White Paper

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Using Technology to Prepare ELLs in Math for College and Career

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Global Competitiveness

The economic welfare of any country is largely dependent on the skills and knowledge of its workforce. In the new knowledge economy, a country's global competiveness and ability to drive economic development and expansion depends on its workforce's expertise in advanced manufacturing, energy, information technology, healthcare, and other high-tech industries. This is true especially in the United States, as we move further away from agriculture and manufacturing as our primary modes of economic production and toward industries that require highly-skilled workers trained in science and technology.

Within the past decade, the demand for science, technology, engineering, and mathematics graduates in the global market has increased significantly. The Bureau of Labor Statistics projects employment in STEM areas will grow 70% faster than the overall growth for all other occupations. In 2006, the unemployment rate for STEM graduates in the United States dropped to a very low 2.5% (Bureau of Labor, 2005). Global competitors, such as China and India, have increased exponentially their numbers of highly-qualified STEM graduates to meet this demand.

A different picture, however, emerges in the United States. Recent reports broadcast the nation's current workforce crisis and declare that the American worker does not have the skills or knowledge required to compete in today's global market (National Governors Association, 2010; Nelson A. Rockefeller Institute at the University of Albany, 2010). Also, despite the significant growth in STEM-related careers, the number of college degrees awarded annually in the United States in those fields remains stagnant.

As industries in the new knowledge economy continue to grow and as the baby-boomer generation retires, the United States is forced to confront the mounting challenge to its international competitiveness (Bernanke, 2004) – that, very simply, our workforce is neither sufficient in number nor adequately skilled to compete in the global marketplace. If the United States loses its advantage because workers lack the capacity to meet the 21st-century labor market challenges, the consequences for individuals as well as our overall economy are alarming (ACT, 2011).

To remain globally competitive, the United States must develop a system that offers a world-class education to all its students and prepares them well for careers in STEM-related occupations. Education plays a vital role in transforming the United States into the knowledge economy envisioned in *The World is Flat* (Friedman, 2005).

Readiness for College and Career

For individuals, the benefits of a good education are tangible. For most students who graduate high school and attend college, the increase in lifetime earnings far outweighs the cost of education. A four-year degree typically increases a person's income by 14%. High school students earning B's rather than C's (an increase of just one letter grade) will increase their income by 13% by age 28 (Roksa, Jenkins, Jaggers, Zeidenberg, Cho, 2009). STEM graduates earn higher starting salaries than graduates in other areas and have more job stability and security, which leads to faster wealth creation. In turn, wealthier households are less affected by recessionary periods (Pew, 2011). In addition to greater wealth, STEM students can expect more security, better health, closer family, and stronger community, which represent the real value of an education (College Board, 2010). The average annual income for a high school dropout in 2005 was $17,299, as compared to $26,933 for a high school graduate, which represents a difference of $9,634 (U.S. Bureau of the Census, 2006).

The impact on the national economy is staggering. If every student who dropped out of the US high school class of 2007 had graduated, the nation's economy would have benefited from an additional $329 billion in income over their lifetime (Alliance for Education, 2007). Each dropout, over his or her lifetime, costs the nation approximately $260,000. Unless our educators can convince students that a good education has real value and prepare them to be college and career-ready in greater numbers, more than 12 million students will drop out during the course of the next decade. The result will be a loss to the nation of $3 trillion (Rouse, 2005).

News articles are rife with statistics demonstrating the United States' failure to adequately prepare public school students for college and career. Yet, worldwide, other countries are improving their educational systems, educating their students to compete at a higher level in the global economy, and surpassing the United States in producing a well-educated workforce. The failure of the American education system to produce a highly-skilled workforce is neither conjecture nor anecdotal but statistically proven. Recognized as a standard measure of international competitiveness, the Programme for International Student Assessment (PISA) has been administered every three years since 2000. In 2009, PISA was administered to 15-year-olds in 65 countries, including the United States, to measure reading, mathematics, and science skills. The results indicated that students in the United States, compared to their international peers, scored 17th in reading, 23rd in science, and 31st in mathematics (PISA, 2007).

The inadequacies of our educational system have dire consequences for the economic welfare of the United States but also are increasing the economic inequality among ethnic and racial groups in the country. In a recent study by Pew Research Center, researchers found that in 2009, Caucasian households had a median wealth 20 times greater than African American households and 18 times greater than Hispanic households, which reflects a significant widening of the wealth gap – "roughly twice the size of the ratios that had prevailed between these three groups for the two decades prior to the Great Recession that ended in 2009" (Kochhar, 2011).

The United States' appalling PISA performance and the ever-widening wealth gap among Caucasians, Hispanics, and African Americans only reinforces how imperative it is that a college-readiness and career-readiness agenda is implemented throughout the American educational system, so that our students will graduate equipped to compete against their global peers and in the global marketplace. It is crucial for individuals and our society as a whole that every child is educated to high standards and offered opportunities to be successful in career, in college, and in an increasingly competitive global economy.

To be college and career ready, high school students must take challenging courses (Roderick, Nagoaka, Coca, 2009). While most states define their own high school graduation requirements, we must insist students be prepared in course content that reflects the knowledge and skills demanded by colleges and employers, such as Algebra 1, Geometry, and Algebra 2. Whether due to a lack of readiness or a perception that the courses are too difficult, students are guided away from these core courses. Instead, they are often shuffled into a variety of math courses, all with different names, such as consumer mathematics, basic math, and algebra concepts, but all characterized by a lack of rigor. Although many students aspire to post-secondary education, fewer than 50% of students take appropriate preparatory courses in mathematics and science (InnovateEd, 2011). Studies indicate that the more rigorous the courses taken by high school students, the greater the chances of earning a college degree (Roksa, Jenkins, Jaggers, Zeidenberg, Cho, 2009).

Preparing ELL and Hispanic Students to Graduate

Hispanics are the fastest-growing segment of the population in the United States' workforce, and Hispanic students are now the largest minority group in American schools. Hispanics will account for 51% of US population growth between the years 2000-2050. In 2009, the mean age for Hispanics in the United States was 25 years old. From 1990 to 2009, the national Hispanic student population increased from 6% to 22% at grade 4, and from 7% to 21% at grade 8. Already, Hispanic youths comprise 25% or more of the student population in many school districts in several states.

As a result, a growing number of schools are charged with educating students from linguistically and culturally-diverse backgrounds. Many of these students are English language learners (ELL). The number of ELLs increased by 65% between 1993 and 2004, while the total U.S. school age population grew by less than 7% (National Clearinghouse for English Language Acquisition, 2006). The more than 5.1 million ELL students comprise more than 10% of the country's student population (Abedi, 2007 & 2009). Faced with a dramatically changing student population and not enough resources, educators across America are struggling to address the unique learning needs of English language learners. The need for identifying appropriate educational programs and approaches, utilizing ongoing research, and providing educational services for the Hispanic community has never been greater.

The Department of Education's National Center for Educational Statistics (NCES, 2010) reports the "sobering" fact that the Hispanic-Caucasian educational achievement gap has remained wide over the past two decades. The NCES report indicated that since the 1990s, math and reading scores for Hispanic students have increased, but the Hispanic-Caucasian achievement gap on the National Assessment of Educational Progress (NAEP) has persisted. Comparing data on the achievement gap between Hispanic and Caucasian public school students in grades 4 and 8 over the past two decades, NCES estimated that the average achievement gap between Hispanic and Caucasian students in mathematics and reading is roughly 20 points on the 500-point NAEP scale. Only about 58% of Hispanic students will graduate on time with a regular diploma, compared to 80% of Asian students and 76% of Caucasian students. U.S. Education Secretary Arne Duncan stated, "Race and ethnicity shouldn't be factors in the success of any child in America. Hispanics face grave educational challenges that are hindering their ability to pursue the American dream." Low graduation rates, large numbers of high-school dropouts and a cavernous achievement gap necessitates a sustained intervention. The need to eliminate the achievement gap compels educational leaders and teachers to implement proven practices and programs to address the needs of Hispanic students and ELLs in STEM courses.

Filling In the Learning Gaps for ELLs

ELLs receive lower grades, are judged by their teachers to have lower academic abilities, and score below their classmates on standardized tests in reading and math (Moss & Puma, 1995). In NCLB terms, ELLs are classified as a single subgroup. However, there are differing characteristics of students within this group. These differing characteristics include ELLs who are newly arrived to the United States with adequate schooling, newly arrived with limited formal schooling, and long-term English learners. Each group possesses specific characteristics and different instructional issues (Freeman, & Freeman, 2002). ELLs who are newly arrived or have limited formal schooling may have significant gaps in their conceptual or skill development from elementary through high school (Cobb, Yackel, Wood, 1993).

Standards-based reform was intended to close achievement gaps and lead towards greater educational equity. However, there has been a trend toward narrowing curricula, which limits ELLs' ability to be college and career ready (Lee & Luykx, 2008). Narrowing a curriculum is the result of teachers' insufficient knowledge of the content in relation to students' cultural and linguistic diversity and the teachers' lack of skills in differentiating instruction and addressing the unique learning needs of ELLs (Aguirre-Muñoz & Amabisca, 2010; McNeill, 2000). Inexperienced teachers may confuse language acquisition issues with inability to understand complex material.

In general, teachers find it difficult to differentiate instruction by proactively modifying instruction for students. Differentiation requires teachers to determine readiness to learn, to adjust learning experiences, and to teach to the learning strengths of each student (Renick, 1996; Mason, 1999; Tomlinson, 1999). Educational researchers contend that in order to develop critical thinking skills and mathematical reasoning, we must leverage moment-by-moment interactions with ELLs to adjust and support learning (Aguirre-Muñoz, 2010). With crowded classrooms and limited expertise and resources to differentiate instruction, teachers are not equipped to provide the moment-by-moment interactions so crucial to the success of ELLs.

Linguistic Challenges in Math

Tragically, some schools ignore mathematics instruction for ELLs, claiming that classroom time should be focused only on English literacy. However, most educators agree that math should be a primary focus for all students (National Mathematics Advisory Panel, 2008). While acknowledging the importance of mathematics, we must recognize that ELLs face the challenge of mastering a new language while learning subject-area content. The transition from simple arithmetic to contextualized problem-solving in mathematics defies the misconception that math does not depend on language. Algebra and other higher-level mathematical courses presuppose language skills. Students cannot attain proficiency in mathematics without understanding the language in which the mathematics is being expressed.

Syntactic and semantic challenges abound in mathematics instruction. The language of mathematics lacks the rhythm and patterns inherent in a natural language, thus providing minimal cues for guessing content, inferring meaning, or predicting context. In Algebra, students cannot read mathematics sentences the same way as natural language sentences. For example, the phrase "the number is five less than the number b" is often translated as $a = 5 – b$, rather than the correct translation $a = b-5$ (Dale & Cuevas, 1992). Complex sentence structures, comparatives, passive voice, and other advanced language structures make the language of mathematics difficult for ELLs to master. Because of our nation's growing emphasis on mathematic skills—both for college and career readiness—ELLs must acquire mathematic skills as they are gaining English language ability. Effective mathematics programs ensure that ELLs gain necessary mathematics instruction while building upon English language skills. For ELLs to be successful, concurrent acquisition of English and mathematics language is critical.

Advancing Learning and Fostering Success in Math for ELLs

In addition to supporting English and mathematical languages concurrently and differentiating instruction, other instructional strategies are essential to advance the learning of mathematics for ELLs. Modification of assessment questions to reduce unnecessarily complex language will mitigate barriers to learning and performance (CRESST, 2001). Nonlinguistic representation of difficult concepts supports ELLs ability to recognize patterns and understand complex ideas. Technology supports classroom strategies by creating new routes to understanding complicated, abstract material, thereby addressing multiple learning needs, modifying difficulty levels, and presenting new materials at strategic moments (Aguirre-Muñoz, Z., 2010).

Teaching mathematics requires the sequencing of small steps in learning, especially for ELLs. Mathematics instruction at the class level presupposes that each student in the class has the same level of prerequisite knowledge and that new learning will build on a base of previous knowledge. However, in reality, the knowledge of each student in a class can vary widely, and gaps in knowledge, especially ELLs, are unique to each student. Every student has a unique "knowledge state", that is, a body of knowledge on a particular topic, such as Algebra (Diognon & Falmagne, 1999). Once a student's knowledge state in a course, that is, "what the student can do", has been determined, a list of "what the student is ready to learn", that is, what she has the prerequisite knowledge to learn successfully, can be created. By identifying the gaps in students' learning and the boundaries of their knowledge, educators can customize learning activities, assessments, intervention, and lessons for their students.

By monitoring students' aptitudes and weaknesses while solving different types of problems, technology can differentiate the lessons, modify assessments, and perform real-time corrections to support learning and promote success (Georgouli, 2001). The use of successful iterative learning and adaptive assessment systems maximize the use of technology to reduce frustration by tailoring presented material to the student's ability to grasp concepts, to fill learning gaps, and to address the learning needs of ELLs. To effectively minimize an ELL's learning gap, the tasks must not be too simple or too perfunctory, and no critical step can be missed. The skills and concepts presented must build upon the students' strengths and reflect what the student is most ready to learn next. Students learn best when presented with moderate challenges. The work or material should not be so difficult that the student feels threatened and quits, and not so simple that the student is not obliged to think deeply or solve new problems (Bess, 1998; Csikszentmihalyi, Rathunde, Whalen, 1993; Tomlinson, 1999).

Conventional assessments and assignments test the different capabilities of students, but the content is static, not adaptive to the individual test-taker. Most of the questions are lower or higher, rather than equivalent to the students' capabilities. Students either waste time in solving average assignments that do not excite, challenge, or interest them, or are presented with material that is too difficult for their specific capabilities. Moreover, conventional tests presuppose a specific level of difficulty (or lack thereof) that frequently does not match the skills of the test takers. In addition, a score of (say) 75% on a test containing easy items has different implications for instruction than a score of 75% on a test containing difficult items (Segall, 2000).

The use of technology has solved some of the problems inherent in conventional assessments with static content. Computer adaptive tests (CATs) determine learner's proficiency on the percentage of correct responses as well as the difficulty level of the items the learner answered correctly (Foster, 2000). The range of available content on which a student can be tested is much wider. Therefore, in a class of test-takers, a student with advanced skills can be tested at a higher level than another student in the class who has weaker knowledge. Not all CATs are alike, however. Some CATs are merely paper and pencil tests transferred to an electronic medium. Often these tests are still multiple-choice. In general, the current generation of CATs is only adaptive in the crudest sense.

The best computer adaptive tests and programs provide many advantages. They promote better balancing of test content areas for all ability levels, real-time item updating, quicker reporting, a better test-taking experience, and customized assessments to meet the individual learner needs. In contrast with paper-and-pencil multiple-choice tests, these kinds of CATs embed complex cognitive skills assessments directly in interactive, problem-solving, or open-ended tasks (Bennett & Persky, 2002). Ideally, CATs assess a learner's competency through a minimum number of questions. Consequently, CATs reduce the length of the assessment while providing the most information about the ELL's knowledge state when the student shows a mastery level in a certain field (Gouli et al. 2001).

CATs can allow a learner to identify learned content (the student's knowledge state), to recognize strengths and weaknesses (ready to learn and gaps in learning), and to observe personal learning progress. Furthermore, CATs become a part of the diagnostic process as the learner's knowledge state and proficiency level are used to guide the differentiation of the instruction and assessment (VanLehn, 1988). This model of technology, iterative learning, and adaptive assessment fosters increased rigor and proficiency for ELLs in mathematics by differentiating instruction, addressing learning needs, teaching to strengths, diagnosing weaknesses, and reducing language barriers. In particular, one program, the computerized assessment and learning software ALEKS (**A**ssessment and **L**earning in **K**nowledge **S**paces), utilizes this model.

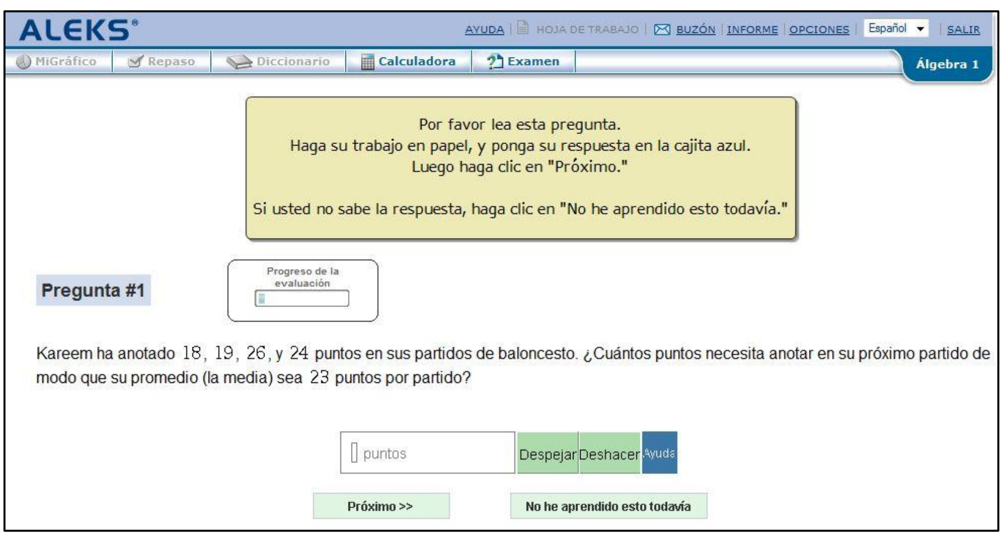
How ALEKS Fosters Math Success

ALEKS is a web-based, artificially-intelligent assessment and learning system. It is a two part system – a computer-adaptive assessment that assesses a student's initial knowledge and a learning program (called the Learning Mode) that plugs gaps in the student's knowledge and introduces new concepts that the student is ready to learn. ALEKS uses its artificial intelligence and adaptive questioning to assess quickly and accurately what a student knows and does not know in a course and provides targeted instruction on the material that the student is currently ready to learn. Since ALEKS comprehensively determines the student's initial "knowledge state" (which includes the topics the student has already mastered) and precisely what the student is ready to learn next, the student is not forced into working on material he or she already knows or material that is too difficult and for which he or she has not acquired the prerequisite knowledge to learn successfully.

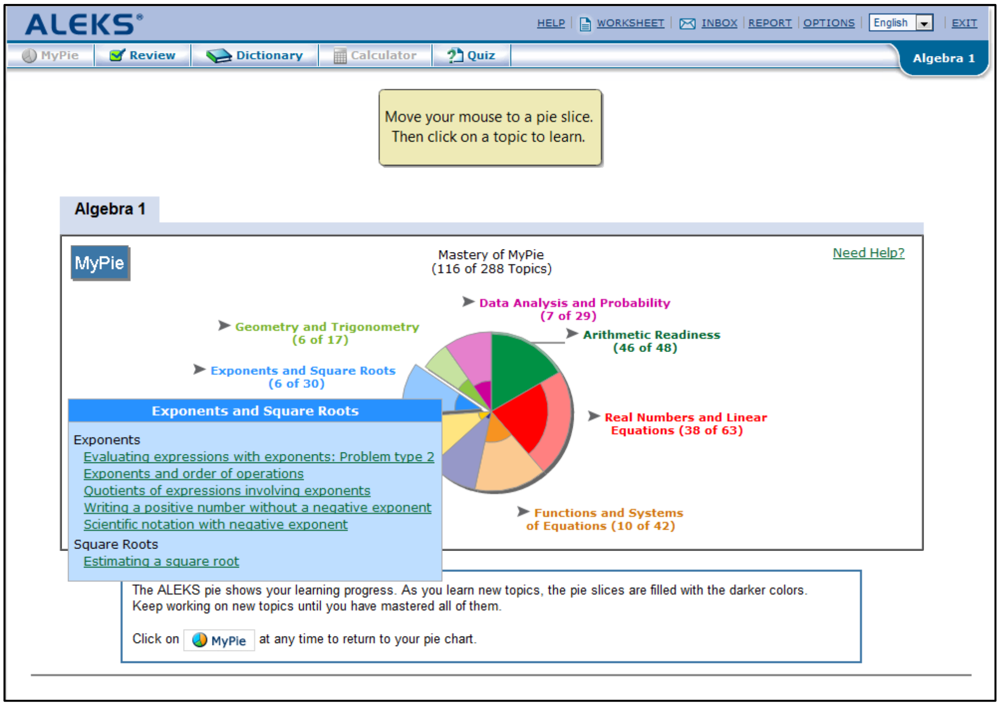
ALEKS also contains a number of tools that help create an optimal learning environment:

- Students are given flexible and easy-to-use answer tools that mimic paper and pencil. None of the tools provided by ALEKS indicate the correct response. By design, the ALEKS Answer Editor always contains math input tools greater in number than what the student actually needs to answer the problem. The Answer Editor is chosen carefully for each problem type by professional mathematicians;
- Questions in ALEKS are algorithmic, are true free response, and avoid multiple-choice, which essentially eliminates any chance for students to guess the correct answer. In other words, students are required to produce authentic mathematical input, and
- ALEKS for mathematics is entirely English/Spanish bilingual. By presenting materials in both English and Spanish, ALEKS provides the unique advantage of a truly bilingual experience and eliminates one of the core obstacles to learning for ELLs.

A student in an ALEKS course first takes an initial assessment, which determines the student's "knowledge state". ALEKS chooses each question on the basis of the student's answers to *all the previous questions*. Each student, and therefore, each set of assessment questions, is unique. Due to the algorithmic nature of the material in ALEKS, students can neither predict the questions asked nor cheat because no student will receive the exact same question. Also, at any time, including before beginning the initial assessment, students can click on the "English/Español" toggle button at the top of the screen to translate the entire program to Spanish. Because Spanish-speaking ELLs are able to take the initial assessment in their native language, ALEKS will be able to truly assess their mathematical knowledge without the taint of problems arising from language barriers.



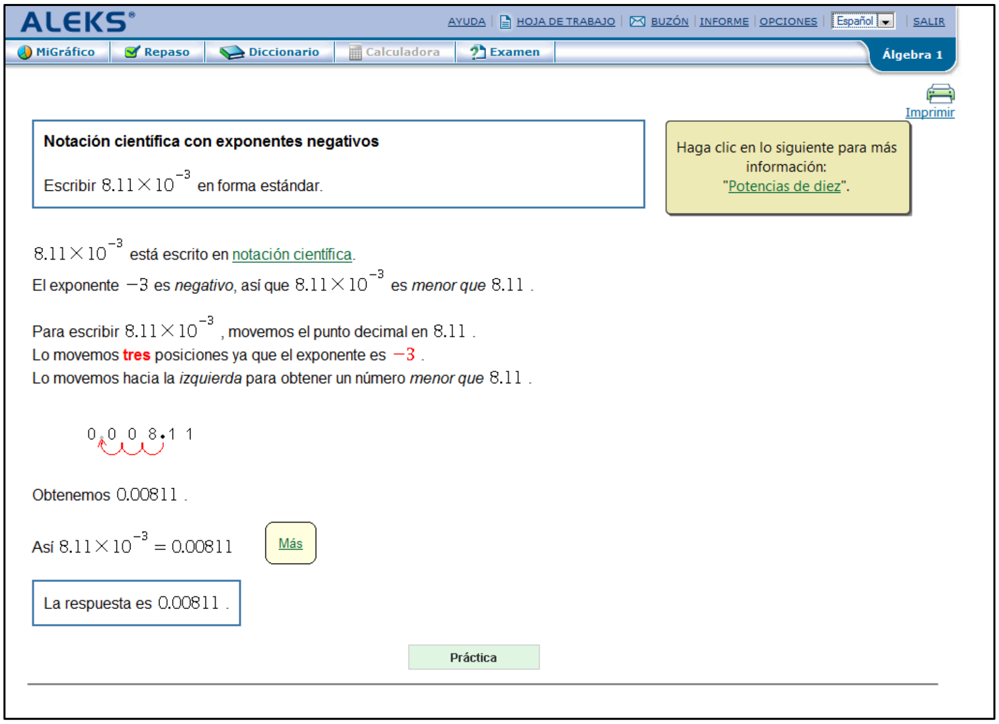
By the time the student has completed the initial assessment, ALEKS has developed a precise picture of the student's knowledge of the course and knows which topics he or she has and has not mastered. The student's knowledge state is represented by a multicolor pie chart called the ALEKS Pie. The ALEKS Pie is also the student's entry into the Learning Mode. In the Learning Mode, the student is offered a choice of topics that he or she is ready to learn. In the ALEKS Pie, each slice corresponds to a particular area of the course (for example, "whole numbers" or "geometry"). The degree to which each slice is filled by a darker color shows the extent to which the student has mastered that particular area of the course. Each slice of the Pie may be opened to produce a list of "ready-to-learn" topics.



The student starts the Learning Mode by selecting a topic to learn. ALEKS offers practice problems to teach the topic selected. These problems are algorithmically-generated and are, therefore, different enough that the student must understand the core principle defining the topic in order to answer the problems correctly. Students receive immediate feedback and, in some cases, suggestions for correcting mistakes. If the student does not understand or know how to solve a problem, he or she can access a complete explanation of that problem. The explanation typically provides a step-by-step solution to the problem, with commentary. In some cases, an alternative or more detailed explanation is also available. After reading the explanation(s), the student can practice on another instance of the problem. If the student is successful in solving the new problem, the system will generally offer two or three more instances of the same topic to make sure the student has learned it. As the student learns new topics, ALEKS updates its understanding of the student's knowledge and, correspondingly, the ALEKS Pie.

Students also have the ability to practice new instances of topics that they have already learned through a review feature, which can assist in refreshing their knowledge before an assessment. Studies have shown that periodic testing not only forces students to adopt better study habits but also improves long-term retention (Roediger, 2006). As the student works through a course, ALEKS periodically reassesses the student to ensure that topics learned are also retained. These automatic reassessments are given to improve retention and to verify that the students are retaining what they are learning. Topics that are not retained are placed back into the student's Pie for them to review and master.

The bilingual nature of ALEKS provides several key advantages for ELLs.



- When the Spanish translation is selected, all the text in ALEKS is translated, including the interface, the explanations, and definitions. ALEKS, thereby, reduces, if not eliminates, the language barrier to learning faced by bilingual students;
- Since the language barrier is mitigated, ALEKS will be able to target a bilingual student's learning gaps more accurately and facilitate the student's success at learning mathematical material;
- Because students can switch back and forth between English and Spanish, and therefore, be able to see the same problem in both English and Spanish, bilingual students can increase their English mathematical vocabulary;
- The bilingual nature of ALEKS also promotes parental and family involvement in their learning. Because parents and family of bilingual students may face the same language barriers, they often cannot engage in the student's academic life or provide the necessary support to help a student succeed in school. With ALEKS, parents and family are able to engage with their children in their coursework and see their progress by toggling to Spanish.

ALEKS' powerful combination of artificially-intelligent assessment and learning and its bilingual nature are key to fostering math success for bilingual students. By providing differentiated, in-depth coursework for multiple grades and by eliminating language barriers, ALEKS bridges learning gaps by enabling bilingual students to concentrate on grade-level appropriate content, excel at mathematics, and become college and career ready. Ultimately, ALEKS provides each student with a bilingual, personalized cycle of assessment and learning.

About ALEKS and ALEKS Corporation

ALEKS is the practical realization of Knowledge Space Theory – the result of ground-breaking research in mathematical cognitive science initiated by Dr. Jean-Claude Falmagne at New York University (NYU) and the University of California, Irvine (UCI) and Dr. Jean-Paul Doignon at the University of Brussels. The core mathematical theory was created between 1983 and 1992. In 1992, Dr. Falmagne obtained a multi-million dollar NSF grant for the development of the ALEKS educational software based on Knowledge Space Theory. To this end, he assembled at UCI a team of software engineers and mathematical cognitive scientists. The Corporation was founded in 1996 by Falmagne and key members of his development team to implement, maintain, and further develop the software on the internet and make it available to K-12 and college students. The ALEKS software has been granted by UCI to ALEKS Corporation under an exclusive, worldwide, perpetual license.

ALEKS Corporation develops, manages, and supports the ALEKS products entirely within the company's operations, and therefore, has a full-time staff of content writers, editorial and production staff, software engineers, computer programmers, mathematicians, mathematical cognitive scientists, research and development (R&D) professionals, business professionals, trainers, customer support representatives, and support staff. In addition, the Company employs professional academics on a consulting basis to assist in writing and reviewing ALEKS content in various disciplines. ALEKS has been used by millions of students in more than 50 academic subjects ranging from elementary school mathematics to pre-calculus at thousands of schools and other educational institutions throughout the world.

ALEKS Success Stories

Located in the heart of Silicon Valley, one of the key centers for STEM-related careers in the United States, Santa Clara Unified School District (SCUSD) has a student enrollment of 14,000 in twenty-three schools. Thirty-three percent of the SCUSD students are English language learners, speaking 47 different languages with the primary ELL language being Spanish. Based on a recommendation of a high-school mathematics teacher, SCUSD decided to employ ALEKS with students who had failed the California High School Exit Exam (CAHSEE). Since more than 50% of these students were native Spanish speakers, the most important aspect of ALEKS for them was the ability to toggle between

English and Spanish. Based on the success of the test preparation course, SCUSD expanded their use of ALEKS to remediate students who failed Algebra. Using ALEKS assessment results and data, teachers identified small groups of struggling students to provide direct instruction while ALEKS provides individualized, differentiated instruction. Once students demonstrated proficiency in the Algebra content they were allowed to move on.

SCUSD has now expanded the use of ALEKS in the areas of credit recovery, summer school, an intervention tool, after-school programs, and even extended learning for third grade students. Kathie Kanavel, Education Technology Coordinator, declared, "ALEKS has allowed us to focus on the individual needs of our students in the area of mathematics and has provided teachers with diagnostic information that helps them fine tune their instruction in order to increase student achievement. ALEKS is a program that keeps students engaged in their learning and teachers informed about their instruction. It has made a significant difference for our district."

Santa Clara Unified School District
ALEKS Results for December 2008-June 2010
California State Test (CST) Results

Buchser School

- 129 students used ALEKS
- 51% moved up at least one CST level in mathematics
- 77% improved their CST math scaled score
- Average CST math scaled score increased by 28 points
- Buchser students gained an average of 63 percentage points toward mastery of concepts on the ALEKS assessments.

Cabrillo School

- 108 students used ALEKS
- 32% moved up at least one CST level in mathematics
- 62% improved their CST math scaled score
- Average CST math scaled score improved by 18 points
- Cabrillo students gained an average of 70 percentage points toward mastery of concepts on the ALEKS assessments.

Irving Independent School District (Irving ISD), just west of Dallas-Fort Worth, implemented ALEKS to a targeted student population throughout all of the 18 elementary, middle, and high schools. Of the 881 students using ALEKS, 366 were ELLs. Through the strategic and targeted use of ALEKS, the average mastery rate for ELLs increased by 11%. In 2007, Irving ISD's ESL department hosted Bilingual-ESL Education Association of the Metroplex (BEAM) Conference for north Texas school districts, educational affiliates, teachers and administrators. After learning about ALEKS at the conference, Elda Rojas, Irving ISD's ESL High School Coordinator, invited ALEKS representatives to Irving ISD for a presentation and contacted other school districts using ALEKS for ELLs. The following features of ALEKS were particularly appealing to the Irving ISD ESL department:

- The use of artificial intelligence to address individual students' needs, target deep gaps in knowledge, and improve learning and retention;
- The capability for ELLs to toggle from English to Spanish, and
- The appropriateness of the level of Spanish CALP.

In Spring 2010, six Irving ISD secondary schools piloted ALEKS for elected ESL and Special Education classes. Based on strong positive outcomes, the use of ALEKS in ESL classes was expanded to all middle schools and high schools for the 2010-2011 school year. Elda Rojas noted, "The data shows concentrated and extended use of ALEKS leads to greater results […] so scheduling sufficient time for student's to use ALEKS is important."

Conclusion

The United States must confront the mounting challenge to its international economic competitiveness (Bernanke, 2004). The economic status of the United States is dependent upon the skill and knowledge of the workforce and if it loses its advantage because workers lack the capacity to meet the 21st century labor market challenges, the consequences for individuals as well as our overall economy are alarming (ACT). It is crucial for individuals and our society as a whole to ensure that every child is educated to high standards and offered opportunities to be successful in a career, in college, and in an increasingly competitive global economy.

Between 2000 and 2050, Hispanics will account for 51% of the United States population growth and are the fastest-growing population in the United States' workforce. Hispanic students are the largest minority group in American schools, and the national Hispanic student population increased from 6% to 22% at grade 4, and from 7% to 21% at grade 8 from the years 1990 to 2009. Hispanic youths comprise 25% or more of the student population in many school districts in several states.

A growing number of schools are charged with educating students from linguistically and culturally diverse backgrounds, many who are English language learners (ELLs). With crowded classrooms and limited expertise, teachers may not have the expertise and may not be equipped to provide the linguistic support, the subject content mastery, and the differentiated instruction critical to the success of ELLs.

In addition to supporting English and mathematical language concurrently and differentiating instruction, other essential instructional strategies are requisite to advance the learning of mathematics for ELLs. Technology supports classroom strategies by creating new routes to understanding complicated, abstract material, addressing multiple learning needs, modifying difficulty levels, and presenting new materials at strategic moments. The use of iterative learning and adaptive assessment systems maximize the use of technology to reduce frustration by tailoring presented material to the student's ability to grasp concepts, to fill learning gaps, and to address the learning needs of ELLs.

ALEKS is a web-based, artificially intelligent assessment and learning system. Using artificial intelligence and adaptive questioning, ALEKS quickly and accurately identifies the student's knowledge state to provide targeted instruction on the material the student is ready to learn. Key to supporting bilingual students, ALEKS eliminates core obstacles to learning by presenting materials in both English and Spanish providing the unique advantage of a truly bilingual experience. With the ability to transfer from English to Spanish, ALEKS promotes parental and family involvement in the ELLs learning. By providing differentiated, in-depth coursework for grades 3-12 and college, ALEKS bridges learning gaps by enabling ELLs to concentrate on grade-level appropriate content, excel at mathematics, and become college and career ready. ALEKS provides each student with an artificially intelligent, personalized cycle of assessment and learning in a fully bilingual format.

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