triad work, role play activities, dramatizations, games, panels, symposiums, colloquia, or round table discussions. Activities demonstrating group projects or assignments in syllabi may involve listening to others' strategies to evaluate the strengths and weaknesses of each, accepting constructive criticism by respecting differing opinions, or reviewing group work to provide constructive criticism including positives as well as suggested changes. Group projects that require class presentations, in-class activities requiring collaboration and short written responses, small group work or paired activities interpreting literary works or mathematical concepts together all demonstrate additional examples of group projects or assignments in syllabi. Group jigsaw presentations, group debates, and group writing activities also demonstrate this form of collaboration. Additional demonstrations in syllabi may include table group assignments as well as lab work with a partner or small group. In Calculus syllabi, group projects or assignments may be demonstrated in discovery-learning activities as students are introduced to new topics through group work. Having the opportunity to work cooperatively on in-class work, graded AP problems, and take-home exams also demonstrates group projects or assignments in syllabi.

Small-group or whole class dialogue opportunities. Syllabi for AP courses may demonstrate collaboration through either small-group or whole class dialogue opportunities. Whole class discussions provide opportunities for instructors to ensure all students are clear on task and performance expectations, as well as the course content. Class discussions demonstrate collaboration in the form of dialogue opportunities, providing a time for students to exchange ideas and better understand the course content through graded discussion activities, class debates, electronic discussion boards on which all students are required to participate, and development of their own questions about course content based on the Socratic seminar models.

Games involving whole class participation include Jeopardy for review, vocabulary Bingo, and literary work Charades also demonstrate whole class dialogue opportunities in the syllabi. Syllabi requiring a minimum amount of student participation within a particular amount of time also demonstrate whole class dialogue opportunities. Students may discuss homework questions in small groups, while unresolved questions are saved for discussion with the entire class and demonstrate these whole class dialogue opportunities in the syllabi. Creating a role of "homework boss" in the classroom requires individual students to serve for several days weeks leading the homework reviews for the entire class and soliciting volunteers to share their work, ensuring that all students are keeping up with assignments completion and understanding the content requirements. Inclusion of a "homework boss" demonstrates whole class dialogue opportunities in the syllabi. An additional example of whole class dialogue opportunities in the syllabi is using text annotations as a basis for class discussions, allowing students the opportunity

to add to and correct these annotations as the class progresses. All of the above activities demonstrate whole class dialogue opportunities in the syllabi.

Small-group dialogue opportunities provide students with additional opportunities to discuss perspectives of reading assignments, ideas about the content covered, as well as to clarify any expectations regarding coursework. Activities requiring students to pair up and ask their partner challenging questions about their writing ideas or arguments, small-group online discussions of reading assignments, round table discussions on individual or group research projects, and developing study circles to address questions and concerns in both reading and other course assignments are all demonstrations of small-group dialogue opportunities in the syllabi. Assignments requiring students to create questions for sharing with a partner after summarizing an article that is different from partner's article, and providing opportunities for each student to answer clarifying questions, also demonstrate small-group dialogue opportunities in the syllabi. Pre-reading activities requiring collaboration with partner to tell a story about book or chapter based on a picture, diagram, or bolded key words throughout the text are additional examples demonstrating this form of collaboration. Assignments requiring students to pair up and discuss characteristics of literary works or mathematical concepts, then share the information discussed with the whole class, would demonstrate a think/pair/share activity as a small-group dialogue opportunities in the syllabi.

Reciprocal teaching. Peer interactions demonstrating reciprocal teaching in the syllabi include those requiring each student in a small group to learn specific content and then teach this content to the peers in the group. These jigsaw activities require each person or group to learn one piece of the "big picture", then teach this information to the whole group so all participants learn all pieces. Inner/outer circle discussions where students from two groups read different articles on the same topic, one group discusses the issues while the other group takes notes, and then finally reversing this process is another demonstration of reciprocal teaching in the syllabi. Assignments requiring students to create questions for sharing with a partner after summarizing an article that is different from partner's article, and providing opportunities for each student to answer clarifying questions, also demonstrate reciprocal teaching in the syllabi. Jigsaw activities often incorporate learning and teaching about a reading assignment, but sometimes they may involve sharing research with fellow students in a symposium, or sharing some other item related to course content thematically but not incorporated in the instruction. Demonstrations in syllabi that indicate students are learning and teaching content to each other in a jigsaw manner are examples of reciprocal teaching.

Peer review or editing. Activities that demonstrate peer review or editing in AP English syllabi include the review of peer writing assignments, listening to others' strategies and evaluating the strengths and weaknesses of each, and providing constructive criticism including positive points as well as needed revisions. Syllabi may demonstrate peer review or editing by stating the expectation that students accept constructive criticism by respecting differing opinions and maintaining civility. Activities such as face-to-face or online discussion boards to provide peers feedback on writing assignments, developing rebuttals to feedback encouraging writing or argument changes, and group development of a rubric for evaluating writing assignments all demonstrate peer review or editing in AP English syllabi.

Training Procedures

Step 1: Initial training session

During the initial training session, the researcher will go through the Training Manual and Codebook with the rater. After this step is complete, the researcher will go through 2 sample syllabi from one subject area (Calculus, English Language and Composition, or English Literature and Composition) that have already been scored to show the rater how each syllabus was scored. The sample syllabi will have annotations on the right side of the page identifying curricular requirements met. These annotations should be ignored and should not play a role in the scoring process. Decision rules for scoring will be discussed at this time and the rater will have the opportunity to ask questions throughout the process.

Next, the rater will review a third syllabus and verbally share their scoring process as the syllabus is reviewed. Any differences between how the trainer scored the syllabus and how the rater scored the syllabus will be discussed as the scoring is taking place to reduce error. Decision rules for scoring will be discussed again, especially where any discrepancies between scoring occurred. Finally, the rater will score a fourth sample syllabus alone and compare the final scoring with the trainer's scores. Decision rules will again be discussed and any further questions the rater has about the process will be addressed.

Step 2: Solo syllabus rating (training)

Once the initial training session is completed, the rater will review four additional training syllabi alone. At the completion of this task, the scoring for all four syllabi will be reviewed by the trainer for inter-rater agreement.

Step 3: Solo syllabus rating (random sample)

If the agreement is at least 80%, then the rater will be given a random sample of 13 syllabi from the same subject area, taken from the researcher's random sample of 125 syllabi in the subject.

Benchmarking Process

The rater will review the syllabi in order, and every third syllabus will serve as a benchmark to be compared with the researcher's scoring. If at any point in this process the benchmarked syllabi scores do not match at least 80% of the time, the trainer will review the scoring process with the rater on new syllabi and retrain the rater on any scoring that is different from the researcher's scores. Adjustments to the scoring process may be made at this time in order to increase reliability.

Repeat Step 1 with new subject

Once the rater has completed the random sample of 13 syllabi, training will begin on the second subject area in the same order as above. When inter-rater agreement is established with the second subject area, training will begin on the third and final subject area.

Scoring Procedures

Each syllabus has been saved as a pdf for you to review three times. First, review the syllabus for evidence of Problem Solving. When you come across an activity that is evidence of one or more of the subcomponents of Problem Solving (Understanding the problem, Hypothesizing, Strategizing), mark "Problem Solving" in the left margins of the syllabus pdf and indicate which subcomponent was found by writing "Understanding the problem", "Hypothesizing", and/or "Strategizing" in the margins as well. A paper copy of the Excel sheet you will be using for scoring will be provided for you to use to keep track of evidence as you review the syllabus. When evidence for components and subcomponents are found, enter Yes or Y in the appropriate column. If you identify any subcomponents of Authentic Learning or Collaborative Learning, be sure to mark them as you go. Review the syllabi a second time for Authentic Learning (Experiential/Active learning, Connection to students' lives) and a third time for Collaborative Learning (Using out of class time effectively, Group Projects, Dialogue, Reciprocal Teaching, or Peer Review- English syllabi only). Any empty columns at the end of your review can be filled with a No or and N on your paper scoring sheet.

After reviewing the syllabus 3 times, complete the Excel sheet electronically by answering Yes if there is any evidence for each component (Problem Solving, Authentic Learning, and Collaborative Learning) and which subcomponent there was evidence found for each component. Either Yes or No must be filled out for each component AND each subcomponent.

General questions about whether evidence of a component (Problem Solving, Authentic Learning, Collaborative Learning), or any of the subcomponents within each component are present in the syllabi can be found in the Decision Rules on page 31. Definitions and examples of each component and subcomponent can be found in the codebook in the following pages.

General Decision Rules

How much evidence is enough evidence? In general, there often needs to be more than just the presence of a word that fits a component (Problem Solving, Authentic Learning, or Collaborative Learning). There must also be a description of the activity that demonstrates why a particular activity represents one of the subcomponents. Part of the syllabus may list an activity early on without any description, but list the activity again later with more information presented showing it meets the subcomponent criteria. At the time the description is provided, it is acceptable to count that/those subcomponent(s) as being present.

When to select more than one component/subcomponent: Any time the description of an activity provides evidence for multiple components/subcomponents, you may count the activity as meeting the criteria for as many components/subcomponents as applicable. For example:

Labs that specifically state students work with a partner or group could be evidence of both Authentic Learning (Experiential/active learning) AND Collaborative Learning (group project, dialogue if enough description of the activity involving discussion with peers). If description of the lab includes an activity that relates to students' lives outside of school, the activity may also meet the criteria for Authentic Learning, Connection to students lives.

Any activity that specifies a Problem Solving approach (Hypothesizing a solution, Strategizing by using multiple steps to solve the problem such as checking work and retrying a different solution to the problem) while working on a lab (Authentic Learning, Experiential/Active Learning), in a group (Collaborative Learning, Group project). An activity could be scored in all three categories at the same time if there is evidence of this.

Where will I most likely find evidence in the syllabus? You may find that activities may described in more detail in different parts of the syllabus. This will vary from syllabus to syllabus. In some syllabi, a listing of the activities can be found in the Course Planner, while more detail can be found under Teaching Strategies and Student Activities. Depending on the instructor who developed the syllabus, this may not always be the case. Sometimes the Course Planner or Objectives sections *do* hold evidence of Problem Solving, Authentic Learning, or Collaborative Learning. Look in all sections of the syllabus to make sure evidence is not overlooked. Also look under Student Evaluation sections. Sections not likely to hold enough evidence (but should still be reviewed) include Textbook, Overview, and Course Outline.

Word choice matters. The words describing student activities can make a difference in whether or not criteria are met for components/subcomponents. Providing students the choice to demonstrate their knowledge may be evidence for Authentic Learning, Connection to students lives (Choice), but if one of the choices could represent Problem Solving it will not count because it is only an *option* and not something that every student will be expected to participate in. Pay close attention to the words being used in the

syllabi. Phrase such as "Students may participate in", and "Students choose from the following topics" are examples of activities that are not required for all students.

Key words. Key words may help to flag potential evidence of subcomponents. These words alone will not be enough to demonstrate a subcomponent, but watching for these key words listed in the definitions for the subcomponents could help in identifying potential evidence.

If in doubt, look at the syllabi as a student. When you are unsure about the presence of evidence in the syllabi, imagine you are a student who know nothing about the course who is attending class for the first day. As you read the syllabus, do you understand what is being expected of you? After reading the description of the activity, is it clear what you are going to be doing? This is the lens you should view the activity when you are undecided.

Component Definitions:

Problem Solving: Any activity that requires students to go through multiple steps to resolve a problem.

Authentic Learning: Activities requiring students to resolve real-world problems or apply new learning to better understand it.

Collaborative Learning: Activities requiring students to work within a group of peers to solve a problem/complete an assignment together.

Subcomponents for English

Problem Solving
Understanding the Problem: English Lit/Lang

Definition:
Explaining what students understand about new information helps them understand the information more deeply and apply it to new, similar problems.

Activities or assignments that require restating the problem in your own words. This may be in the form of written work or paired verbal exchange with peer.

Examples:
Statements such as…
Students will write in their own words. No cut-and-paste research!
Students may rephrase information, but should also include their own unique insights. Avoid mere paraphrase or summary.

Required **reading responses/reading journals** following reading assignments to address the main conflicts or issues being discussed, or **reflect** on a piece of writing and document student's perception of the work.

Students write a **summary of readings in own words** before beginning to write for assignment; gather research to **support and develop students' own opinions** rather than just restating opinions in literature.

Assignments requiring students to **use their own words to identify the main conflicts** or issues in their reading.

Requests to **include students' own insights** along with rephrasing others' opinions.

Assignment to **describe how the author organizes writing** as opposed to merely summarizing the plot.

Rather than listing items found in writing, students may be asked to **share how all of those items fit together**.

Accounting for rhetorical choices in students' writing on submission forms.

Problem Solving
Hypothesizing: English Lit/Lang

Definition:
Predictions help students increase their understanding of reading and their writing process.
This may be in the form of written work or paired verbal exchange with peer.

Examples:

Asking students to make **predictions about what will happen next in reading or what they can do next in writing assignments. Peer verbal exchange** regarding potential outcomes of reading or what will happen if writing choices are made.

Students are asked to speculate outcomes if characters made different choices **or if students made different choices in their own writing** and are required to **explain their thinking**.

Any assignment that presents students with **pieces of literature that have gaps within the story line,** requiring students to guess what happened despite this missing information.

Students may also be asked to **speculate about potential outcomes in their reading**, predicting not only what may happen next but also how the story may end.

Students may be asked to **predict exam questions based on material covered in class.**

*May appear in the syllabi as***:**

Top 50 Organizer: Predict the top 50 works of art by time period and top 50 vocab to be on exam.

Gaps of information are presented in a story requiring students to guess what happened.

Pre-reading activity requiring collaboration with partner to tell a story about book/chapter based on picture at beginning; Chapter Pre-view: identify the main idea of each visual image in the chapter (pictures, photographs, maps, charts, and graphs).

Problem Solving
Strategizing: English Lit/Lang

Definition: Explaining the reasons behind problem-solving choices helps students to correct errors in their thinking, and strengthens their understanding of the concepts learned.

This may be in the form of written work or paired verbal exchange with peer.

Examples:
Multiple step writing process. These steps may be called different names by different instructors, but they often involve a planning or pre-writing phase, followed by multiple drafts that require proofreading, editing, and revising that incorporates feedback from peers and instructors.

May appear in the syllabus as: Mandatory 3 Revision minimum; Students will start writing in class but assignment must be typed and proofread when turned in; Group workshopping to develop a 6-point rubric for evaluation of writing.

Quizzes and exams also require students to demonstrate their knowledge learned through class by responding to questions in a limited amount of time. Students are required to provide specific information in a particular format in order to receive full credit, requiring students to strategize in order to meet these expectations.

May appear in the syllabus as: Timed essay to prepare for AP exam, Free-response to released items, AP Exam; Reading quizzes.

Assignment requirements for **writing conventions** including the appropriate use of **writing mechanics, use of formatting guides such as MLA or APA, as well as grammar, sentence construction and punctuation in both writing assignments and oral presentations**.

May appear in the syllabus as: Papers are graded for idea, structure, grammar, and voice; understanding and use of MLA style.

Writing assignments that require students to **analyze issues of audience by focusing on use of tone, whether to use a formal or informal style, and choosing the appropriate sentence structure for their purposes**.

May appear in the syllabus as: Students develop their ability to work with language and text with a greater awareness of purpose and strategy.

Problem Solving:
Strategizing: English Lit/Lang Examples (cont.)

Writing assignments and *oral presentations* that require the use of a **variety of writing styles such as argumentative or position essays, expository, narrative, business, persuasive, research or reflection papers** demonstrate strategizing as well. These assignments may require students to **compare or contrast as well as interpret texts**.

May appear in the syllabus as: Comparative, Document Based Question, and Change Over Time Essays; Expository, Short Answer Question, & Research Papers; Reflection, Free Response, and Research papers; Informal, in class free-write activities ; poetry-reading journal, where students will record initial questions, impressions, and responses to the poems; Compare/contrast.

Critical reading and writing. Writing assignments that require careful reading and writing about literary work in order to **explain and evaluate a position or claim**. Essays requiring students to **identify the main ideas or claims** of a literary work, and **create questions** about that work that may be answered through additional research. Assignments that require **constructing arguments in support of or opposition to the key claim, using research to support** these arguments. Activities requiring students to **evaluate the influences or implications of literary work** could take the form of **essays, critical reading journals, or formal and informal debates with peers**.

Any activity, whether **written or oral,** that requires students to **select the best way to construct a logical argument that also meets instructor requirements**.

Assignments that require students to **analyze and develop their own research questions** pertaining to reading or content covered in the course, requiring students **use research to support their claims**.

Key words or phrases in syllabi that *may* indicate strategizing include *analyze, apply, assess, compare, contrast, critique, describe, discuss, elaborate, evaluate, examine, exemplify, explain, express, identify, illustrate, interpret, synthesize,* or *understand.*

May appear in the syllabus as:

Essays

Essential questions/big ideas

Critical reading journals

Review the key features of definitional arguments and **create questions** about each one that might be answered through research.

After the claim has been identified, take a position in opposition to it.

Writing to understand, explain, & evaluate.

Authentic Learning
Experiential opportunities or Active participation: English Lit/Lang.

Definition: Projects that allow students to apply, practice, and review their knowledge. This subcomponent may be demonstrated through homework activities.

Examples:

Activities that promote active learning: *debates, discussions, experiences in the field, field trips, hands-on activities, labs, projects, role plays, simulations, or any activity where students actively participate in learning.*

May appear in the syllabi as: Creative assignments including any of the following tasks.

Creating an art project to demonstrate knowledge of a concept (opportunity to synthesize vocabulary, methods and concepts and apply them) through activities such as Foto-novella projects, collages depicting themes of reading, etc.
Writing a song synthesizing the main points of a literary work.
Participating in a **service learning project in the community.**
Developing a **six-minute walk through** the major events of a literary work.
Producing a **scavenger hunt** requiring students to find and document key themes from a literary work after being given items to find.
Document shuffle, requiring small groups to review 12-15 documents to determine theme, chronological order, and which documents don't fit in with others.
Students taking on **roles of major characters** in literary works and prepare for a **debate** between them, or **public address on a current issue**. (War of 1812 simulation: Students take on roles of state reps and prepare speeches these reps would write in the day).
Small student **groups presenting their research in a nontraditional (nonlecture) format** for one 30-minute class period (**commercial, tv show, time travel, song, etc**.).
Creating a brochure and song about art periods or literature themes.
Listening to radio programs and **reading actual publications in Spanish to practice skills/engage** in authentic materials.
Field trips
Labs
Designing museum exhibits
Historical reenactments
Role play trials of unique characters in history or literature.
Developing a **Marketing campaign** for different historical groups in history or literature
Creating **election campaign website**.

Long term projects that involve generating and testing hypotheses.
Experiential education such as **practicum, apprenticeships, internships, work/study programs, cooperative education, field projects**

Authentic Learning
Connection to students' lives outside of school

Definitions: Connecting students' classroom education to their lives outside of school, also known as the "real world" through activities that may provide *any or all of the following*:

Meaningful: Meaning and understanding is increased when classroom information is connected to students' lives or interests**.** Meaning is constructed from our experiences and background knowledge, such as culture, language, and heritage. Using these experiences to connect to learning demonstrates meaningful connections to students' lives outside of school.

Relevance to students' lives: Activities that are connected students' current lives outside of school as well as future directions (life after high school).

Opportunities to engage in real-world problems/solve problems professionals in the field are attempting to solve. Projects that help improve the students' community designed to solve, address, or make students aware of current problems.

Choice: Students are able to select reading materials or writing topics and how they demonstrate knowledge.

Authentic Learning
Connection to students' lives outside of school: English Lit/Lang.

Definition: Connecting students' classroom education to their lives outside of school, also known as the "real world" through activities that may provide *any or all of the following*:

Meaningful: Meaning and understanding is increased when classroom information is connected to students' lives or interests**.** Meaning is constructed from our experiences and background knowledge, such as culture, language, and heritage. Using these experiences to connect to learning demonstrates meaningful connections to students' lives outside of school.

Examples:
Assignments using **personal experiences** as a context for applying new information; connecting course to students' lives/interests such as music, movies, clothes, money, cars, cell phones, etc.

Relate topic of drama to the "drama" of taking AP poetry.
Connecting lecture topics or activities to cultural or other background knowledge students may bring with them, or inviting students to build on the knowledge of the community and a culture already known to students.
Field trips to museums **requiring students to compare and contrast what they just viewed to their own lives.**
Activities such as a **scavenger hunt** requiring students to find items in the museum that **connect to their lives** in some way.
Starting the year **using concepts students are more familiar with**, and then using these ideas to **connect to more challenging concepts** helps connect the course content to students' lives.
Using a variety of **authentic and current texts** to expand knowledge and understand current diverse perspectives.
Encouraging students to submit their **best poetry to school's literary magazine**.

May be found in the syllabi as: Additional creative demonstrations may include…

Creating a family tree history that connects a students' family history with the story line in literary works.
Creating a **bumper sticker** that could be used in the time period of the literary work being studied that **requires students to visually represent a concept from the course and relate it to a modern slogan** or bumper sticker in currently seen in circulation.
Assignment requiring students **to write a newspaper article connecting the literary work with current events**.

Assignments or activities dealing with **current events, or linking academic and real-world problems.**

Authentic Learning
Connection to students' lives outside of school: English Lit/Lang.

Relevance to students' lives: Activities that are connected students' current lives outside of school as well as future directions (life after high school).

Examples:

Reading about an issue that impacts students' lives.

Activities that will help students **succeed in the class, not just worksheets**. Such as students providing an example of how a major concept relates to each of the units covered in the course.

Assignments requiring students to **apply their subject knowledge to an activity in a way that directly ties in to the subject content**, rather than using worksheets that do not require students apply their knowledge.

Using journals to keep track of a variety of student thoughts including **reflection journals** for literary works or math textbook reading assignments requiring documentation of initial questions and impressions. **Assignments requiring use of these journal entries later when students develop essays and engage in group discussions** makes the journal activity more relevant for later success in the course.

Activities giving students the **opportunity to correct writing and exam errors with an analysis of their errors, or providing written responses to former AP exam prompts give students the opportunity to discover weaknesses in conceptual understanding or in their communication skills**.

Matching activities requiring students to **pair main characters in literature with quotes from those characters and writing a paper describing why they belong together**

Opportunities for grading peers' exams to better understand instructor expectations.

Activities aiding students in course success and **helping organize student thinking to increase comprehension** of subject matter.

Creating useful **study guides** for upcoming exams and **writing chapter summaries**.

Assignments requiring students to **create graphic organizers and other visual mapping activities** such *as timelines, geographical mapping, change of culture or practice over time representations, or thematic mapping*.

Authentic Learning
Connection to students' lives outside of school: English Lit/Lang. (Relevance cont.)

Additional activities **improving students' study skills and note-taking**, activities requiring students to **create exam or assignment questions**, or activities asking students to **build a rubric for evaluation of assignments or exams** help students to organize their thinking.

Designing **quizzes for whole class on content from your group presentation**.

Developing **flash cards** for exam reviews, and **summarizing class information on notecards** to use during quizzes, both help students learn to organize their ideas concisely and assist students in applying their knowledge to their exams.

Highlighting unfamiliar vocabulary to later define, and **compiling student-developed questions at the beginning of each major section** to be covered on the exam for the class members to focus their exam review.

Using **SOAPSTone** text analysis strategy requiring students to look at the Speaker, Occasion, Audience, Purpose, Subject, and Tone of texts they read to improve analysis.

Syntax Analysis Chart requiring students reflect on their own and others' writing styles by using a 5 column technique focusing on Number of sentences, first four words, special features, verbs, and number of words per sentence to identify how style contributes to meaning and purpose. This technique also helps students revise their writing and identify problem areas.

Dialectical Notebooks/Double-Entry journals requiring students to create 2 columns and recording notes about the text in one column, while recording their responses, comments, etc. in the second.

Activities helping students **prepare for life after high school**: writing/reviewing college entrance essays, preparing and taking college entrance exams. Assignments providing **college entry essay practice** or reviewing student samples of **personal essays** to critique.

Assignments requiring students to **critique each other's work.**

Assignments requiring students **research a potential career** and the academic skills needed for success in that career or in any postsecondary coursework required.

Activities requiring students to **understand the "whys" of a process** rather than just memorizing the process.

Applying critical thinking skills learned in class to new literary works or writing assignments.

Assignments requiring students show how their argument helps us understand and deal with problems in the real world, and activities requiring students to critically evaluate all sources of information both recent and historical.

Authentic Learning
Connection to students' lives outside of school: English Lit/Lang.

Opportunities to engage in real-world problems/solve problems professionals in the field are attempting to solve. Projects helping to improve the students' community designed to solve, address, or make students aware of current problems.

Examples:

Projects helping improve the **students' community** designed to **solve, address, or make students aware of current problems.**

Activities that professionals in the field may engage in. Reading and writing for real purposes and real audiences such as reading about an **issue that impacts students' lives**, **writing letters to politicians, and conducting a service learning activity t**o address the problem. Similarly, **reading discipline-related journals** that professionals in the field read to keep updated on current research, or working on **problems that professionals are currently addressing**.

Assignments **addressing actual problems professionals in the field are currently struggling to solve**. Activities requiring students to **follow and examine current trends in the subject area, projects addressing issues or solving problems that currently exist**. **Submission of research projects into high school research competitions, presenting the new information to the public in a poster presentation**, or sharing the new information in some other way.

May appear in the syllabi as:

Participating in **service learning projects** in the community.

Activities requiring students follow **current events in newspapers or other media** and relate problems/solutions of the larger community to actual problems in the students' community.

Projects applying concept knowledge towards helping the **students' community**.

Critiquing current articles in the field.

Mini-Medical School and Residencies. Using the "New Pathways" curriculum of Harvard Medical School as a model, students work in a self-directed manner to fill out study guides on major themes/concepts in the course.

Authentic Learning
Connection to students' lives outside of school: English Lit/Lang.

Choice: Students selecting their own reading materials, research/writing topics, or demonstrations of knowledge.

Examples:

Selecting reading materials or writing/research topics.
Participate in **poster presentation** assignments requiring students to **review current research in the field related to class that is of interest to each student**, display this information in poster form, and present this information to the class.
Requiring students to **research and critique articles in the field that are of most interest**.

Selecting how students will demonstrate their knowledge.

Requiring students choose from a variety of different formats to show they understand the material taught in the course. Formats may include using a **research essay, document analysis, annotated bibliography, film analysis, cartoon or visual analysis, or PowerPoint presentation**.

Open-ended tasks: Tasks that don't have rigid requirements for how they should be completed but allow students to define the parameters of the assignment.

Collaborative Learning
Using out of class time effectively for study group learning: English Lit/Lang.

Definition: Any activity that promotes using out of class time effectively for study group learning. Students may be required to participate or attendance may be optional.

Examples:

Seeking help sessions outside of class in the form of **tutoring circles, learning groups with peers, or even learning groups with the instructor.**

Exam review sessions, test preparation and study skill sessions

Encouragement by instructors for students to regularly attend **office hours**

Participating in the **school's Writing Center**

Extra credit opportunities for participating in any of the above out-of-class Collaborative Learning opportunities

May appear in the syllabi as:

Exam review sessions

Inner/outer circle activity: One group of students (inner circle) dialogues while another group observes from an outer circle. The outer circle shares their observations of the interaction after the inner circle finishes the dialogue.

Tutoring and review sessions

Tutorial sessions after class

Peer study groups

Optional review sessions

Video clips **before and after school for extra credit on quizzes/test:** correlates with knowledge they already have.

Collaborative Learning
Group projects or assignments: English Lit/Lang.

Definition: Any work together with peers on assignments or projects.

Examples:

Requiring students to participate **in brainstorming activities, triad work, role play activities, dramatizations, games, panels, symposiums, colloquia, or round table discussions .**

Table group assignments, or lab work with partner/group: These activities may involve listening to others' strategies to evaluate the strengths and weaknesses of each, accepting constructive criticism by respecting differing opinions, or reviewing group work to provide constructive criticism including positives as well as suggested changes. Having the opportunity to **work cooperatively on in-class work, graded AP problems, and take-home exams.**

Group projects requiring **class presentations**, in-class activities requiring collaboration and **short written responses**, small group work or paired activities **interpreting literary works or mathematical concepts together.**

Group **jigsaw presentations** (each group/group member presents on one aspect of a topic), **group debates**, and **group writing activities.**

May appear in the syllabi as:

Graded discussions

Group projects with **creative presentation**; presentation encouraged to include performance, skits, cuisine

Participation and collaboration in the form of **in-class activities and short written responses**.

Small groups or pairs to interpret poetry

Cooperative learning activity/**jigsaw group presentation.**

Debate/presentation: dividing class into 6 groups with each group defending a different point of view in 6 minutes.

Writing essays, **pairing with peer & deciding which one is stronger**, then share main ideas with whole group.

Group journal-keeping.

Collaborative Learning
Dialogue Whole Class/Small Group: English Lit/Lang.

Definition: Dialogue opportunities that provide time for students to exchange ideas and better understand the course content. Activities providing more opportunities for students to share their thoughts and work through them with fewer peers interacting at the same time when in small groups.

Examples for Whole Class:

Providing opportunities for instructors to **ensure all students are clear on task and performance expectations, as well as the course content**.

Providing time for students to **exchange ideas and better understand the course content** through **graded discussion activities, class debates, electronic discussion boards** on which all students are **required to participate**, and development of their own questions about course content based on the **Socratic seminar models**.

Requiring minimum amounts of student participation in class. Students may discuss homework questions in small groups, while **unresolved questions** are saved for whole class.

Creating a role of **"homework boss"** in the classroom requiring individual students to serve for several days/weeks leading the homework reviews for the entire class and soliciting volunteers to share their work, ensuring that all students are keeping up with assignments completion and understanding the content requirements.

Using **text annotations** as a basis for class discussions, allowing students the opportunity to add to and correct these annotations as the class progresses.

Examples for Small Group:

Providing opportunities for students to **discuss perspectives of reading assignments, ideas about the content covered, as well as to clarify any expectations regarding coursework.**

Activity requiring students to **pair up and discuss characteristics of literary works or mathematical concepts, then share the information discussed with the whole class (think/pair/share activity).**

Pairing up and **asking their partner challenging questions** about their writing ideas or arguments**, small-group online discussions of reading assignments, round table discussions on individual or group research projects, and developing study circles** to address questions and concerns in both reading and other course assignments. Assignments requiring students to **create questions for sharing with a partner after summarizing an article that is different from partner's article**, and providing opportunities for each student **to answer clarifying questions.**

Collaborative Learning
Dialogue Whole Class/Small Group: English Lit/Lang. (cont.)

Pre-reading activities requiring collaboration with partner to tell a story about a book or chapter based on a **picture, diagram, or bolded key words** throughout the text**.**

May appear in the syllabi as:
Games for review: Jeopardy; vocabulary Bingo; and literary work Charades; Dry erase recall; Dominoes (make connections from one piece of literary work to another as line up dominoes).

Class Senate/debate

Literary work speed dating;

Sharing deliberations over students' research in **classroom-based study groups**. Developing their own **questions for discussion** based on the Socratic seminar models. Conferring with other students about **writing**.

Requiring participation: 4 instances within 2 seminars.

Participating in discussions on electronic discussion boards.

Inner/outer circle discussions where students from 2 groups read different articles on same topic, one group discusses issues while other group takes notes, then vice versa.

Literature study circles.

Challenge City: Pairing up and asking a partner challenging questions about their presentation with extensive questioning.

Web discussions of reading

Round table discussion on research projects

Think/pair/share activity: Small group activities requiring students to think individually about a concept/topic, pair up to discuss thoughts with a partner, and share out to whole/bigger group.

Pre-reading activity requiring collaboration with a partner to tell a story about book/chapter based on a picture at the beginning

Creating questions to share with a partner **after summarizing** an article read (different from partner's article) and **answering clarifying questions**.

Collaborative Learning
Reciprocal Teaching: English Lit/Lang.

Definition: Activities requiring each student in a small group to learn specific content and then teach this content to the peers in the group.

Reciprocal teaching allows students to actively process text read in small groups by **questioning, clarifying, predicting, and summarizing.**

Examples:

Jigsaw Activities: Activities requiring each student in a small group to learn specific content and then teach this content to the peers in the group. Jigsaw activities require each person or group to learn one piece of the "big picture", then teach this information to the whole group so all participants learn all pieces. Jigsaw activities often incorporate learning and teaching about a reading assignment, but sometimes they may involve sharing research with fellow students in a symposium, or sharing some other item related to course content thematically but not incorporated in the instruction.

Inner/outer circle discussions: Students from two groups read different articles on the same topic, one group discusses the issues while the other group takes notes, and then finally reversing this process.

Reciprocal teaching allows students to actively process text read in small groups by **questioning, clarifying, predicting, and summarizing.** Assignments requiring students to create questions for sharing with a partner after summarizing an article that is different from partner's article, and providing opportunities for each student to answer clarifying questions.

Small group members **bouncing questions off peers**, gaining a better understanding of challenging concepts in the process. Discussion activities run more smoothly when the expectations for the process and student roles are clearly described in advance.

May appear in syllabi as:

Reading jigsaw: Choosing to read a literary work and sharing analysis of it with class. Presenting literary works to class/teaching about chosen piece when come to it in lecture/course.

Research symposium: Sharing research projects with fellow students.

Collaborative Learning
Peer Review: English Lit/Lang.(Only)

Definition: Reviewing other students' writing as part of their writing process.

Examples:

Reviewing peer writing assignments.

Listening to others' strategies and evaluating the strengths and weaknesses of each.

Providing **constructive criticism** including positive points as well as needed revisions. **Stating the expectation** that students accept constructive criticism by respecting differing opinions and maintaining **civility**.

Providing peer feedback on writing through face-to-face or online discussion;

developing rebuttals to feedback encouraging writing or argument changes;

and group development of a **rubrics for evaluating writing assignments.**

May be found in syllabi as:

Face to face AND Online discussion boards for working through reading assignment issues or providing feedback on writing.

After the drafts are returned, as an author, **responding to the opposition by developing a rebuttal** to the opposing stance.

Group workshopping to develop a **6-point rubric for evaluation of writing**.

Subcomponents for Calculus

Problem Solving
Understanding the Problem: Calculus

Definition: Explaining what students understand about new information helps them understand the information more deeply and apply it to new, similar problems.

Activities or assignments that require restating the problem in your own words. This may be in the form of written work or paired verbal exchange with peer.

Process involving 1. Identifying the goal; 2. Describing barriers preventing goal completion; 3. Identifying possible solutions for overcoming barriers.

Examples:
Statements such as…
Students will write in their own words. No cut-and-paste research!
Students may rephrase information, but should also include their own unique insights.
Avoid mere paraphrase or summary.

Activities requiring students to **identify the goal of the Problem Solving process** of a math problem or assignment, **describing the barriers** preventing goal completion, and **identifying possible solutions** for overcoming those barriers. **Calculus journal** to reflect on student understanding of concepts **in their own words**, not just repeating definitions and explanations rote from the textbook or lecture.

Active reading assignments requiring **text annotation** for texts may require students to highlight new information and summarize this new information in their own words, adding the material that is new and writing out any questions they may have in a journal.

Assignments requiring students to **create their own math problems**.

May appear in the syllabi as:

Students are required to keep a **Calculus Journal** and encouraged to write frequently.

Active reading **text annotation** in reading: Students will highlight new information and summarize in student's own words (not just restructuring the sentences) material that is new and will write out any questions about the material in notebook and bring these up later in class.

Students **create their own math problems** to demonstrate concepts from the course.

Problem Solving
Hypothesizing: Calculus

Definition: Making predictions about what will happen/what to do next after each step in Problem Solving process.

Speculating outcomes and explaining thinking. Hypothesize solutions and which will likely be the best option.

This may be in the form of written work or paired verbal exchange with peer.

Examples:

Assignments that ask students to **predict what will happen next after choosing an approach to solving the problem**, or requiring students to **think about what they can do next after each step in Problem Solving process**.

Assignment that requires students to **speculate the outcomes of choosing a particular path for solving a problem**, and requiring students to **explain the thinking behind this choice**.

Assignments that require students to **hypothesize solutions and which will likely be the best option for solving their problem**.

Common words that may be used in syllabi to encourage hypothesizing are words or phrases like *predict, make projections, or make a good guess.*

May appear in the syllabi as:

Use these regression equations to **make projections** about data and to address the very important question about the reasonableness of the projection.

Using geometric and analytic information as well as calculus to **predict the behavior** of a function.

Related rates and "**Optimization**" questions where, the first step is to come up with an appropriate equation that models the described situation. The student can be asked, before number crunching, what a **plausible range of answers** might be, **why they chose their particular equation**, and **whether/why it seems possible to solve** the problem from their equation.

Problem Solving
Strategizing: Calculus

Definition: Explaining the reasons behind problem-solving choices helps students to correct errors in their thinking, and strengthens their understanding of the concepts learned.

This may be in the form of written work or paired verbal exchange with peer.

Examples:

Requiring students to use **multiple strategies or to solve the problem using multiple steps**. One step in this process involves **planning the approach for solving the problem**. Any mention of this requirement in the syllabi would demonstrate strategizing. Examples of using multiple steps for solving the problem include **estimating possible solutions and strategies prior to attempts to solve the problem**, writing assignments that require **showing and explaining the choices taken in the Problem Solving process**, and through **verbal exchanges** with peers requiring students to **justify their reasoning behind their chosen steps**. Once students have hypothesized a possible solution, in the strategizing portion of the Problem Solving process students will **try their hypothesized solutions and explain why they are or are not the correct choices**. If necessary, students would then **test other hypotheses until they found the correct solution**.

May appear in the syllabi as: Explain how the answer was obtained.

Activities requiring students to **analyze the mathematical situation and choose the interpretation that is more likely correct and reasonable, justifying this choice, then retracing their steps when they select an incorrect one**.

After students complete a math problem, syllabi requires they **check their work for accuracy**.

Quizzes and exams to demonstrate knowledge learned through class by responding to questions in a limited amount of time. Students are required to provide specific information in a particular format in order to receive full credit, requiring students to strategize in order to meet these expectations.

May appear in the syllabi as: Quizzes with items from AP exam.

Key words or phrases in the syllabi that *may* indicate strategizing include the use of verbs referring to Problem Solving such as *analyze, apply, approximate, calculate, classify, compute, conduct, construct, demonstrate, describe, design, determine, differentiate, employ, estimate, evaluate, experiment, explain, express, factor, find, formulate, graph, hypothesize, identify, interpret, investigate, judge, justify, match, model, organize, perform, plan, recognize, relate, represent, simplify, sketch, solve, speculate, understand, & validate*.

Authentic Learning
Experiential opportunities or Active participation: Calculus

Definition: Projects that allow students to apply, practice, and review their knowledge through activities. These may be demonstrated through homework activities.

Examples:

Activities that promote active learning: *debates, discussions, experiences in the field, field trips, hands-on activities, labs, projects, role plays, simulations, or any activity where students actively participate in learning.*

May appear in the syllabi as:

Labs. Labs or projects demonstrating concepts learned in the textbook and lectures. (Ball Toss, Tootsie Roll Pops, Play Doh).

Optimization Project or **Drawing Slope Fields.**

Making a model from a written description of a physical situation.

Matching game. Game requiring students to match 4 types of cards: a graph of the function, a graph of the derivative of the function, a written description of the function, and a written description of the derivative of the function.

Explorations using graphing calculators.

Projects to apply concept knowledge.

Using **discovery-learning activities** as students are introduced to new topics through group work; Discovery activities/labs ie Discovering Relationships lab.

Projects, simulations, presenting programs designed by students.

Play-acting, role-playing, games, and challenges engaging students in learning.

Hands-on laboratory work helps solidify each concept.

Field trips.

Year-end video representing knowledge learned for incoming students.

Long term projects that involve generating and testing hypotheses.

Experiential education such as *practicum, apprenticeships, internships, work/study programs, cooperative education, field projects.*

Authentic Learning
Connection to students' lives outside of school

Definitions: Connecting students' classroom education to their lives outside of school, also known as the "real world" through activities that may provide *any or all of the following*:

Meaningful: Meaning and understanding is increased when classroom information is connected to students' lives or interests**.** Meaning is constructed from our experiences and background knowledge, such as culture, language, and heritage. Using these experiences to connect to learning demonstrates meaningful connections to students' lives outside of school.

Relevance to students' lives: Activities that are connected students' current lives outside of school as well as future directions (life after high school).

Opportunities to engage in real-world problems/solve problems professionals in the field are attempting to solve. Projects that help improve the students' community designed to solve, address, or make students aware of current problems.

Choice: Students are able to select reading materials or writing topics and how they demonstrate knowledge.

Authentic Learning
Connection to students' lives outside of school: Calculus

Meaningful: Meaning and understanding is increased when classroom information is connected to students' lives or interests**.** Meaning is constructed from our experiences and background knowledge, such as culture, language, and heritage. Using these experiences to connect to learning demonstrates meaningful connections to students' lives outside of school.

Examples:

Assignments requiring students to **write mathematical word problems that apply to their lives** outside of school.

Assignments requiring students to **apply the programming tools they have learned to real-life examples of problems.**

Offering **cross-disciplinary assignments** that require **writing in math through the use of math journals or reflection papers on students' Problem Solving process** increase the meaning of new concepts for students. Assignments requiring students to **communicate their mathematics understanding in both verbal and written forms** also increases the meaning of new concepts for students, as do assignments requiring students to **represent problems through both graphic and numerical formats**.

Assignments that require students to **extract a problem from a new context, analyze the problem with processes learned in class, and interpret the solution back in to context**. Explaining the results of solutions by providing a **written interpretation rather than just a number in a box.**

Assignments using **personal experiences** as a context for applying new information. Or connecting course to students' lives/interests such as music, movies, clothes, money, cars, cell phones, etc.

Connecting lecture topics or activities to cultural or background knowledge students may bring with them, or inviting students to build on the knowledge of the community and a culture already known to students.

Field trips to museums **requiring students to compare and contrast what they just viewed to their own lives.**

Activities such as a **scavenger hunt** requiring students to find items in the museum that **connect to their lives** in some way.

Starting the year **using concepts students are more familiar with**, and then using these ideas to **connect to more challenging concepts** helps connect the course content to students' lives.

Authentic Learning
Connection to students' lives outside of school: Calculus (Meaningful cont.)

Using a variety of **authentic and current texts** to expand knowledge and understand current diverse perspectives.

May be found in the syllabi as: Additional creative demonstrations include…

Creating a family tree history that connects a students' family history with the story line in literary works.

Creating a **bumper sticker** that could be used in the time period of the literary work being studied that **requires students to visually represent a concept from the course and relate it to a modern slogan** or bumper sticker in currently seen in circulation.

Assignment requiring students **to write a newspaper article connecting the literary work with current events**.

Assignments or activities dealing with **current events, or linking academic and real-world problems.**

Authentic Learning
Connection to students' lives outside of school: Calculus

Relevance to students' lives: Activities that are connected students' current lives outside of school as well as future directions (life after high school).

Examples:

Activities offering the use of **graphing computer software programs** (such as WinPlot, Geometer's Sketchpad, Calculus in Motion) to make graphing assignments more understandable, providing opportunities for students to discover weaknesses in conceptual understanding or in their communication skills **by requiring they respond to former AP exam writing prompts**, and requiring students complete **reflection journal** activities explaining how concepts in AP Calculus tie together throughout the year.

Activities requiring students to **use mathematical tools to analyze current problems in their world.**

Activities helping students **succeed in the class, not just worksheets**. Such as students providing an example of how a major concept relates to each of the units covered in the course.

Text annotation activities requiring students to highlight new information in reading assignments and re-stating the material in their own words, organizing the concepts into a logical and hierarchical order, and applying or reacting to the material.

Assignments requiring students **apply their subject knowledge to an activity in a way that directly ties in to the subject content**, rather than using worksheets that do not require students apply their knowledge.

Requiring students keep track of a variety of thoughts through the use of **reflection journals** for literary works or math textbook reading assignments, documenting initial questions and impressions. **Assignments requiring students use these journal entries later when students develop essays and engage in group discussions.**

Giving students the **opportunity to correct writing and exam errors with an analysis of their errors, or providing written responses to former AP exam prompts give students the opportunity to discover weaknesses in conceptual understanding or in their communication skills**.

Matching activities requiring students to **pair main theorists with their math theories writing a paper describing how you know why they belong together**.

Grading peers' exams to better understand instructor expectations.

Presenting posters of **research conducted in last year as it relates to class**.

Authentic Learning
Connection to students' lives outside of school: Calculus (Relevance cont.)

Activities that aid students in course success and **helping organize student thinking to increase comprehension** of subject matter.

Creating useful **study guides** for upcoming exams and **writing chapter summaries**.

Assignments requiring students to **create graphic organizers and other visual mapping activities** such *as timelines, geographical mapping, change of culture or practice over time representations, or thematic mapping*.

Additional activities **improving students' study skills and note-taking**, activities requiring students to **create exam or assignment questions**, or activities asking students to **build a rubric for evaluation of assignments or exams** help students to organize their thinking.

Designing **quizzes for whole class on content from group presentations**.

Developing **flash cards** for exam reviews, and **summarizing class information on notecards** to use during quizzes, both help students learn to organize their ideas concisely and assist students in applying their knowledge to their exams.

Highlighting unfamiliar vocabulary to later define, and **compiling student-developed questions at the beginning of each major section** to be covered on the exam for the class members to focus their exam review.

Activities helping students **prepare for life after high school**: writing/reviewing college entrance essays, preparing and taking college entrance exams. Assignments providing **college entry essay practice** or reviewing student samples of **personal essays** to critique.

Assignments requiring students to **critique each other's work**

Assignments requiring students **research a potential career** and the academic skills needed for success in that career or in any postsecondary coursework required.

Activities requiring students to **understand the "whys" of a process** rather than just memorizing the process.

Applying critical thinking skills learned in class to new literary works or writing assignments.

Assignments requiring students show how their argument helps us understand and deal with problems in the real world, and activities requiring students to critically evaluate all sources of information both recent and historical.

Authentic Learning
Connection to students' lives outside of school: Calculus

Opportunities to engage in real-world problems/solve problems professionals in the field are attempting to solve. Projects helping to improve the students' community designed to solve, address, or make students aware of current problems.

Examples:

Projects helping improve the **students' community** designed to **solve, address, or make students aware of current problems.**

Activities that professionals in the field may engage in. Reading and writing for real purposes and real audiences such as reading about an **issue that impacts students' lives, writing letters to politicians, and conducting a service learning activity t**o address the problem. Similarly, **reading discipline-related journals** that professionals in the field read to keep updated on current research, or working on **problems that professionals are currently addressing**.

Assignments **addressing actual problems professionals in the field are currently struggling to solve**. Activities requiring students to **follow and examine current trends in the subject area, projects addressing issues or solving problems that currently exist**. **Submission of research projects into high school research competitions, presenting the new information to the public in a poster presentation**, or sharing the new information in some other way.

May appear in the syllabi as:

Participating in **service learning projects** in the community.

Activities requiring students follow **current events in newspapers or other media** and relate problems/solutions of the larger community to actual problems in the students' community.

Projects applying concept knowledge towards helping the **students' community**.

Critiquing current articles in the field.

Mini-Medical School and Residencies. Using the "New Pathways" curriculum of Harvard Medical School as a model, students work in a self-directed manner to fill out study guides on major themes/concepts in the course.

Authentic Learning
Connection to students' lives outside of school: Calculus

Choice: Students selecting their own reading materials, research/writing topics, or demonstrations of knowledge.

Examples:

Selecting reading materials or writing/research topics.
Participate in **poster presentation** assignments requiring students to **review current research in the field related to class that is of interest to each student**, display this information in poster form, and present this information to the class.
Requiring students to **research and critique articles in the field that are of most interest**.

Selecting how students will demonstrate their knowledge.

Requiring students choose from a variety of different formats to show they understand the material taught in the course. Formats may include using a **research essay, document analysis, annotated bibliography, film analysis, cartoon or visual analysis, or PowerPoint**

Open-ended tasks: Tasks that don't have rigid requirements for how they should be completed but allow students to define the parameters of the assignment.

Collaborative Learning
Using out of class time effectively: Calculus

Definition: Any activity that promotes using out of class time effectively for study group learning. Students may be required to participate or attendance may be optional.

Examples:

Seeking help sessions outside of class in the form of **tutoring circles, learning groups with peers, or even learning groups with the instructor.**

Activities such **as regularly scheduled study groups, optional after-school study sessions to read and analyze supplemental texts, and student-formed study or tutoring groups** that rely on peer support.

Exam review sessions, test preparation and study skill sessions

Encouragement of instructors for students to regularly attend **office hours**

Participating in the **school's Writing Center**

Extra credit opportunities for participating in any of the above out-of-class Collaborative Learning opportunities

May appear in the syllabi as:

Peer study groups: Students form study groups and tutor themselves.

Experienced programmers helping the novices in a **mentoring program** after school. This promotes student leadership and propels in-class learning

Encouraging students to **study in groups, ask questions in class**, see teacher regularly during **office hours**, and participate in the **one-hour weekly review sessions**.

Participating in outside of class **tutoring circles or learning groups** with peers and/or instructor.

Exam review sessions, Tutoring and review sessions, Tutorial sessions after class, Optional review sessions

Inner/outer circle activity: One group of students (inner circle) dialogues while another group observes from an outer circle. The outer circle shares their observations of the interaction after the inner circle finishes the dialogue.

Collaborative Learning
Group projects or assignments: Calculus

Definition: Any work together with peers on assignments or projects.

Examples:
Group projects or assignments using discovery-learning activities as students are introduced to new topics through group work.

Table group assignments, or lab work with partner/group: These activities may involve listening to others' strategies to evaluate the strengths and weaknesses of each, accepting constructive criticism by respecting differing opinions, or reviewing group work to provide constructive criticism including positives as well as suggested changes. Having the opportunity to **work cooperatively on in-class work, graded AP problems, and take-home exams.**

Requiring students to participate **in brainstorming activities, triad work, role play activities, dramatizations, games, panels, symposiums, colloquia, or round table discussion**

Group projects requiring **class presentations**, in-class activities requiring collaboration and **short written responses**, small group work or paired activities **interpreting literary works or mathematical concepts together.**

Group **jigsaw presentations** (each group/group member presenting on one aspect of a topic), **group debates**, and **group writing activities.**

May appear in the syllabi as:

Using discovery-learning activities in a group when new topics are introduced to students. Encouraging students to work cooperatively on **in-class worksheets**, **graded AP problems, and take-home exams.**
Graded discussions, Group work, partner projects, Lab work in pairs.
Group projects requiring each group to provide one example of **how their major theme relates to each of the units covered in the course.**
Group projects requiring a **creative presentation**; presentation encouraged to include performance, skits, cuisine.
Participating and collaborating in the form of **in-class activities and short written responses**.
Cooperative learning activity**/jigsaw group presentation.**
Debate/presentation: dividing class into 6 groups with each group defending a different point of view in 6 minutes.
Writing essays, **pairing with peer & deciding which one is stronger**, then share main ideas with whole group.
Group journal-keeping.

Collaborative Learning
Dialogue Whole Class/Small Group: Calculus

Definition: Dialogue opportunities providing time for students to exchange ideas and better understand the course content. Activities providing more opportunities for students to share their thoughts and work through them with fewer peers interacting at the same time when in small groups.

Examples for Whole Class:

Providing opportunities for instructors to **ensure all students are clear on task and performance expectations, as well as the course content**.

Providing time for students to **exchange ideas and better understand the course content** through **graded discussion activities, class debates, electronic discussion boards** on which all students are **required to participate**, and development of their own questions about course content based on the **Socratic seminar models**.

Requiring minimum amounts of student participation in class. Students may discuss homework questions in small groups, while **unresolved questions** are saved for whole class.

Creating a role of **"homework boss"** in the classroom requiring individual students to serve for several days/weeks leading the homework reviews for the entire class and soliciting volunteers to share their work, ensuring that all students are keeping up with assignments completion and understanding the content requirements.

Using **text annotations** as a basis for class discussions, allowing students the opportunity to add to and correct these annotations as the class progresses.

Examples Small Group:
Opportunities to **discuss perspectives of reading assignments, ideas about the content covered, as well as to clarify any expectations regarding coursework.**

Activity requiring students to **pair up and discuss characteristics of literary works or mathematical concepts, then share the information discussed with the whole class (think/pair/share activity).**

Pairing up and **asking their partner challenging questions** about their writing ideas or arguments**, small-group online discussions of reading assignments, round table discussions on individual or group research projects, and developing study circles** to address questions and concerns in both reading and other course assignments. Assignments requiring students to **create questions for sharing with a partner after summarizing an article that is different from partner's article**, and providing opportunities for each student **to answer clarifying questions.**

Collaborative Learning
Dialogue Whole Class/Small Group: Calculus (cont.)

Pre-reading activities requiring collaboration with a partner to tell a story about a book or chapter based on a **picture, diagram, or bolded key words** throughout the text**.**

May appear in the syllabi as:

Games for review: Jeopardy; vocabulary Bingo; and literary work Charades; Dry erase recall; Dominoes (make connections from one piece of literary work to another as line up dominoes).

Class Senate/debate

Literary work speed dating

Sharing deliberations over students' research in **classroom-based study groups**. Developing their own **questions for discussion** based on the Socratic seminar models. Conferring with other students about **writing**.

Requiring participation in class discussions: 4 instances within 2 seminars.

Participating in discussions on electronic discussion boards.

Inner/outer circle discussions where students from 2 groups read different articles on same topic, one group discusses issues while other group takes notes, then vice versa.

Literature study circles.

Challenge City: Pairing up and asking a partner challenging questions about their presentation with extensive questioning.

Web discussions of reading

Round table discussion on research projects

Think/pair/share activity: Small group activities requiring students to think individually about a concept/topic, pair up to discuss thoughts with a partner, and share out to whole/bigger group.

Pre-reading activity requiring collaboration with a partner to tell a story about book/chapter based on a picture at the beginning

Creating questions to share with a partner **after summarizing** an article read (different from partner's article) and **answering clarifying questions**.

Collaborative Learning
Reciprocal Teaching: Calculus

Definition: Activities requiring each student in a small group to learn specific content and then teach this content to the peers in the group.

Reciprocal teaching allows students to actively process text read in small groups by **questioning, clarifying, predicting, and summarizing.**

Examples:

Jigsaw Activities: Activities requiring each student in a small group to learn specific content and then teach this content to the peers in the group. Jigsaw activities require each person or group to learn one piece of the "big picture", then teach this information to the whole group so all participants learn all pieces. Jigsaw activities often incorporate learning and teaching about a reading assignment, but sometimes they may involve sharing research with fellow students in a symposium, or sharing some other item related to course content thematically but not incorporated in the instruction.

Inner/outer circle discussions: Students from two groups read different articles on the same topic, one group discusses the issues while the other group takes notes, and then finally reversing this process.

Reciprocal teaching allows students to actively process text read in small groups by **questioning, clarifying, predicting, and summarizing.** Assignments requiring students to create questions for sharing with a partner after summarizing an article that is different from partner's article, and providing opportunities for each student to answer clarifying questions.

Small group members to **bouncing questions off peers**, gaining a better understanding of challenging concepts in the process. Discussion activities run more smoothly when the expectations for the process and student roles are clearly described in advance.

May appear in syllabi as:

Reading jigsaw: Choosing to read a literary work and sharing analysis of it with class. Presenting literary works to class/teaching about chosen piece when come to it in lecture/course.

Research symposium: Sharing

Concept Overview: English
(ps) Problem Solving: Any activity that requires students to go through multiple steps to resolve a problem.
(ps.u) **Understanding the problem:** Activities that require students to restate the problem in their own words.
(ps.h) **Hypothesizing**: Any activity that requires students to predict what will/could happen in reading or writing assignments.
(ps.s) **Strategizing:** Any activity that requires several steps to solve the problem or several strategies to complete the assignment, for example meeting a variety of expectations such as writing style, sentence structure, or writing conventions in one assignment.
(al) Authentic Learning: Requiring students to resolve real-world problems or apply new concepts to better understand them.
(al.exp) **Experiential opportunities or active learning:** Any activity in the syllabi that promotes active learning and provides opportunities for students to apply information learned in class.
(al.conn) **Connection to students' lives:** Connecting students' classroom education to their lives outside of school, also known as the "real world" through activities that may provide any or all of the following: **-Meaningful:** Connects classroom information to students' prior knowledge (culture, language, heritage, experiences) or connects new information in one subject to information in another.   **- Relevance**: Activities that are connected students' current lives and future directions.   **- Opportunities to engage in real-world problems/solve problems of professionals in the field.**   **- Choice:** Able to select reading materials or writing topics and/or how demonstrate knowledge.
(cl) Collaborative Learning: Working within a group of peers to solve a problem/complete an assignment together.
(cl.out) **Using out of class time effectively for study group learning:** Any activity that promotes using out of class time effectively for study group learning.
(cl.group) **Group projects or assignments:** Any work together with peers that requires more than dialogue/discussion, but specifies some sort of group work together on assignments or projects resulting in a product that is turned in or presented formally to the instructor or class.
(cl.dial) **Dialogue through whole class or small group discussions:** Dialogue opportunities that provide time for students to exchange ideas and better understand the course content.
(cl.rec) **Reciprocal Teaching:** Activities requiring each student in a small group to learn specific content and then teach this content to the peers in the group.
(cl.peer) **Peer Review:** Review other students' writing as part of their writing process.

Concept Overview: Calculus Rev.
(ps) Problem Solving: Any activity that requires students to go through multiple steps to resolve a problem.
(ps.u) **Understanding the problem**. Any activity that requires students to restate the problem in their own words.
(ps.h) **Hypothesizing**: Any activity requiring students to predict what will/could happen in math assignments (best solutions, what will happen when solution path is chosen, etc.).
(ps.s) **Strategizing:** Any activity requiring students to use multiple strategies or to solve the problem using multiple steps. One step in this process may be planning the approach for solving the problem.
(al) Authentic Learning: Activities requiring students to resolve real-world problems or apply new concepts to better understand them.
(al.exp) **Experiential opportunities or active learning:** Any activity in the syllabi that promotes active learning and provides opportunities for students to apply information learned in class.
(al.conn) **Connection to students' lives outside of school:** Connecting students' classroom education to their lives outside of school, also known as the "real world" through activities that may provide any or all of the following: **- Meaningful:** Connects classroom information to students' prior knowledge (culture, language, heritage, experiences) or connects new information in one subject to information in another.   **- Relevance**: Activities that are connected students' current lives and future directions.   **- Opportunities to engage in real-world problems/solve problems of professionals in the field.**   **- Choice:** Able to select reading materials or writing topics and/or how demonstrate knowledge.
(cl) Collaborative Learning: Working within a group of peers to solve a problem/complete an assignment together.
(cl.out) **Using out of class time effectively for study group learning:** Any activity that promotes using out of class time effectively for study group learning.
(cl.group) **Group projects or assignments:** Any work together with peers that requires more than dialogue/discussion, but specifies some sort of group work together on assignments or projects resulting in a product that is turned in or presented formally to the instructor or class.
(cl.dial) **Dialogue through whole class or small group discussions:** Dialogue opportunities that provide time for students to exchange ideas and better understand the course content.
(cl.rec) **Reciprocal Teaching:** Activities requiring each student in a small group to learn specific content and then teach this content to the peers in the group.

Training Session Syllabi Decision Rules

<u>Calculus</u>

Syllabus 2

p. 1 Course Outline, "you will be able to do…": This is a list of skills students should be able to take away with them, but does not describe an activity or "how" the students will be gaining/practicing these skills. These items do NOT provide enough evidence of any of the categories being present in the syllabus. Neither do any of the activities listed under Technology Requirement. These activities do not tell us how students use the calculator during specific activities, just that they will engage in the activities. This is not enough evidence.

p. 5 Unit 4, Calculate: This is listed as a key word for Problem Solving, Strategizing. Not enough information is provided for this activity, so it cannot be evidence of this subcomponent.

p. 6 "An exploration is conducted…" Also not enough evidence. Nor for Unit 6 "calculations" or integrating.

p. 7 Textbook, "I encourage cooperative learning and I believe…". Not enough evidence of Collaborative Learning here (which subcomponent?), but more specific examples were provided throughout the syllabus.

Syllabus 3

p. 1 Course design, "we stress the why behind our major ideas": Not enough evidence to show us how this is done through classroom activities/assignments. More specifics later in syllabus, but this example does not enough evidence.

"Students will better understand concepts when they see concrete applications". This looks like Authentic Learning, but there are not enough details about how students would do this aside from using the Calculator Based Laboratory. More information is needed for this to count as evidence of Authentic Learning.

"Students form study groups and tutor themselves". This meets the criteria for Collaborative Learning, Dialogue. Not enough information has been presented here to determine WHEN students meet, so it could be either during or outside of class. If more information was provided about meeting outside of class, this would count as evidence for "Using out of class time effectively".

p. 3 Course Outline: This is a list of topics but provides no evidence regarding how students would learn them. The topics sound close to meeting criteria, but more description is needed.

Syllabus 4

p. 1 Pedagogical Issues, "Sometimes… free-response". More information is needed here to determine how previous AP exams are used, how consistently, etc. This is not evidence of any of the components. Later in the syllabus, "all student assignments require…" is more specific and consistent, and therefore *does* count as evidence.

p. 4 Lists of topics covered, does not provide evidence of how students will be learning this information.

Riemann sums: This activity comes close to providing evidence of Hypothesizing and Strategizing, but there is not enough explicit description. Prediction is mentioned, which could be evidence of Hypothesizing, but it is not clear if the students are making the predictions or if the activity addresses prediction. There is also mention of Riemann sums not being a good predictor of the answer, implying that students test out their predictions and retrace their steps when errors occur, but this is assumed and not explicit. Therefore this activity does not provide evidence of Hypothesizing NOR Strategizing since the reader has to make too many assumptions.

Syllabus 1

p.3 "*Using* Calculus to *Determine* Distance Driven". Both of these words are listed as key words under Problem Solving, Strategizing. But there is no additional information given in this phrase so it does not qualify as evidence of Problem Solving. Note that additional information about the activity is given under Student Activity 5 that demonstrates that criteria are met for multiple categories and subcomponents. You may find that activities may be described in more detail in different parts of the syllabus. This will vary from syllabus to syllabus. In this one a listing of the activities can be found in the Course Planner, while more detail can be found under Teaching Strategies and Student Activities.

p. 4 Applications to Geometry: Exploring volume. This activity does not tell us "how" it will be done, but we see more description in Student Activity 7.

p. 6 Student activity 5: The description of this activity meets criteria for multiple components and subcomponents. One word is used in this description that is included as a key word for Problem Solving, Strategizing. The way it is used in this description does not require students to explain their thinking, just explain how they collected their data. It does not meet the criteria for Strategizing here, but many other aspects of this description do.

Training Session Syllabi Decision Rules

English Literature Composition

Syllabus 2

No Decision Rules

Syllabus 3

p. 1 " Lesser papers will be written regularly in class to spur thinking, STIMULATE DISCUSSION…": This sounds like Collaborative Learning, but there is no description of the activities. More description is needed for this to count as Collaborative Learning.

p. 4 Paper topics: This general listing of potential paper topics provide some options for students to demonstrate knowledge (Authentic Learning, Connection to students' lives, choice) but these are only POSSIBLE topics. One of the options requires students to "Explain the title of the novel." This would be evidence of Problem Solving, Understanding the Problem. But because these are only possibilities and not what is actually assigned, it does not count as evidence.

November 20-21: Discussion again of genre. Discussion is mentioned several times here alluding to potential Collaborative Learning. However, more detail is needed before this example counts as evidence of Collaborative Learning, Dialogue. Are the discussions oral? Or are students discussing the genre in their writing? More information is needed.

Syllabus 1

p. 1 "…structure, style…" This is a list of topics to be covered, but no information is provided here to describe how these topics (which fall under Problem Solving, Strategizing) would be learned by students. Look for more evidence later for this component/subcomponent. Similarly below ("The kinds of writings in this course are varied, but include…critical writing") there must be more description of the activity to count a component being present.

p. 3 Grading: "working cooperatively". This does not provide enough description to meet the criteria for Collaborative Learning. There is no information about how students will do this, whether through group projects, discussions, etc. More description is needed here.

p. 5 Week 1: language (style); audience. These activities are both examples of Problem Solving, Strategizing, but they lack any descriptors. In Week 2, tone is mentioned but also includes an activity. This example from Week 2 would therefore meet criteria for Problem Solving, Strategizing under issues of audience, but not the example from Week 1.

p. 6 Critical and Analytic Writing: This is an example of Problem Solving, Strategizing, but no description is given for this assignment/activity. There is not enough evidence of Problem Solving in this example.

p. 7 Group Sharing: Not enough description of activity to indicate Collaborative Learning, Dialogue. Are the groups presenting their songs to the whole class? Is discussion involved? What is happening during this activity? More information is needed before this can count as evidence of Collaborative Learning or any of its subcomponents.

p. 1 Course Goals: Listed in this section include "carefully read and critically analyze literature" and "consider a works' structure, style, and themes". Both of these fall under Problem Solving, Strategizing, but there is no description of activities provided here. There must be more information provided for these examples to count as evidence. This is also true for items 7 and 8 on page 2 (critical analysis and tone).

p. 4 #2: Asked for your opinion, post to discussion board. Sounds like Collaborative Learning, Dialogue, but need more information. Are students required to interact with each other or only if they have questions? More description about this activity is needed. p. 8 d) Discussion. More information about this discussion is needed. Is it verbal? Written?

Training Session Syllabi Decision Rules

English Language Composition

Syllabus 2

p. 1 "Purpose of course is to "emphasize expository, analytical, and argumentative writing"": This mentions writing styles that are examples of Problem Solving, Strategizing. However, these styles are only listed as types of writing to be read and not described here as an activity requiring students to differentiate between. This is not enough evidence. This is also true for page 4 "Exposition and Argumentation".

p. 2 SOAPSTone strategy: The syllabus states that students receive instruction on this interdisciplinary strategy for analyzing texts, which implies critical reading/writing but fails to describe how students will use it. This is not enough evidence for Problem Solving, Strategizing. However, this is a particular strategy listed under Authentic Learning, Connection to students' lives as an example of Relevance. More description of this activity is provided on page 8 of the syllabus and would count as Authentic Learning, Connection to students' lives. In future syllabi, any mention of using SOAPSTone can count as Authentic Learning, Connection to students' lives since it is a strategy taught to teachers through the AP program.

Syllabus 3

p. 1 "…examining the authors' purposes as well as audiences". This states what the students should be able to do but not how they will do it. This is not enough evidence for Problem Solving, Strategizing under the area of audience.

"our course teaches "students…to cite sources using MLA"": Not enough evidence for Problem Solving, Strategizing under writing conventions. An activity needs to be described requiring this activity (see page 3).

"We structure the course- and choose texts- based on teaching critical reading." Here one of the examples of Problem Solving, Strategizing is mentioned (critical reading) but not described. This is not enough evidence of critical reading or Problem Solving.

p. 2 Interactive Blackboard site: This example looks like Collaborative Learning, but there is not enough description yet. On page 3 more details are provided about how the discussion board is used, and at that point enough description is provided for Collaborative Learning, Dialogue.

Reading journal: This activity is described as a critical reading journal, meeting the criteria for Problem Solving, Strategizing under critical reading. It is possible that this journal could then be used by students for later success in class (help develop and essay, create test questions, etc.) which would be evidence of Authentic Learning, Connection to students' lives through under Relevance. But more evidence would be needed for this to count as Authentic Learning.

Syllabus 4

p. 1 Students are expected to read critically, think analytically, and communicate clearly both in writing and in speech: Sounds like Problem Solving, Strategizing, but how will they do this? Need more evidence.

p. 1 Read and carefully ANALYZE… The presence of the word analyze is a key word for Problem Solving, Strategizing. This word is a potential flag for Strategizing activities, but more description is needed. This is not evidence.

"Course readings feature expository, analytical, personal, and argumentative texts." Listing these writing styles is not enough evidence for Problem Solving, Strategizing under writing styles. More description of how students will be expected to engage in an activity discriminating amongst these styles is needed.

Summer reading and writing required: This sounds like it could be evidence for Collaborative Learning, Using out of class time effectively for study group learning, but there is no mention of work with peers in study group. There is only evidence of required assignments to be completed outside of class. This is not enough evidence.

p. 2 "The entire class considers…" This sounds like it could be evidence of Collaborative Learning, Dialogue. More information about how the activity actually takes place is needed here. Is it through whole class discussion or small peer groups? Individually? This is not enough evidence to count.

p. 3 One-on-one conferences with teacher. This includes potential topics to be covered, but not a specific syllabus item/activity for ALL students during the year. Because these are not activities that all students engage in, this is not evidence.
do.

APPENDIX E

SAMPLE SCORING TOOL

Syllabus Number	Problem Solving	Understanding the Problem	Hypothesizing	Strategizing	Authentic Learning	Experiential Opp or Active Learning	Connect-ion to Students' Lives	Collaborative Learning	Using Out of Class Time	Group projects or Assignments	Dialogue through Whole Class or Small Group	Reciprocal Teaching	Peer Review (English Only)

APPENDIX F

CALCULUS STRATEGIZING REVISIONS

Problem Solving (Revised)

Strategizing: Calculus
Definition:
Explaining the reasons behind problem-solving choices helps students to correct errors in their thinking, and strengthens their understanding of the concepts learned.
Examples:
Requiring students to use **multiple strategies or to solve the problem using multiple steps**. One possible step in this process involves **planning the approach for solving the problem**.

- Examples of using multiple steps for solving the problem include 1.) **estimating possible solutions and strategies prior to attempts to solve the problem**, 2.) requiring students **show and explain the choices taken in the Problem Solving process**, and 3.) through **verbal exchanges** with peers requiring students to **justify their reasoning behind their chosen steps**.

- Once students have hypothesized a possible solution, in the strategizing portion of the Problem Solving process students will **try their hypothesized solutions and explain why they are or are not the correct choices**. If necessary, students would then **test other hypotheses until they found the correct solution**, requiring them to re-try these alternative hypotheses until the correct solution was obtained.

- Activities requiring students to **1.) analyze the mathematical situation and choose the interpretation that is more likely correct and reasonable, 2.) justifying this choice, then 3.) retracing their steps when they select an incorrect one**.

- After students complete a math problem, syllabi requires they **check their work for accuracy**.

May appear in the syllabi as: Explain how the answer was obtained after predicting the solution.

Quizzes and exams to demonstrate knowledge learned through class by responding to questions in a limited amount of time **OR** in take-home exams. Students are required to provide specific information in a particular format in order to receive full credit, requiring students to strategize in order to meet these expectations.

May appear in the syllabi as: Quizzes with items from AP exam, tests.

Key words or phrases in the syllabi that *may* indicate strategizing include the use of verbs referring to Problem Solving such as *analyze, apply, construct, demonstrate, describe, design, determine, differentiate, employ, evaluate, experiment, explain, express, factor, find, formulate, graph, hypothesize, interpret, investigate, judge, justify, match, model, organize, perform, plan, relate, represent, simplify, sketch, solve, speculate, understand, & validate*.

Authentic Learning (Revised)

Experiential opportunities or Active participation: Calculus

Definition: Projects that allow students to apply, practice, and review their knowledge.

Examples:

Activities that promote active learning: *debates, discussions, experiences in the field, field trips, hands-on activities, labs, projects, role plays, simulations, or any activity where students actively participate in learning.*

May appear in the syllabi as:

Labs. Labs or projects demonstrating concepts learned in the textbook and lectures. (Ball Toss, Tootsie Roll Pops, Play Doh).

Optimization Project or **Drawing Slope Fields** AP activities**.**

Making a model from a written description of a physical situation.

Matching game. Game requiring students to match 4 types of cards: a graph of the function, a graph of the derivative of the function, a written description of the function, and a written description of the derivative of the function.

Graphing calculator labs.

Projects to apply concept knowledge.

Using **discovery-learning activities** as students are introduced to new topics through group work; Discovery activities/labs ie Discovering Relationships lab.

Projects, simulations, presenting programs designed by students.

Play-acting, role-playing, games, and challenges engaging students in learning.

Hands-on laboratory work helps solidify each concept.

Field trips.

Year-end video representing knowledge learned for incoming students.

Long term projects that involve generating and testing hypotheses.

Experiential education such as **practicum, apprenticeships, internships, work/study programs, cooperative education, field projects.**

APPENDIX G

REVISED CALCULUS CONCEPT OVERVIEW

Concept Overview: Calculus (Revised)
(ps) Problem Solving: Any activity that requires students to go through multiple steps to resolve a problem.
(ps.u) **Understanding the problem**. Any activity that requires students to restate the problem in their own words.
(ps.h) **Hypothesizing**: Any activity requiring students to predict what will/could happen in math assignments (best solutions, what will happen when solution path is chosen, etc.).
(ps.s) **Strategizing:** Any activity requiring students to use multiple strategies or to solve the problem using multiple steps. One step in this process may be planning the approach for solving the problem.
(al) Authentic Learning: Activities requiring students to resolve real-world problems or apply new concepts to better understand them.
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(cl.dial) **Dialogue through whole class or small group discussions:** Dialogue opportunities that provide time for students to exchange ideas and better understand the course content.
(cl.rec) **Reciprocal Teaching:** Activities requiring each student in a small group to learn specific content and then teach this content to the peers in the group.

APPENDIX H

CALCULUS HYPOTHESIZING CODEBOOK REVISIONS

Problem Solving (Revised)

Definition:

Making predictions about what will happen/what to do next after each step in Problem Solving process.

Speculating outcomes and explaining thinking. Hypothesize solutions and which will likely be the best option.

Examples:

Assignments that ask students to **predict what will happen next after choosing an approach to solving the problem**, or requiring students to **think about what they can do next after each step in Problem Solving process**.

Assignment that requires students to **speculate the outcomes of choosing a particular path for solving a problem**, and requiring students to **explain the thinking behind this choice**.

Assignments that require students to **hypothesize solutions and which will likely be the best option for solving their problem**.

Common words that may be used in syllabi to encourage hypothesizing are words or phrases like *predict, make projections, or make a good guess BEFORE* attempting to solve the problem.

May appear in the syllabi as:
Use these regression equations to **make projections** about data and to address the very important question about the reasonableness of the *BEFORE* solving the problem.

Using geometric and analytic information as well as calculus to **predict the behavior** of a function *BEFORE* solving the problem.

Related rates and "Optimization" questions where, the first step is to come up with an appropriate equation that models the described situation. The student can be asked *BEFORE* number crunching, what a **plausible range of answers** might be, **why they chose their particular equation**, and **whether/why it seems possible to solve** the problem from their equation.

BEFORE calculating the regression model, predict (based on the model's assumptions and the given data) whether it will be a reasonable fit.

Based on previous experience with functions that look similar to this one, **predict** whether this ***limit/intercept/whatever*** exists. If it does, **predict** a range of possible values.

APPENDIX I

CALCULUS HYPOTHESIZING DECISION RULES ADDENDUM

Decision Rules: Corrections
Initial Training Session

Syllabus1
p. 5, Student activity 1: Students find the slope of the line and compare it to their estimation of the instantaneous velocity.
p. 5 Student activity 3: Students model the rate of change of the radius with some function of time. Students them use this rate of change to estimate the rate of change….
p.6 Student activity 5: Students then graph speed versus time and use integration techniques to approximate the distance traveled over the 20-minute interval.

Syllabus 4
p. 3 Item #6: Estimating limits from graphs and from tables of values.
p. 3 Note 3: Students will use the graphing calculator to estimate limits…
p.4 Note 1: Students discover Riemann sums are not always good predictors of the answer if area is the question.

Syllabus 3
p.2 Item #3: Approximating the derivative at a point using numerical methods.
p. 2 Item #4: Approximating the value of a definite integral using numerical methods.
p. 3 The Derivative of the Sine Function: Estimate the slope of the tangent line at various x-values….To test this conjecture, graph the numerical derivative of the sine in the same window.

Syllabus 2
p. 3 CBL experiment: Average velocities are calculated over different time intervals and students are asked to approximate instantaneous velocity.
p.5 An exploration using the graphing calculator: Students are then asked to approximate f(0.1) using the tangent line….
p. 5 Unit 4.A: Approximating areas (Riemann sums)

Syllabus Tcalc2

p. 9 Item #96: Approximate solution to a differential equation by Euler's method. This was initially scored as evidence of Problem Solving, Hypothesizing, by the researcher. However, this is NOT actually an example of Hypothesizing. When students are asked to "approximate" in this way, they are really being asked to use an actual formula and then round their answer. Not guessing or predicting, which is how approximate was originally defined by the researcher.

SyllabusTcalc3

p.3, V.3: Approximating area with Riemann sums, the Trapezoidal rule, or Definite integrals. In calculus, this is considered rounding and not guessing. We did not count that as evidence when we reviewed our scoring, so that is still correct.

APPENDIX J

REVISED CALCULUS GROUP AND DIALOGUE CODEBOOK

Collaborative Learning Revised
Group projects or assignments: Calculus

Definition: Any work together with peers that requires more than dialogue/discussion, but specifies some sort of group work together on assignments or projects resulting in a product that is turned in or presented formally to the instructor or class.

Examples:
Group projects or assignments using discovery-learning activities as students are introduced to new topics through group work that may require discussion but MUST require a work product that is turned in or presented formally to the instructor or class.
Table group assignments, or lab work with partner/group: These activities may involve listening to others' strategies to evaluate the strengths and weaknesses of each, accepting constructive criticism by respecting differing opinions, or reviewing group work to provide constructive criticism including positives as well as suggested changes. **(Both CL.G & CL.D)**
Students **work cooperatively on in-class work, graded AP problems, and take-home exams.**

Requiring students to participate **in activities/assignments/projects such as brainstorming activities, triad work, role play activities, dramatizations, games, panels, symposiums, colloquia, or round table discussion** *(depending on the description of the activity, these could all be BOTH CL.G & CL.D).*

Group projects requiring **group presentations** to the class, in-class activities requiring **collaboration and short written responses** put together by the group (rather than individual reflections on the group work), small group work or paired activities **interpreting literary works or mathematical concepts together** *(depending on the description of the activity, these could all be BOTH CL.G & CL.D).*

Group jigsaw presentations (each group/group member presenting on one aspect of a topic), **group debates**, and **group writing activities.**

Collaborative Learning Revised

Group projects or assignments: Calculus (cont.)
May appear in the syllabi as:

Using discovery-learning activities in a group when new topics are introduced to students (*NOT CL. Dialogue if discussion not explicitly mentioned*).
Students working together cooperatively on **in-class worksheets**, **graded AP problems, and take-home exams** (*NOT CL. Dialogue if discussion not explicitly mentioned: could be working side by side but not interacting*).
Graded discussions, Group work, partner projects, Lab work in pairs (CL.G, CL.D & AL.Exp).
Group projects requiring each group to provide one example of **how their major theme relates to each of the units covered in the course** (depending on description, could be CL.G, CL.D & AL.Exp).
Students **working in groups using graphing calculator** (Can also be AL. Exp).
Students working together and presenting their results to the class (Both CL.G and CL.D).
Group projects requiring a **creative presentation**; presentation encouraged to include performance, skits, cuisine.
Participating and collaborating in the form of **in-class activities and short written responses**.
Cooperative learning activity/**jigsaw group presentation.**
Debate/presentation: dividing class into 6 groups with each group defending a different point of view in 6 minutes.
Writing essays, **pairing with peer & deciding which one is stronger**, then share main ideas with whole group.
Group journal-keeping.

Decision Rules:

An activity may count as evidence of multiple subcomponents of collaboration. **If a group work activity also includes discussion**, it is evidence of both CL.Group AND CL.Dialogue.

If an activity **does not specify** whether students actually have discussion when they "work together", this would be CL. Group only.

Be careful interpreting the syllabus when students are given the "*opportunity*" to work together. Does this really mean they DO work together or merely "encouraged" to so but it isn't required?
Examples: "Students are given the *opportunity* to work cooperatively on in-class work." "Students are *encouraged* to work together on take-home exams.

Collaborative Learning Revised

Dialogue Whole Class/Small Group: Calculus

Definition: Dialogue opportunities providing time for students to exchange ideas and better understand the course content. Activities providing more opportunities for students to share their thoughts and work through them with fewer peers interacting at the same time when in small groups.

Description of student interaction is provided.

Examples for Whole Class:

Providing opportunities for instructors to **ensure all students are clear on task and performance expectations, as well as the course content**.

Providing time for students to **exchange ideas and better understand the course content** through **graded discussion activities, class debates, electronic discussion boards** on which all students are **required to participate**, and development of their own questions about course content based on the **Socratic seminar models.**

 (interaction is described rather than just "students present ideas to class". CL.D).

Requiring minimum amounts of student participation in class. Students may discuss homework questions in small groups, while **unresolved questions** are saved for whole class.

Creating a role of **"homework boss"** in the classroom requiring individual students to serve for several days/weeks leading the homework reviews for the entire class and soliciting volunteers to share their work, ensuring that all students are keeping up with assignments completion and understanding the content requirements.

Using **text annotations as a basis for class discussions**, allowing students the opportunity to add to and correct these annotations as the class progresses.

Examples Small Group:

Opportunities to **discuss perspectives of reading assignments, ideas about the content covered, as well as to clarify any expectations regarding coursework.**

Activity requiring students to **pair up and discuss characteristics of literary works or mathematical concepts, then share the information discussed with the whole class (think/pair/share activity).** *CL.Group if product is due at the end of activity.*

Pairing up and **asking their partner challenging questions** about their writing ideas or arguments**, small-group online discussions of reading assignments, round table discussions on individual or group research projects, and developing study circles** to address questions and concerns in both reading and other course assignments.

Assignments requiring students to **create questions for sharing with a partner after**

summarizing an article that is different from partner's article, and providing opportunities for each student **to answer clarifying questions.**

Pre-reading activities requiring collaboration with a partner to tell a story about a book or chapter based on a **picture, diagram, or bolded key words** throughout the text**.**

May appear in the syllabi as:

Games for review: Jeopardy; vocabulary Bingo; and literary work Charades; Dry erase recall; Dominoes (make connections from one piece of literary work to another as line up dominoes).

Class Senate/debate or **Literary work speed dating**

Sharing deliberations over students' research in **classroom-based study groups**. Developing their own **questions for discussion** based on the Socratic seminar models. Conferring with other students about **writing or Problem Solving**.

Requiring participation in class discussions: 4 instances within 2 seminars.

Participating in discussions on electronic discussion boards that require more than just posting questions to peers but also describe how a discussion is created/maintained on this discussion board.

Inner/outer circle discussions where students from 2 groups read different articles on same topic, one group discusses issues while other group takes notes, then vice versa.

Literature study circles.

Challenge City: Pairing up and asking a partner challenging questions about their presentation with extensive questioning.
Web discussions of reading with specific details in place regarding expectations for actual dialogue fluidity and not just posting questions.
Round table discussion on research projects
Think/pair/share activity: Small group activities requiring students to think individually about a concept/topic, pair up to discuss thoughts with a partner, and share out to whole/bigger group.
Pre-reading activity requiring collaboration with a partner to tell a story about book/chapter based on a picture at the beginning
Creating questions to share with a partner **after summarizing** an article read (different from partner's article) and **answering clarifying questions**.

Small group work gives students the opportunity to **discuss their work** with one another. (Both CL.G AND CL.D)

APPENDIX K

REVISED CALCULUS EXPERIENTIAL OPPORTUNITIES/ACTIVE

LEARNING CODEBOOK

Authentic Learning (Revised v.2)

Experiential opportunities or Active participation: Calculus

Definition: Projects that allow students to apply, practice, and review their knowledge through hands'-on, active learning.

Examples:
Activities that promote active learning: *debates, discussions, experiences in the field, field trips, hands-on activities, labs, projects, role plays, simulations, or any activity where students actively participate in learning.*

May appear in the syllabi as:

Labs. Labs or projects demonstrating concepts learned in the textbook and lectures. (Ball Toss, Tootsie Roll Pops, Play Doh). Hands-on laboratory work helps solidify each concept.

Optimization Project or **Drawing Slope Fields** AP activities **ONLY** if this specific language is used. These are specific activities the College Board trains their AP instructors on how to perform. Activities that may sound similar *could* count as AL. E *if* adequate description is included that demonstrates active, hands'-on learning and not just reading and completing assignments.

Making a model from a written description of a physical situation.

Matching game. Game requiring students to match 4 types of cards: a graph of the function, a graph of the derivative of the function, a written description of the function, and a written description of the derivative of the function.

Graphing calculator labs.

Projects to apply concept knowledge. Projects, simulations, presenting programs designed by students.

Using **discovery-learning activities** as students are introduced to new topics through group work; Discovery activities/labs ie. Discovering Relationships lab.

Play-acting, role-playing, games, and challenges engaging students in learning.

Field trips.

Year-end video representing knowledge learned for incoming students.

Long term projects that involve generating and testing hypotheses.

Experiential education such as *practicum, apprenticeships, internships, work/study programs, cooperative education, field projects*

APPENDIX L

ENGLISH LITERATURE AND COMPOSITION CODEBOOK

REVISIONS: COLLABORATIVE LEARNING USING OUT OF

CLASS TIME FOR STUDY GROUP LEARNING

Collaborative Learning (Revised)

Using out of class time effectively for study group learning: English Lit/Lang.

Definition: Any activity that promotes **using out of class time** effectively for study group learning. Students may be required to participate or attendance may be optional. This includes **working with other students and/or the instructor outside of class time**. This does not include summer assignments unless the above evidence is met.

Examples:

Seeking help sessions outside of class in the form of **tutoring circles, learning groups with peers, or even learning groups with the instructor.** **Exam review sessions, test preparation and study skill sessions**
Encouragement by instructors for students to regularly attend **office hours**
Participating in the **school's Writing Center**
Extra credit opportunities for participating in any of the above out-of-class Collaborative Learning opportunities

May appear in the syllabi as:

Exam review sessions after school**.**

Inner/outer circle activity: One group of students (inner circle) dialogues while another group observes from an outer circle. The outer circle shares their observations of the interaction after the inner circle finishes the dialogue.

Tutoring and review sessions after/before school.

Tutorial sessions after class after/before school.

Peer study groups after/before school.

Optional review sessions after/before school.

Video clips **before and after school for extra credit on quizzes/test:** correlates with knowledge they already have.

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