Enriching Teaching and Learning in a New Age of Standards, Instruction, and Technology:

The Rationale for StarrMatica Learning Systems

A StarrMatica Teaching and Learning Monograph

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Executive Summary

This monograph frames StarrMatica Learning Systems as a unique contributor to effective teaching and learning, and as a solution for comprehensive digital content, within the context of student performance, rigorous and aligned standards, and emerging technology.

Over recent decades, there have been growing concerns that not only are our students failing to meet academic standards, but that they are falling behind peers around the globe. To meet this challenge, related developments have begun to help improve performance:

- A greater emphasis on more rigorous and conceptually-based academic standards, both at the state level and through the Common Core Standards in English language arts and mathematics (with science in development).
- Strengthening and aligning curriculum, instruction, and assessment within systemic frameworks that advance effective teaching and learning.
- Expanding technology to create dynamic support systems for standards and assessments, curriculum and instruction, professional development and professional learning communities, and administration.

When considering technology implementation, the keys are the conceptualization, structure, teaching-learning orientation, content, alignments, and success of programs that offer the most comprehensive solutions. StarrMatica represents such a program as a one-stop solution for:

- Conceptualizing and utilizing technology - StarrMatica is based on the premise that a comprehensive library of digital content which covers entire K-6 curricula and allows educators to efficiently select resources that are best for focusing instruction and impacting student performance is essential to improving teaching and learning.
- Content and standards alignment - StarrMatica contains over 5,000 K-6 reading, mathematics, science, social studies, art, and music simulations, animations, activities, games, and assessments; all aligned to the Common Core and state standards.
- Instructional support and versatility - StarrMatica resources are flexible and geared for whole class instruction, individual interventions, differentiation, review, remediation, and/or enrichment.
- Data use and assessment - StarrMatica provides digital content for whole class formative assessment and closes the gap between data analysis and intervention.
- Effectiveness **-** A district case study showed students performing well above state averages in reading and mathematics than previously, and increases in reading and mathematics proficiency (80% to 96% and 66% to 94%).

1. Introduction

Teaching and learning, the bedrock components of the American educational system, are rapidly evolving; moreso now than ever before in our nation's history. The reasons that stimulate and steer these transformations are evident and many. Most unmistakable is that we live in an increasingly global and complex educational and economic society, where change comes quickly, and from many directions.

As a nation, we face increasing challenges to strengthen the preparedness of our students, and to solidify our ability to compete internationally. The foundation comes at the elementary, K-6 level where academic performance indicators and comparisons across multiple subjects are both substantial and troublesome. Interfacing with these issues are the development of state and national academic standards, the need to align these standards with curriculum, instruction, and assessment, and the content knowledge, instructional expertise, and time management demands upon our teachers.

Additionally, our world society has been and will continue to be dramatically impacted by rapid technology growth, with mushrooming applications, that has far-reaching influence - directly and indirectly - on the lives of its citizens. And while business and industry have embraced technology to provide better products and services, and to reach expanding markets, our education system has lagged behind in technological adoption and in mining its potential treasure trove of teaching and learning applications.

Given these significant education issues as background, the purpose of this monograph is to frame StarrMatica Learning Systems as a unique contributor to effective teaching and learning, and as a solution for comprehensive digital content, within the context of student performance, rigorous and aligned standards, and emerging technology.

2. The Challenge: Academic Performance

The biggest challenge facing our nation's educational system, and the one that serves as the primary catalyst for improved teaching and learning, is how to increase academic performance. Over recent decades, there have been intensified concerns that not only are our students failing to measure up to academic standards, but that they are falling behind students around the globe.

The Nation's Report Card

The most visible indicator of performance in our nation's schools is the National Assessment of Educational Progress (NAEP), referred to as the Nation's Report Card. Since 1969, NAEP assessments have been conducted periodically in reading, mathematics, science, writing, U.S.

history, civics, and geography. NAEP collects and reports information on student performance for grades 4, 8, and 12, providing a common measure and key benchmark for student achievement across the country.

The two most recent NAEP reports in reading and mathematics are based upon the 2011 assessments. While there are slight improvements in recent performance in both subjects, percentages of students performing at the different achievement levels continue to be disquieting. NAEP results are reported as percentages of students performing at or above the Basic and Proficient Achievement levels, and at the Advanced Achievement level. These levels are defined as:

- Basic Achievement - Partial mastery of prerequisite knowledge and skills that are fundamental for proficient work at each grade.
- Proficient Achievement - Solid academic performance; students reaching this level have demonstrated competency over challenging subject matter.
- Advanced Achievement - Superior performance.

NAEP Reading. Two-thirds of 4th graders scored at the Basic Achievement level or above, and 33% were below the Basic level on this latest assessment cycle[1]. Only 8% scored at the Advanced Achievement level. For reference, the following are examples of grade 4 reading skills assessed at different NAEP achievement levels:

- Basic Reading Achievement - Interpret a character's statement to describe a character trait.
- Proficient Reading Achievement - Recognize the main problem that the character faces in a story.
- Advanced Reading Achievement - Use story events to support an opinion about story type.

There are also considerable reading disparities in performance across student groups:

- 22% of White students and 20% of Asian students were below the Basic Achievement level, compared to 51% of Black students and 49% of Hispanic students.
- 11% of White students and 17% of Asian students scored at the Advanced Achievement level, compared to 2% of Black students and 3% of Hispanic students.
- Average scores for students from lower-income families were significantly lower than those from higher-income families.

[1] National Center for Education Statistics. (2011). *The Nation's Report Card: Reading 2011*. (NCES 2012-457.) Washington, DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.

NAEP Mathematics. NAEP Mathematics results have been more encouraging as 82% of the nation's 4th graders scored at the Basic Achievement level or above, with 18% scoring below the Basic level[2]. However, only 7% reached the Advanced Achievement level. Examples of the mathematics knowledge and skills at each achievement level are:

- Basic Mathematics Achievement - Compute the difference of two 4-digit numbers.
- Proficient Mathematics Achievement - Draw a line segment of a given length.
- Advanced Mathematics Achievement - Solve a story problem involving time.

Group performance disparities also existed in the mathematics assessment:

- 8% of White students and 9% of Asian students were below the NAEP Basic Achievement level, compared to 34% of Black students and 28% of Hispanic students.
- 9% of White students and 19% of Asian students scored at the Advanced level, compared to only 1% of Black students and 2% of Hispanic students.
- Students from higher income families scored considerably higher than those from lower-income families.

International Assessments

Another academic performance perspective comes from two major international assessments at the 4th-grade level: the Progress in International Reading Literacy Study (PIRLS) and the Trends in International Mathematics and Science Study (TIMSS). Both measures are important benchmarks for U.S. performance compared to students from other countries.

Progress in International Reading Literacy Study. The PIRLS assesses reading comprehension by measuring performance on a combined reading literacy scale, and on a literary subscale and informational subscale. The literary subscale assesses performance in reading for literary experience, and the informational subscale assesses the ability to acquire and use information.

The latest PIRLS assessment was administered in 2006 in 45 countries and compared the reading performance of U.S. students with their peers around the world[3]. Key findings included:

- Average reading scores for U.S. students were higher than scores for students in 22 countries, lower than scores for students in 10 countries, and similar to students in 12 countries.

[2] National Center for Education Statistics. (2011). *The Nation's Report Card: Mathematics 2011.* (NCES 2012-458.) Washington, DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.

[3] Baer, J., Baldi, S., Ayotte, K., & Green, P. (2007). *The Reading Literacy of U.S. Fourth-Grade Students in an International Context: Results from the 2001 and 2006 Progress in International Reading Literacy Study (PIRLS).* (NCES 2008-017.) Washington, DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.

- Average scores for White and Asian U.S. students were substantially higher than those for Black and Hispanic U.S. students.

Trends in International Mathematics and Science Study. TIMSS is used to measure the mathematics and science knowledge of students, and is designed to align broadly with mathematics and science curricula in participating TIMSS countries. The most recent study was implemented in 2007, and 36 countries participated at the 4th-grade level.

The latest TIMSS report focused on the performance of U.S. students relative to that of their peers in the other participating countries[4]. Major results included:

- The average U.S. mathematics score was higher than those of students in 23 other countries, lower than those in 8 countries, and similar to those in 4 countries.
- The average U.S. science score was higher than those of students in 25 other countries, lower than those in 4 countries, and similar to those in 6 countries.
- 10% of U.S. students scored at or above the advanced international benchmark in mathematics, and 15% scored at or above the advanced international benchmark in science.

3. Meeting the Challenge: Rigorous Standards

While state and national standards are not new concepts, the attention given to them has grown incrementally in recent years. Much of the impetus has to do with concerns about academic performance and its long-term impact upon the nation's economic security. As a result, states, the federal government, professional organizations, private businesses, and educational associations have all entered into the standards' arena.

State Standards

The Elementary and Secondary Education Act requires states to develop challenging student academic standards and assessment systems. The standards must include both content and achievement standards, and content standards must:

- Be the same that the state applies to all public schools and public school students.
- Specify what all students are expected to know and be able to do.
- Include at least mathematics, reading/language arts, and science.
- Contain coherent and rigorous content, and encourage teaching of advanced skills.

[4] Gonzales, P., Williams, T., Jocelyn, L., Roey, S., Kastberg, D., & Brenwald, S. (2008). *Highlights from TIMSS 2007: Mathematics and Science Achievement of U.S. Fourth- and Eighth-Grade Students in an International Context.* (NCES 2009-001 Revised.) Washington, DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.

State achievement standards must define at least two levels of proficiency (e.g., proficient and advanced), and at least one level for students who are not yet proficient in the content for their grade. Separate standards must be set for each grade level and be subject assessed. States also develop alternative standards for students with significant cognitive disabilities, modified standards for students with lesser disabilities, and English language proficiency standards.

State standards and assessment systems are reviewed and approved by the Department of Education. There are 52 jurisdictions - all 50 states plus Puerto Rico and the District of Columbia. As of May 2012, a majority had their systems approved or approval was expected: 32 were fully approved or fully approved with recommendations, 14 were identified as approval pending, and 6 were identified as in progress[5].

The National Academy of Sciences has reported that state leaders now generally take standards-based reform and accountability for granted, viewing this approach as a central framework that guides state education policy and practice[6]. It further reported that state standards-based reform has led to:

- Greater awareness and attention to the academic performance of disadvantaged students.
- The expectation that all students will meet rigorous standards.
- A more uniform education system within states.
- Instruction that is tailored to the needs of individual students.

Common Core Standards

The Common Core State Standards are the result of collaboration between the Council of Chief State School Officers and the National Governors Association. These organizations have worked with states, educators, content experts, researchers, other national organizations, and community groups to develop K-12 standards that communicate what is expected of students at each grade level in English language arts and mathematics[7].

The Common Core Standards focus on core conceptual understandings starting in the early grades. These enable teachers to take the time needed to thoroughly teach core concepts and procedures, and give students the opportunity to master them. The criteria used to develop the Common Core Standards included that they be:

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[5] U.S. Department of Education, Office of Elementary and Secondary Education. (2012). *Report to Congress on the Elementary and Secondary Education Act, School Year 2009-10.* Washington, DC: Author.

[6] National Research Council. (2008). *Common Standards for K-12 Education?: Considering the Evidence: Summary of a Workshop Series.* (Committee on State Standards in Education: A Workshop Series.) Washington, DC: The National Academies Press.

[7] National Governors Association Center for Best Practices, & Council of Chief State School Officers. (2010). *Common Core State Standards.* Washington DC: Authors.

- Rigorous in content and applications of knowledge through high-order skills.
- Built upon the strengths and lessons learned from current state standards.
- Informed by top-performing countries.
- Evidence and/or research-based.

Common Core Standards in English Language Arts. The Common Core Standards for English language arts include expectations for reading, writing, speaking, listening, and language applicable to a range of subjects, including but not limited to English language arts[8]. The categories (with an exemplar for each at grade 4) for the K-5 Common Core Standards in English language arts include:

- Reading for Literature: Key Ideas and Details - Refer to details and examples in a text when explaining what the text says explicitly and when drawing inferences from the text.
- Reading for Informational Text: Key Ideas and Details - Determine the main idea of a text and explain how it is supported by key details; summarize the text.
- Reading Foundational Skills: Phonics and Word Recognition - Know and apply grade-level phonics and word analysis skills in decoding words.
- Writing: Text Types and Purposes - Write opinion pieces on topics or texts, supporting a point of view with reasons and information.
- Speaking and Listening: Comprehension and Collaboration - Engage effectively in a range of collaborative discussions with diverse partners on grade level topics and texts, building on others' ideas and expressing their own clearly.
- Language: Conventions of Standard English - Demonstrate command of the conventions of standard English grammar and usage when writing or speaking.

Common Core Standards in Mathematics. The development of the Common Core Standards in mathematics has been guided by the belief that the mathematics curriculum must become substantially more focused and coherent. The standards stress conceptual understanding of key ideas, and the returning to organizing principles such as place value or the properties of operations to structure those ideas. They have two interfacing components: Standards for Mathematical Practice and Standards for Mathematical Content. The Standards for Mathematical Practice describe ways in which students increasingly ought to engage with the subject matter, and are designated for all grade levels:

- Make sense of problems and persevere in solving them.
- Reason abstractly and quantitatively.
- Construct viable arguments and critique the reasoning of others.

[8] The descriptions of the Common Core State Standards in English language arts and mathematics are taken from the Common Core State Standards website - http://www.corestandards.org.

- Model with mathematics.
- Use appropriate tools strategically.
- Attend to precision.
- Look for and make use of structure.
- Look for and express regularity in repeated reasoning.

The Standards for Mathematical Content are a balanced combination of procedure and understanding. The Common Core Grade 4 Content Standards are presented below, and include an illustration for each standard:

- Operations and Algebraic Thinking - Use the four operations with whole numbers to solve problems.
- Number and Operations in Base 10 - Generalize place value understanding for multi-digit whole numbers.
- Number and Operations: Fractions - Extend understanding of fraction equivalence and ordering.
- Measurement and Data - Solve problems involving measurement and conversion of measurements from a larger unit to a smaller unit.
- Geometry - Draw and identify lines and angles, and classify shapes by properties of their lines and angles.

K-12 Next Generation Science Standards. Although not yet a formal component of the Common Core Standards, it is important to recognize the development of the state-led K-12 science standards. These new standards will be rich in content and practice, and arranged in a coherent manner across disciplines and grades to provide all students with an internationally-benchmarked science education[9].

The framework for the standards was developed by the National Research Council with a vision that students must be engaged at the nexus of three dimensions: science and engineering practice, crosscutting concepts, and disciplinary core ideas [10]. The Next Generation Science Standards will require that students demonstrate a sense of contextual understanding with regard to scientific knowledge, how it is acquired, and how science is connected through a series of concepts that help further understanding of the natural and designed world.

Adoption and Implementation of the Common Core Standards. States have been making serious efforts to implement the Common Core Standards; and as of January 2012, 46 states

[9] Achieve. (2012). *Closing the Expectations Gap: 50 State Progress Report.* Washington, DC: The American Diploma Project Network.

[10] National Research Council. (2012). *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas.* (Committee on a Conceptual Framework for New K-12 Science Education Standards.) Washington, DC: The National Academies Press.

and the District of Columbia had adopted the standards in both English language arts and mathematics[11]. Despite earlier perceptions that they would not be demonstrably different from past versions of state standards, states generally agreed that the Common Core Standards were more rigorous than their previous standards, and would improve English language arts and mathematics skills.

Most states that have adopted the Common Core Standards expect to fully implement them by 2014-15. Elements will include developing and disseminating a comprehensive, long-term enactment plan; requiring districts to implement the standards; and carrying out special initiatives to ensure that the standards are fully implemented in the state's lowest performing schools. It will be important that they understand the effectiveness of their efforts; including whether all educators are being reached, whether support and resources are meeting the needs of educators, and what challenges exist and require further state and local attention[12].

4. Meeting the Challenge: Aligned Curriculum, Instruction, and Assessment

The development and implementation of rigorous standards represents the foundation needed upon which to build and advance world-class teaching and learning. The standards specify the blueprints that can lead to performance improvement. However standards alone will not affect educational change. Standards provide the foundations for a systemic framework that aligns, integrates, and supports the key elements of effective teaching and learning. The actual bricks and mortar that will structure and shape our students' educational growth and attainment are strengthened and aligned curriculum, instruction, and assessment.

Strengthening Curriculum

The bases for cultivating a strengthened, standards-based curriculum are captured in *How People Learn* which suggests that to develop competence, students must:

- Have a deep foundation of factual knowledge.
- Understand facts and ideas in the context of a conceptual framework.
- Organize knowledge in ways that facilitate retrieval and application[13].

Consequently, to provide a knowledge-centered classroom environment, attention must be given to what is taught, why it is taught, and what competence or mastery looks like.

[11] Kober, N., & Rentner, D.S. (2012). *Year Two of Implementing the Common Core State Standards: States' Progress and Challenges.* Washington, DC: Center on Education Policy.
[12] Achieve. (2012). See footnote 9.
[13] National Research Council Committee on Learning Research, & Commission on Behavioral and Social Sciences and Education. (1999). *How People Learn: Bridging Research and Practice.* M. Donovan, J. Bransford, & J. Pellegrino (Eds.). Washington DC: The National Academies Press.

The new standards lay out a rigorous and detailed framework which describes the learning outcomes that students should reach. And there is growing evidence that the interaction between the curriculum and a standards-based learning environment is associated with an increase in achievement[14]. Commensurately, there is evidence that failing schools, regardless of whether in urban, rural, or suburban settings, are characterized by a breakdown in focus on teaching and learning, and not paying enough attention to using high-quality curricula[15].

Aligning Curriculum with Standards. A hallmark of effective principals is the demand for content that ensures achievement of standards, and curriculum alignment with district and school goals, standards, assessments, and resources[16]. States and districts support this effort by providing teachers with the resources they need to design curriculum based on the standards[17]. However, the work of translating individual standards into a sequence of integrated and incremental lessons that are meaningful and instructive to students is just beginning.

The Education Trust has outlined a series of things that teachers need, so that the standards have a significant impact on classrooms and students[18]. Foremost is the need to create curricula maps that outline the knowledge and skills required by the standards. Essentially, teachers need to understand what skills and content the new standards require students to know. To facilitate this, there should be curricular maps that incorporate the demands and qualities embedded in the standards, and that provide teachers with a clear, detailed, and incremental guide of what to teach. These frameworks must be coordinated, logical progressions of skills and knowledge aligned with how students learn at particular ages and in specific content areas.

Improving Instruction

Delivering effective, high-quality instruction requires several interacting factors. An RMC teaching and learning brief describes program elements that are critical for all subjects at all grade levels:

- Consistently implemented, high quality initial classroom instruction and follow-up small group instruction that is well-differentiated according to student needs.

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[14] Tarr, J.E., Reys, R.E., Reys, B.J., Chavez, O., Shih, J., & Osterlind, S.J. (2008).The Impact of Middle-Grades Mathematics Curricula and the Classroom Learning Environment on Student Achievement. *Journal for Research in Mathematics Education*, *39* (May), 247-280.

[15] Wakelyn, D. (2011). *State Strategies for Fixing Failing School and Districts.* NGA Center for Best Practices Issue Brief. Washington, DC: National Governors Association.

[16] National Association of Elementary School Principals. (2008). *Leading Learning Communities: Standards for What Principals Should Know and Be Able to Do.* Alexandria, VA: Author.

[17] Collins, C., Thomas, M., Lord, J.M., & Street, S. (2008). *Set for Success: Improving Reading and Mathematics Achievement in the Early Grades.* Atlanta, GA: Southern Regional Education Board.

[18] Almy, S. (2012). *Instructional Supports: The Missing Piece in State Education Standards.* Washington, DC: The Education Trust.

- Use of student performance data to guide instruction and allocate instructional resources.
- Resources to provide interventions to struggling students.

It describes these core areas of excellence as found in almost all schools that have achieved teaching-learning success for their students[19].

To meet new standards and increase the performance of all students by implementing world-class instruction, it is incumbent upon schools, districts, and states to support teacher effectiveness in every way possible. This includes comprehensive professional development for all teachers to support student learning. Research reveals several common elements of effective professional development that influence teacher practice and improve student achievement. These include that professional development should:

- Primarily meet the individual needs of teachers.
- Be ongoing and afford teachers time to practice what they have learned and receive feedback on how well they are implementing what they have learned.
- Be connected to school and district goals for student learning.
- Be focused on improving a teacher's content knowledge[20].

Aligning Instruction with Standards. To ensure that standards translate into good classroom teaching, the Education Trust recommends the development of comprehensive banks of detailed curricular resources aligned with the learning progressions outlined in the new standards. These are highly organized, logically-sequenced resource banks that build on the curricular maps and include model units, lesson plans, strategies for intervention and differentiation, multimedia resources, and exemplars of student work. They must be comprehensive in that they are materials teachers can trust to be of good quality; and that they can review, download, customize, and use in their classrooms without having to create a multitude of other complementary materials[21].

Achieve suggests that much can be done at state and district levels to plan for a smooth, transparent, and productive transition to instructional materials that reflect the standards[22]. This includes developing a rubric to support districts' adoptions of aligned materials and suggests the following categories for consideration:

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[19] Torgesen, J., Houston, D., Rissman, L., & Kosanovich, K. (2007). *Teaching All Students to Read in Elementary School: A Guide for Principals.* Portsmouth, NH: RMC Research Corporation, Center on Instruction.
[20] Grossman, T., & Hirsch, E. (2009). *State Policies to Improve Teacher Professional Development.* NGA Center for Best Practices Issue Brief. Washington, DC: National Governors Association.
[21] Almy, S. (2012). See footnote 18.
[22] Achieve. (2012). See footnote 9.

- Content/Goals - Does the material represent appropriate rigor, display clear development of conceptual understanding, support appropriate skill development and problem skills?
- Supplemental Materials/Classroom Assessments - Does the material include application-level and developmental-level assessment, provide guidance to teachers regarding integration of assessment into classrooms?
- Student Experiences - Does the material support multiple opportunities for students to experience the content, it is engaging, does it allow for multiple learning styles?
- Teacher Support - Does the material support differentiation of instruction, does it support all learners?

Tailoring Assessment

One cornerstone of the standards movement has been the increased emphasis on all types of assessment. The NAESP Foundation Task Force on Early Learning recommends that assessments be used to inform and improve classroom practices, to highlight and share best practices, and be based on a growth model that gauges how much progress an individual child is making[23]. A primary goal is that assessments are organized around a well-defined set of learning progressions along multiple dimensions within subject areas, which guide instructional decisions, classroom-based assessment, and external assessment[24].

An important leadership standard for elementary school principals is to effectively use knowledge and data. Specifically, the emphases are on making performance data a primary driver for school improvement; measuring student, teacher, and school performance using a variety of data; and building the capacity of students and teachers to use knowledge effectively in making decisions[25].

Aligning Assessment with Standards. There are a number of assessment issues that have come to the forefront to guide standards alignment[26]. Principal among them is that assessments be grounded in a thoughtful standards-based curriculum, and are managed as part of a tightly integrated system of standards, curriculum, assessment, instruction, and teacher development.

[23] National Association of Elementary Schools Principals Foundation Task Force on Early Learning. (2010). *Building & Supporting an Aligned System: A Vision for Transforming Education across the Pre-K-Grade Three Years.* Alexandria, VA: Author.
[24] Darling-Hammond, L., & Pecheone, R.; with Jacquith, A., Schultz, S., Walker, L., & Wei, R.C. (2010). *Developing an Internationally Comparable Balanced Assessment System that Supports High-Quality Learning.* (The National Conference on Next Generation Assessment Systems.) Princeton, NJ: Educational Testing Service.
[25] National Association of Elementary School Principals. (2008). See footnote 16.
[26] Darling-Hammond, L., & Pecheone, R.; with Jacquith, A., Schultz, S., Walker, L., & Wei, R.C. (2010). See footnote 24.

Assessments should also include evidence of actual student performance on challenging tasks that evaluate 21st-century learning.

Most importantly, aligned assessments should be structured to continuously improve teaching and learning. The Cognitively Based Assessment *of, for, and as* Learning, recently developed by the Educational Testing Service, is an initiative designed to develop an understanding of what learning standards are, what high quality work looks like, and what is needed for student learning. It is a model for an innovative K-12 assessment system that documents what students have achieved (*of learning*); helps identify how to plan instruction (*for learning*); and is considered by students and teachers to be a worthwhile educational experience in and of itself (*as learning*). It intends to not only measure student achievement but also to facilitate it[27].

5. Meeting the Challenge: Expanding Technology

Technology is prevalent throughout the course of most peoples' daily lives - including the lives of our students. Yet education has been slow to respond to the enormous benefits that technology can offer. There also are concerns that technology increments have been piecemeal, without well-thought-out comprehensive policies that consider quality, flexibility, the importance of teaching, and the experiences of students.

Schools cannot conceivably prepare students to participate in a global economy without making concentrated use of technology. Creating a 21st-century education system requires broad and intensive use of technology with a strong technology infrastructure[28]. Technology must be used comprehensively and purposefully to create robust education support systems for standards and assessments, curriculum and instruction, professional development and professional learning communities, and administration.

Current State of Educational Technology

Two recent national reports provide the most comprehensive data on the availability and use of educational technology in our public elementary and secondary schools[29], and among teachers in these schools[30]. The first report examined numbers of computers for instructional and

[27] Bennett, R.E. (2010). Cognitively Based Assessment of, for, and as Learning (CBAL): A Preliminary Theory of Action for Summative and Formative Assessment. *Measurement: Interdisciplinary Research & Perspective Special Issue: Innovations in Test-Based Accountability, 8*, (Issue 2-3).

[28] State Educational Technology Directors Association, & International Society for Technology in Education. (2007). *Maximizing the Impact: The Pivotal Role of Technology in a 21st Century Educational System.* Glen Burnie, MD: Authors.

[29] Gray, L., Thomas, N., & Lewis, L. (2010). *Educational Technology in U.S. Public Schools: Fall 2008.* (NCES 2010-034.) Washington, DC: U.S. Department of Education, National Center for Education Statistics.

[30] Gray, L., Thomas, N., & Lewis, L. (2010). *Teachers' Use of Educational Technology in U.S. Public Schools: 2009.* (NCES 2010-040.) Washington, DC: National Center for Education Statistics, Institute of Education Sciences, U.S. Department of Education.

administrative use, network or Internet access for teaching and learning, and support to integrate technology into instruction. Selected key findings were that:

- 100% of schools had one or more instructional computers with Internet access, and the ratio of students to instructional computers with Internet access was 3.1:1.
- Schools used their district network or Internet to provide assessment data for teachers to individualize instruction (87%), data to inform instructional planning (85%), online student assessment (72%), and high-quality digital content (65%).
- 27% of elementary schools had full-time staff whose only responsibility was technology support and/or technology integration.
- A larger percentage of low poverty than high poverty schools agreed that teachers are sufficiently trained in technology usage and to integrate technology into classroom instruction, and that technical support for educational technology is adequate.

The second report explored the number of classroom computers, availability and use of computers during instructional time, and teacher training to use technology for instruction. Selected key findings were that:

- Teachers or their students used computers in the classroom during instructional time often (40%) or sometimes (29%).
- 97% of teachers had one or more computers located in the classroom every day and the ratio of students to computers every day was 5.3:1.
- Internet access was available for 93% of the computers located in the classroom every day.
- For teachers spending time in annual professional development activities, the number of hours ranged from 1 to 8 hours (53%) to 33 or more hours (7%).

Empowering Teaching and Learning through Technology

The future of education, with the planned and tailored application of technology, will require a shift in how we have come to view the culture of education. Many view this as a shift to a learner-centered environment which uses data to set learning goals and criteria for success, assesses progress, and provides students with a comprehensive system of academic and developmental supports. Technology supports this culture by engaging students in learning, creating compelling learning environments, and energizing classroom teaching[31]. It becomes a key tool for a learning-centered educational system which includes:

- Building conceptual understanding of core content.
- Addressing misconceptions.
- Fostering inquiry and investigation.

[31] Wolf, M.A. (2012). *Culture Shift: Teaching in a Learning-Centered Environment Powered by Digital Learning.* (Digital Learning Series.) Washington, DC: Alliance for Excellent Education.

- Applying knowledge and skills to interdisciplinary challenges.
- Engaging and motivating students.
- Differentiating instruction to meet individual needs[32].

The National Education Technology Plan provides the essential elements and framework for this adaptation[33]. It asserts that technology must be leveraged to provide engaging and powerful learning experiences and content, as well as resources and assessments. Technology will help execute collaborative teaching strategies combined with professional learning that better prepare and enhance educators' competencies and expertise. The Plan presents a model of learning powered by technology with goals and recommendations in five essential areas: learning, assessment, teaching, infrastructure, and productivity.

The model calls for engaging and empowering learning experiences for all students. It focuses on what is taught and how this is matched to what students need to know, how they learn, and where and when they learn. It brings state-of-the-art technology to provide personalized learning to enable, motivate, and inspire every student to achieve, regardless of background, language, or disability. Key learning recommendations include that:

- States continue to revise, create, and implement standards and learning objectives using technology for all content areas that reflect 21st-century expertise and the power of technology to improve learning.
- States, districts, and others develop and implement learning resources that use technology to embody design principles from the learning sciences.
- States, districts, and others develop and implement learning resources that exploit the flexibility and power of technology to reach all learners anytime and anywhere.

The model also describes that classroom educators are fully connected to learning data and tools for using the data; to content, resources, and systems that empower them to create, manage, and assess engaging and relevant learning experiences; and to their students in support of learning both in and out of school. The National Technology Plan recommends that to prepare and connect teachers, we must:

- Expand opportunities for educators to have access to technology-based content, resources, and tools where and when they need them.
- Use technology to provide all learners with online access to effective teaching and better learning opportunities and options, especially in places where they are not otherwise available.

[32] State Educational Technology Directors Association, & International Society for Technology in Education. (2007). See footnote 28.
[33] U.S. Department of Education, Office of Educational Technology. (2010). *Transforming American Education: Learning Powered by Technology.* Washington, DC: Author.

- Provide pre-service and in-service educators with professional learning experiences powered by technology to increase their digital literacy and enable them to create compelling assignments for students that improve learning, assessment, and instructional practice.

6. Meeting the Challenge: StarrMatica Learning Systems

We have seen the critical need to implement rigorous standards, aligned with curriculum, instruction, and assessment, to move our students and our educational system to where our nation expects them to be. Essential to this goal is the fundamental need to expand thoughtfully-conceived, innovative, and integrated educational technology and to take teaching and learning to the next level by maximizing the opportunities that digital learning and technology offer[34].

A central component of this is that our educators need easy access to high-quality and cost-effective aligned classroom materials such as instructional software, formative assessment tasks, and lesson plans to support standards-based instruction[35]. It is within this context that we focus on StarrMatica Learning Systems as a key player in meeting this challenge.

StarrMatica as a Digital Content Solution

When considering technology implementation in our schools, it is important to examine the conceptualization, structure, teaching-learning orientation, content components, standards alignment, and success of those programs that offer the most comprehensive solutions, rather than those that provide only fragmented offerings. One key guideline is the comprehensive definition of digital learning[36]:

- Digital learning is any instructional practice that is effectively using technology to strengthen the student learning experience. It encompasses a wide spectrum of tools and practice, including using online and formative assessment, increasing focus and quality of teaching resources and time, online content and courses, applications of technology in the classroom and school building, adaptive software for students with special needs, learning platforms, participating in professional communities of practice, providing access to high level and challenging content and instruction, and many other advancements technology provides to teaching and learning.

[34] Schwartzbeck, T.D., & Wolf, M.A. (2012). *The Digital Learning Imperative: How Technology and Teaching Meet Today's Educational Challenges.* (Digital Learning Series.) Washington, DC: Alliance for Excellent Education.
[35] Achieve. (2012). See footnote 9.
[36] Schwartzbeck, T.D., & Wolf, M.A. (2012). See footnote 34.

StarrMatica Learning Systems directly parallels this detailed paradigm and represents a primary, one-stop solution for comprehensive, integrated, and online digital learning content. The following sections document how StarrMatica fulfills this role.

A Solution for Conceptualizing and Utilizing Technology. StarrMatica was envisioned and conceptualized by educators who realized, from classroom experience and growing national evidence on its relationship to performance[37], that technology offered extraordinary value in strengthening and tailoring instruction, enhancing learning, engaging students, and increasing achievement. It was evident that teachers would quickly need to become choreographers of technology (e.g., matching computer instruction with an individual student's development, group needs, curriculum sequence) to best harness its instructional potential and maximally support all-student learning.

However, teachers need help in using technology effectively, and the primary assistance teachers need is time-saving access to high-quality, user-friendly digital content. StarrMatica Learning Systems is based, developed, and implemented on the simple premise:

- ***A comprehensive library of digital content which covers entire K-6 curricula and allows educators to efficiently select resources that are best for focusing instruction and impacting student performance is essential to improving teaching and learning.***

The goals of StarrMatica's research-based teaching and learning components have been to provide schools with an online flexible resource that would assist teachers in effectively integrating technology into their daily classroom instruction. Additionally, StarrMatica provides a catalyst for parental involvement in their child's education which includes progress monitoring, instructional reinforcement, and learning materials access. StarrMatica's products and services are designed to help educators make the most of every piece of technology in their classrooms (e.g., interactive whiteboards, projectors, interactive pads, response systems, computers, and tablets); and make best use of their time in easily locating, providing, and tailoring high quality instruction to all students.

A Solution for Content and Standards Alignment. StarrMatica contains over 5,000 K-6 reading, mathematics, science, social studies, art, and music simulations, animations, activities, games, and assessments. These are based on the proven effectiveness of software characteristics that:

- Personalize information.
- Animate objects on the screen.
- Provide practice activities that incorporate challenges and curiosity.

[37] Starr, E. (2006). *Why StarrMatica Is Effective: The Research-Basis for StarrMatica's Interactive Content.* Clinton, IA: StarrMatica Learning Systems.

- Provide a fantasy context.
- Provide learners with a choice in their own learning[38].

Based upon the premise that content designed by educators is organized and presented in ways that are simple and intuitive for other educators and students, StarrMatica's content is written and reviewed by professionals who have taught in elementary classrooms and hold advanced degrees. StarrMatica's lessons are edited and grade-leveled by a single editor to ensure consistency, and go through a multi-step quality-control and testing process before release.

Reflective of the ASCD priority to vet instructional resources for alignment with standards[39], the entire StarrMatica content library is aligned to the Common Core State Standards and to the different state standards (when states release modified versions of the Common Core Standards, StarrMatica aligns to those as well). StarrMatica is further aligned to the standards in those states that have not adopted the Common Core Standards.

StarrMatica's content library is also aligned with standards established by the National Council of Teachers of English, National Council of Teachers of Mathematics, and the National Assessment of Educational Progress. It is further aligned to five textbook curricula: Houghton Mifflin: Math Expressions; Kendall Hunt: Math Trailblazers; McGraw Hill: Everyday Math; Pearson: Envisions; and Pearson: Investigations; and current aligning is taking place with McGraw Hill: Math Connects; and Houghton Mifflin: Go Math!.

StarrMatica standards and textbook alignments are done visually by experienced educators who review and analyze each standard line by line and each textbook page by page so that the digital content is carefully aligned to each standard and lesson. The alignments provide all content related to the skill being taught by the standard or in the lesson. Because of these judiciously-detailed alignments, all 5,000 StarrMatica resources are quickly searchable by grade level, subject and topic, each standard of the Common Core Standards, each state standard and benchmark, and each textbook curriculum lesson.

A Solution for Instructional Support and Versatility. StarrMatica's extensive and comprehensive resources are flexible and geared for whole class instruction, individual interventions, differentiation, review, remediation, and/or enrichment. They support three proven instructional techniques:

- Having students represent new knowledge in graphic/non-linguistic formats.
- Using computer-based manipulatives to explore and practice using new knowledge.

[38] Starr, E. (2006). See footnote 37.
[39] ASCD. (2012). *Fulfilling the Promise of the Common Core State Standards: Moving from Adoption to Implementation to Sustainability.* Alexandria, VA: Author.

- Teaching new knowledge directly through demonstration and explanation, then having students apply it on their own[40].

StarrMatica allows teachers to choose from numerous digital content resources for a single concept, with multiple strategies that facilitate matching interventions with a student's learning style, interests, strengths, and weaknesses. Teachers can find content that is below grade level, at grade level, and above grade level for each concept so students can learn the same skill but at different levels of difficulty.

Teachers can mark content as a favorite and search their favorites for any subject, topic, or topic group to locate preferred resources. Teachers can create a collection of content for a particular topic that includes links to several pieces of content in the library; they can then share that collection with their class or individual students. Students go to a digital backpack that contains the content collections their teacher has shared with them. Teachers use this feature to differentiate instruction and to individualize instruction for students with content that meets specific learning needs.

Teachers can share collections with colleagues and add their own content to a collection, and can add content to a collection that does not reside within StarrMatica's database. This furthers StarrMatica's library concept by not limiting teachers to the content provided. A teacher can copy a colleague's collection, make (or not make) modifications to it, and share it with students. This saves time by allowing teachers to collaborate to create shared collections during common planning time and professional learning communities.

StarrMatica professional development programs ensure that all teachers know how to easily navigate the content library, and understand how to use the content effectively for whole class instruction and to meet individual student needs. These professional development opportunities include:

- On-demand video tutorials.
- Regularly-scheduled web-based live classes.
- Guidance in the form of content and integration e-mails.
- Membership guide with description on how to navigate all StarrMatica areas.
- Instructional newsletters with library updates and resources.
- Advanced integration training.
- On-site training.

[40] Starr, E. (2006). See footnote 37.

A Solution for Data Use and Assessment. StarrMatica provides teachers with digital content for whole class formative assessment with response systems. It closes the gap between data analysis and intervention by allowing teachers to find multiple standards-aligned interventions at multiple ability levels for every individual weakness, which is consistent with ASCD's recommendation that technology be adopted with a priority of meeting teaching and learning needs, but that it also work with new assessments[41].

StarrMatica allows teachers to track student practice to ensure that an intervention is successful or to find an alternative intervention if needed. Students can take a benchmark test which records what they know and what they don't know; and they can then practice their individualized assessment-based information in activities that mix facts they need to practice with facts they know.

Students' progress is tracked in the classroom management system which records a student's first attempt and best attempt at practice activities. Teachers can view scores for multiple years and can set the percentage scales to match their grading scale or other proficiency scale. Teachers can see if there are particular activities that many students are struggling with and/or if a particular student is struggling with many activities. Teachers, students, and parents can view progress online both at school and at home to determine if a student has mastered a concept or needs additional assistance.

In addition to individual student results, teachers can view group or class data. Teachers can view the percentage of their class that knows each fact to determine commonly missed facts that they can then address. Teachers are also able to see two tables for each student: one showing benchmark test results and the other showing the progress towards mastery. Teachers can share a student so all teachers can view scores and share collections with that student. This is used by special education teachers who share students with classroom teachers, and by subject teachers (music, art, etc.) who share specific content with students.

StarrMatica Effectiveness

Determining the effectiveness of any digital content learning system is a contingent undertaking, as use from classroom to classroom, teacher to teacher, and period to period will likely vary over the course of a day, week, month, and year. And instructional software has proven most effective when integrated into classroom instruction. That said, there are several data points that signify the effectiveness of StarrMatica in enriching teaching and learning, and in impacting student performance.

[41] ASCD. (2012). See footnote 39.

From a data-based perspective, a recent case study provides 3rd-, 4th-, and 5th-grade test information from a district that relied heavily on StarrMatica products and services (including professional development activities) for an entire school year[42]. Iowa Tests of Basic Skills results showed students performing well above state averages in reading and mathematics than in previous years. More specifically, 2nd-grade (pre-StarrMatica use) to 3rd-grade (with intensive StarrMatica use) performance increased over the 1-year use period by 16 percentage points in reading (proficiency level from 80% to 96% percent) and 28 percentage points in mathematics (66% at proficient to 94%).

From a teacher and administrator perspective, the systematic feedback on the use and impact of StarrMatica has been consistent and positive. Specific selected comments include:

- **Teachers.** *Since I have started using the StarrMatica reading lessons in conjunction with our reading curriculum, I have noticed an improvement in scores; Once we looked at the assessment data, it was easy to pinpoint activities to help with StarrMatica; StarrMatica has proven to be an invaluable technology resource for us that we use on a daily basis.*
- **Administrators.** *After using StarrMatica, our test scores have gone up and 100% of our 4th graders are now proficient in math on the Iowa Tests of Basic Skills; StarrMatica has improved our teachers' teaching skills in the classroom, made learning more fun for kids, and increased our test scores; We chose StarrMatica because of its user friendliness, creativity of content, how the content related to our curriculum, standards, and benchmarks, and how the content captured our students' attention.*

A third component of measuring StarrMatica's impact is surveying educators about product use and effectiveness. Currently underway, these surveys focus on improvements in teaching, learning, engagement, and performance; as well as quality issues such as ease of use, recommended improvements, training commentary, and product feedback. Taken together, these different effectiveness measures accrue to demonstrate that StarrMatica is improving teaching and learning, and is increasing student academic performance.

7. Concluding Points

This monograph has framed StarrMatica Learning Systems as a unique contributor to effective teaching and learning, and as a solution for comprehensive digital content. It has done so within the context of student performance, rigorous and aligned standards, and emerging technology. The following represent key monograph points:

The Challenge: Academic Performance

[42] Starr, E. (2011). *Pekin Community School District Case Study.* Clinton, IA: StarrMatica Learning Systems.

- The biggest challenge facing our educational system is how to increase student performance.
- Recent reports from the Nation's Report Card and from international assessments of reading, mathematics, and science have shown U.S 4th-grade students performing at lower levels of achievement than expected and desirable; with notable racial-ethnic-income disparities.

Meeting the Challenge: Rigorous Standards

- There has been heightened focus on standards - both from the state level and from a national perspective.
- The development of the Common Core Standards has focused on core conceptual understandings and procedures starting in the early grades.
- The criteria used to develop the Common Core Standards included rigorous content and knowledge applications, use of current state standards' strengths and lessons learned, informed by top-performing countries, and evidence and/or research-based.

Meeting the Challenge: Aligned Curriculum, Instruction, and Assessment

- Standards alone will not affect educational change; the actual bricks and mortar that will structure and shape our students' educational growth and achievement are strengthened curriculum, improved instruction, and tailored assessment.
- To be effective and improve teaching and learning, standards must be aligned with curriculum, instruction, and assessment.

Meeting the Challenge: Expanding Technology

- Creating a 21st-century education system requires broad and intensive use of technology, as schools cannot conceivably prepare students to participate in a global economy without making concentrated use of technology.
- Technology must be used comprehensively and purposefully to create robust education support systems for standards and assessment, curriculum and instruction, professional development and professional learning communities, and administration.

Meeting the Challenge: StarrMatica Learning Systems

- StarrMatica represents a primary solution for comprehensive, integrated, and online digital learning content.
- StarrMatica fulfills this role by offering over 5,000 reading, mathematics, science, social studies, art, and music digital content resources, which cover the entire K-6 curricula and allow educators to select resources that are best for focusing instruction and impacting performance.

- Different effectiveness measures accrue to demonstrate that StarrMatica is improving teaching and learning, and is increasing student academic performance.

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