



ACRE

Accountability and Curriculum Revision Effort
in Response to *A Framework For Change*

PUBLIC SCHOOLS OF NORTH CAROLINA State Board of Education | Department of Public Instruction

Immersive Technology: Gaming, Simulations & Virtual Environments in Education

**Report and Recommendations
to the North Carolina
State Board of Education**

**Friday Update:
July 24, 2009**

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Executive Summary

This report seeks to determine the feasibility and effectiveness of integrating immersive technology into North Carolina's schools as a statewide approach. *Immersive technologies*—computer-based games, simulations, and virtual environments— are on the forefront of innovation and may provide opportunities to improve student learning in a rigorous and relevant way.

Review of the current research suggests that immersive technology can have a positive impact on student achievement when integrated appropriately into instruction and assessment. In addition to increasing student engagement, immersive technology may also be a valuable vehicle for fostering 21st century skills. However, the committee also found that entwined in these benefits are certain challenges associated with moving the state of North Carolina in this direction. Technological challenges with infrastructure and logistical hurdles associated with implementation could require significant financial investment and resource allocation.

Research findings support the following conclusions:

- For instruction or assessment, immersive technology requires careful planning and thoughtful action to ensure that it is the right tool for the right task.
- NCDPI should focus on immersive technology's potential as an authentic assessment tool for both formative and summative use statewide. Instructional use of the tools should be encouraged at the LEA and school level.
- Undertaking systematic reforms for the use of immersive technology in instruction and assessment requires policies and practices different than fostering small-scale educational improvement.

Based on these conclusions, it is recommended that,

- NC State Board of Education continue to support and encourage local initiatives while actively pursuing additional information regarding the effectiveness and feasibility of using immersive technologies as part of a statewide assessment program.
- NCDPI should establish and maintain partnerships and collaborations in order to leverage the resources and human capital available outside NCDPI to strengthen community support and involvement and employ possible cost-cutting measures.

Immersive technology has significant potential to reach and retain students in an unprecedented way. Still, the extent of the investment recommended for the use of these new technologies has yet to be determined. Further work needs to be done to determine the resources and time that North Carolina will be able to dedicate to the integration of immersive technologies.

Purpose

The purpose of this report is to determine whether the state of North Carolina should consider supporting the use of immersive technologies, such as games, simulations, and virtual environments, on a statewide level as a tool for engaging students in authentic instruction and assessment.

The following four questions guided the committee in review of current research.

Guiding Questions:

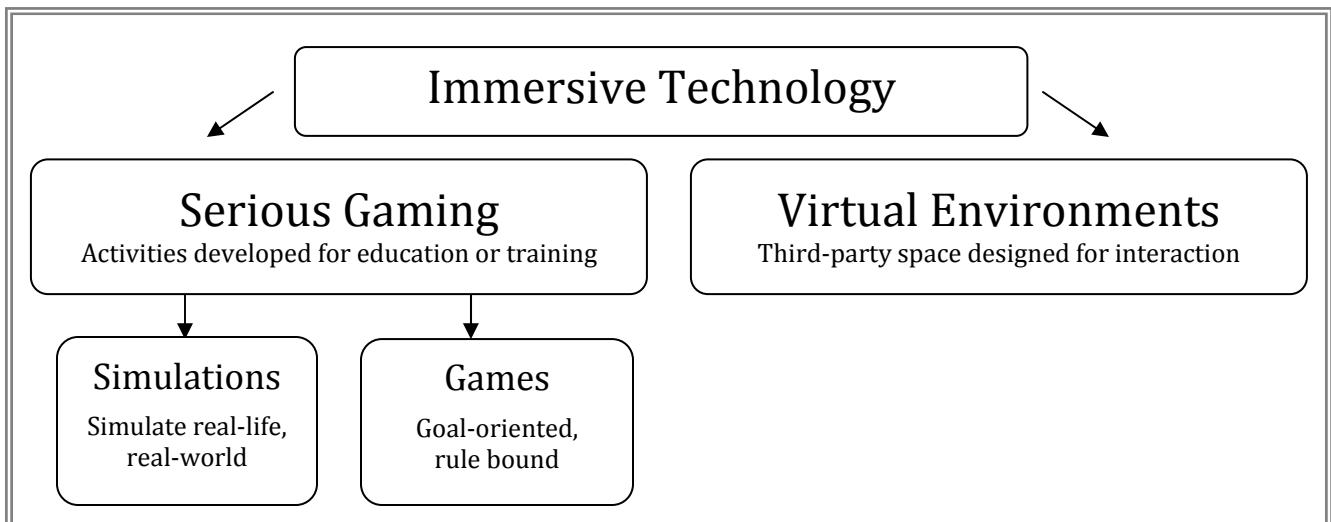
1. What is immersive technology?
2. How is it most effectively used in education?
3. What are the benefits and challenges associated with immersive technology?
4. Is it feasible to implement the use of immersive technology statewide?

Background Information

Defining Immersive Technology

Immersive technology is a broad term that refers to a range of hardware, software, and application-based programs that allow a learner to become immersed into a virtual world to provide opportunities for deeper student engagement, enhanced thought processes, and real-life application of knowledge and skills.

For the purpose of this report, the committee reviewed two types of immersive technology, serious gaming, which is further divided into games and simulations, and virtual environments.



Serious Gaming

Serious gaming refers to activities that are developed with the primary purpose of educating or training the user. Serious gaming is sub-divided into two groups, simulations and games.

- Simulations: creations of artificial worlds or situations that approximate the real one. Users are required to interact with virtual people, materials, and the environment to complete the simulated scenario. No objective is required except to complete the simulation itself.
- Games: activities that have defined rules that the user must follow in order to achieve an objective. Games are inherently competitive, either against actual opponents, the computer, or oneself.

The terms used for these two technologies are often interchangeable as it can be difficult to draw a definitive line between the two. For example, simulations are often altered to incorporate structural elements of a game, including certain rules and objectives, to increase the participant's engagement. In this case, researchers argue that despite simulating reality, the simulation is a game.

Virtual Environments

A virtual environment is a computer-based world “that allows or compels the user [or users] to have a sense of being present in an environment other than the one they are actually in, and to interact with that environment” (Schroeder, 1996). Virtual environments frequently overlap with serious gaming. Simulations and games are often imbedded within the virtual environment to increase interaction in the world. Virtual environments include a wide-spectrum of programs, from software like SimCity to distance learning applications.

Current Wide-Spread Use of Immersive Technologies

Serious gaming and virtual environments are considered highly innovative technologies; however, the use of this technology for education and training purposes is not a new idea. In the fields of medicine, aerospace, criminology and the military, immersive technologies are commonly used to help simulate real-world scenarios for practical application of knowledge and skills. The military is historically, and currently, the largest user of simulation technology. As early as 1992, the military recognized the positive impact on training and cost-benefits for using simulations over traditional instruction methods (Institute for Defense Analyses). In recent years, the use of simulations in the military has grown significantly with a new trend toward gaming as well (Selby, 2008).

Dispelling Immersive Technology Myths

The committee determined that a few misconceptions about immersive technology's purpose, design and use in education exist. The misunderstandings are likely due to the relative new nature of using immersive technology for instruction and assessment.

Myth: Immersive technology is a replacement for direct instruction.

Experts in the field continue to emphasize the importance of viewing technology as a tool, not a teacher. Those who support integrating immersive technology into the classroom recognize the power immersive technologies can have on student learning but note that,

what they will *not* do is replace the need for human teachers, tutors and counselors who can provide expert instruction, provide inspiration, encouragement and discipline, and serve as exemplars of the kinds of expertise a learner can aspire to achieve (The Learning Federation, 2002).

Myth: Immersive technology is just “fun” and games.

In the classroom, immersive technology is used for the primary purpose of educating or training, not entertaining. Student engagement with immersive technology is meant to further instructional objectives, not negate or override learning. If used appropriately, immersive technology is a tool to enhance learning, while making it enjoyable.

Myth: Immersive technology is a silver bullet for student engagement and learning

Researchers who study the integration of immersive technology into the classroom advise educators not to over-assume the capabilities of serious gaming and virtual environments. Richard N. Van Eck (2009) explains,

game-based learning isn't going to work for everyone, it's not going to work all the time, and it's not going to work for all your needs...It's just one tool in your [the teacher's] toolbox that goes along with all the other tools that you have.

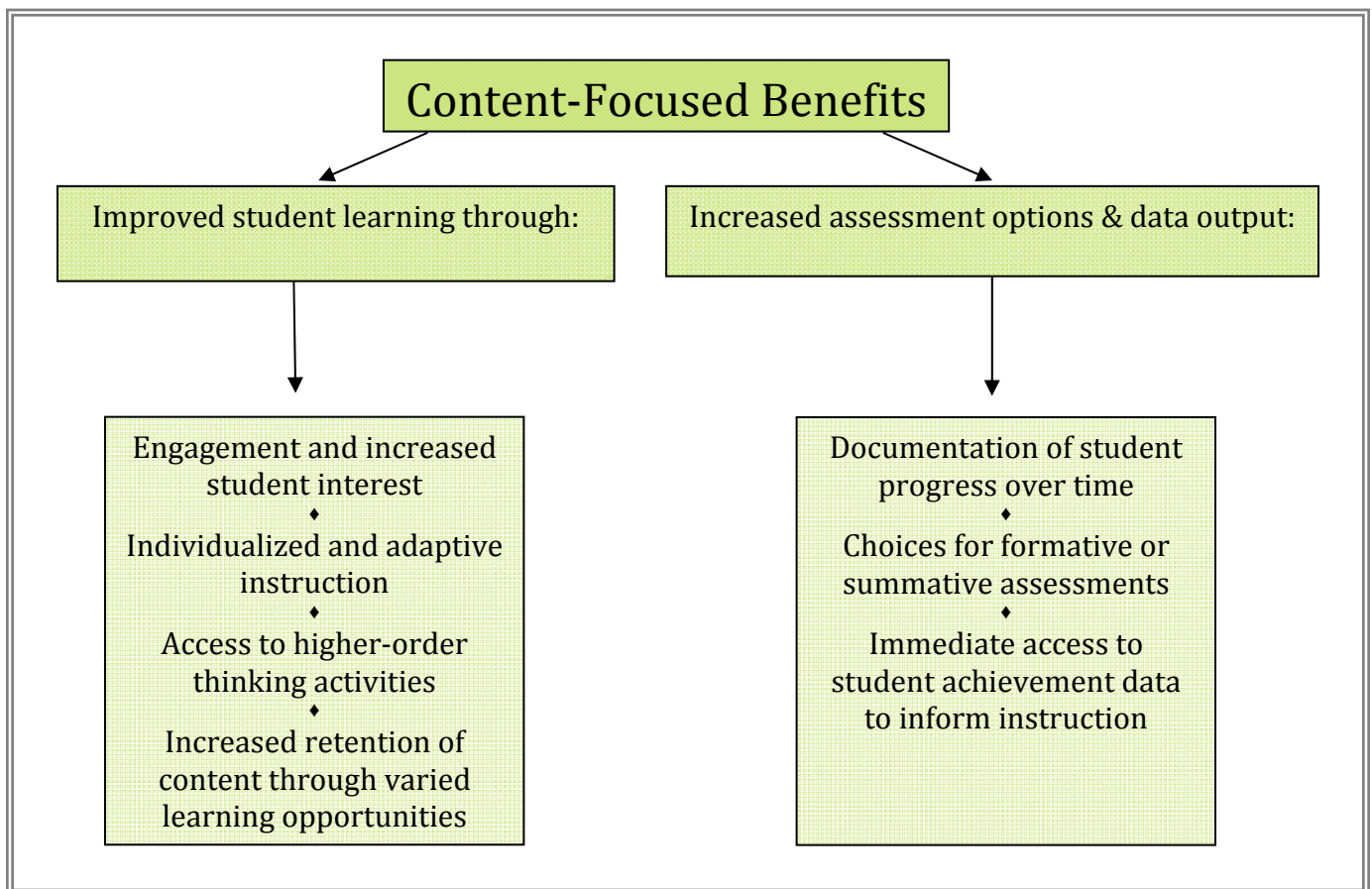
Research Supported Benefits for the Use of Immersive Technology

The use of immersive technology in instruction and assessment has the capability to dramatically improve student learning. Research indicates that in technology-rich classrooms, students are more engaged, assume the roles of more active learners, and show increased achievement (Noeth & Volkov, 2004).

The benefits of using immersive technology fall into two primary categories: content-focused and skill-centered benefits.

Content-Focused Benefits: Impact on Learning

Content-focused benefits include the academic advantages of using immersive technology during instruction and assessment. Trends in research suggest that a major advantage of using immersive technology during instruction is the increase in student engagement. This increase in engagement correlates with a positive impact on students' attitudes toward learning and their own self-concept (Silvin-Kachala & Bialo, 2000). Additional benefits to instruction and assessment are outlined below:

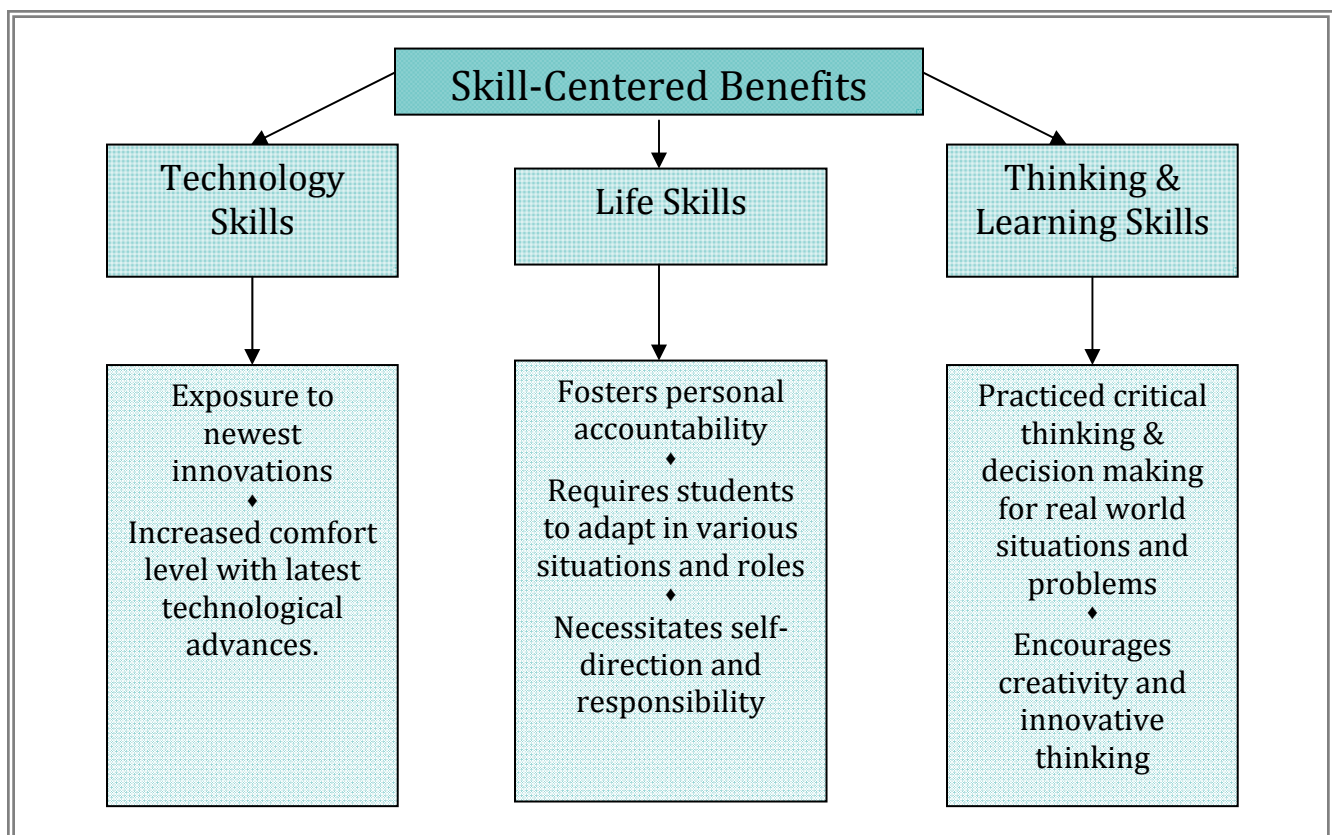


Rigor, Relevance, and Relationship Framework

The approach toward learning embedded within the use of immersive technology ensures that a student's experience with immersive technology is both highly rigorous and highly relevant. When used for instruction and assessment, immersive technology is multidisciplinary in nature and emphasizes an application-based approach to learning. The *Rigor and Relevance Framework*, developed by Daggett (1991), suggests that immersive technology activities can increase understanding and retention of content by requiring students to use higher-order thinking and application skills in a meaningful interaction.¹ Of course, neither rigor nor relevance can be achieved in isolation; as with any tool, the key to successful implementation depends on the relationships established within the school.

Skill-Centered Benefits: Impact on the Student

Immersive technology could be a valuable vehicle for explicitly and indirectly fostering 21st century skills in North Carolina students. Skill-centered benefits include the necessary tools and experiences that a student will need to take away from a learning exercise in order to be globally competitive in the 21st century. The potential influences of immersive technology on a student's development of 21st century skills are outlined below.



¹ A more detailed explanation of the *Rigor & Relevance* model and how immersive technology fits into the framework can be found in Appendix A.

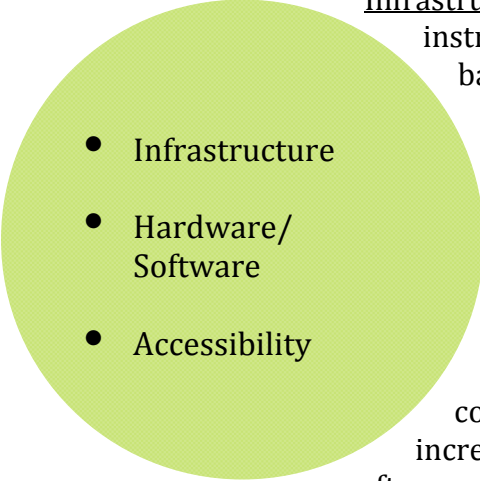
Challenges

The NC Department of Public Instruction (NCDPI) would need to overcome several hurdles in order for immersive technology to be implemented effectively statewide. Research demonstrates a positive impact on student learning and engagement with the use of immersive technology based primarily on small-scale pilots where pockets of innovation exist, mainly in a single classroom, a school or in rare instances, a district. With the gains possible using immersive technology, the committee sought information about what it might take to scale-up these innovations in teaching and assessment for implementation in a district or statewide.

The committee determined that there were three categories of challenges the state would face in scaling-up the use of immersive technology in North Carolina; technological challenges, professional challenges, and financial challenges.

Technological Challenges

The innovative nature of immersive technology requires a level of infrastructure, hardware and software, and accessibility rights that may not exist in most LEAs throughout North Carolina.

- 
- Infrastructure
 - Hardware/
Software
 - Accessibility

Infrastructure In order to incorporate immersive technology into instruction and assessment, North Carolina will need to increase bandwidth capability across the state. The current system in NC is not equipped to handle wide-reaching implementation of immersive technology. NCDPI will also need to support districts in improving their own server capacity and the schools in their network capability.

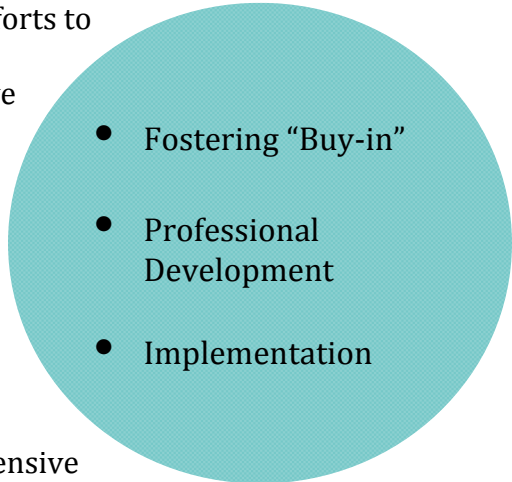
Hardware/Software The quantity of computers needed is estimated to be much larger than North Carolina's current student-to-computer ratio. The state will need to invest in computers that have high-level system requirements including increased processing speed and additional memory. In terms of software, the state will need to purchase, create or identify high-quality and well-developed immersive technology programs and applications that are aligned with the *North Carolina Standard Course of Study*.

Accessibility Currently, many LEAs have firewalls and network restrictions that prohibit schools from accessing web-based immersive technologies. NCDPI will need to work with LEAs to reconfigure these filters to allow access to online content, while addressing challenges related to security, privacy, and student safety.

Professional Challenges

In addition to addressing the technology related challenges, the state will need to invest significant resources into professional development, training, and the comprehensive roll-out of the statewide effort.

Fostering Buy-in DPI will need to pursue wide-ranging efforts to help teachers see the value of incorporating immersive technology into their classrooms. Integration of immersive technology into instruction will require many teachers to reframe their current perspective on traditional teaching and learning. Most teachers are unfamiliar with the use of these new technologies and may be uncomfortable devoting instructional and personal time to its use in their classrooms.

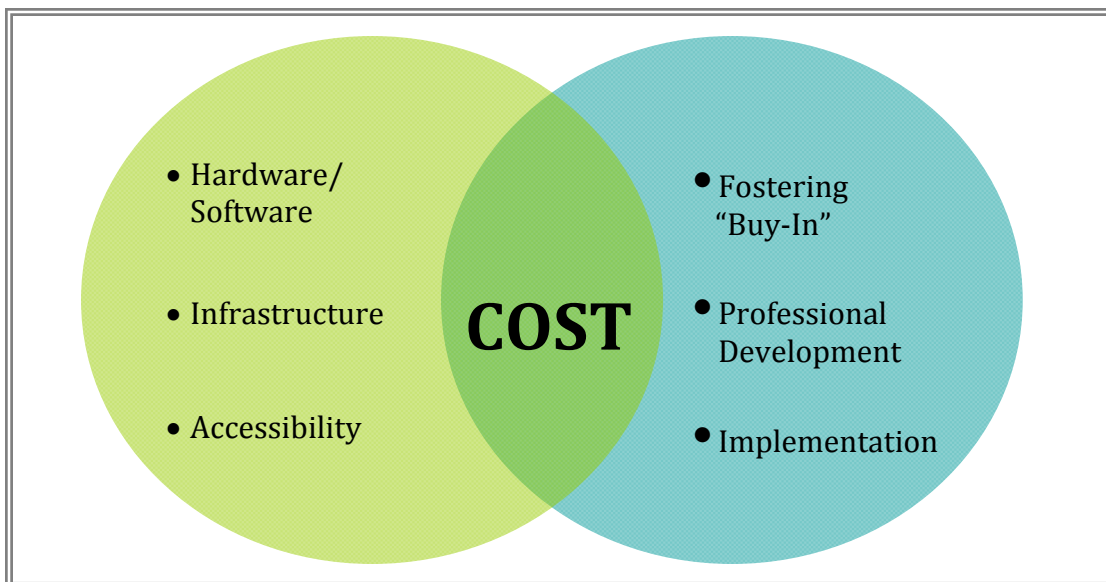


Professional Development Once teachers see the value of using immersive technology, additional training will be required. Prior to implementation, teachers will need extensive professional development on the technology itself and then subsequent, sustained training on integrating its use into effective instruction.

Implementation The implementation of a statewide effort to use immersive technology will take significant time and resources to coordinate. DPI would need to develop a timeline for roll-out across the state keeping in mind certain challenges, including technology requirements, equality throughout the LEAs, establishment of accountability measures, and maintaining innovation over time.

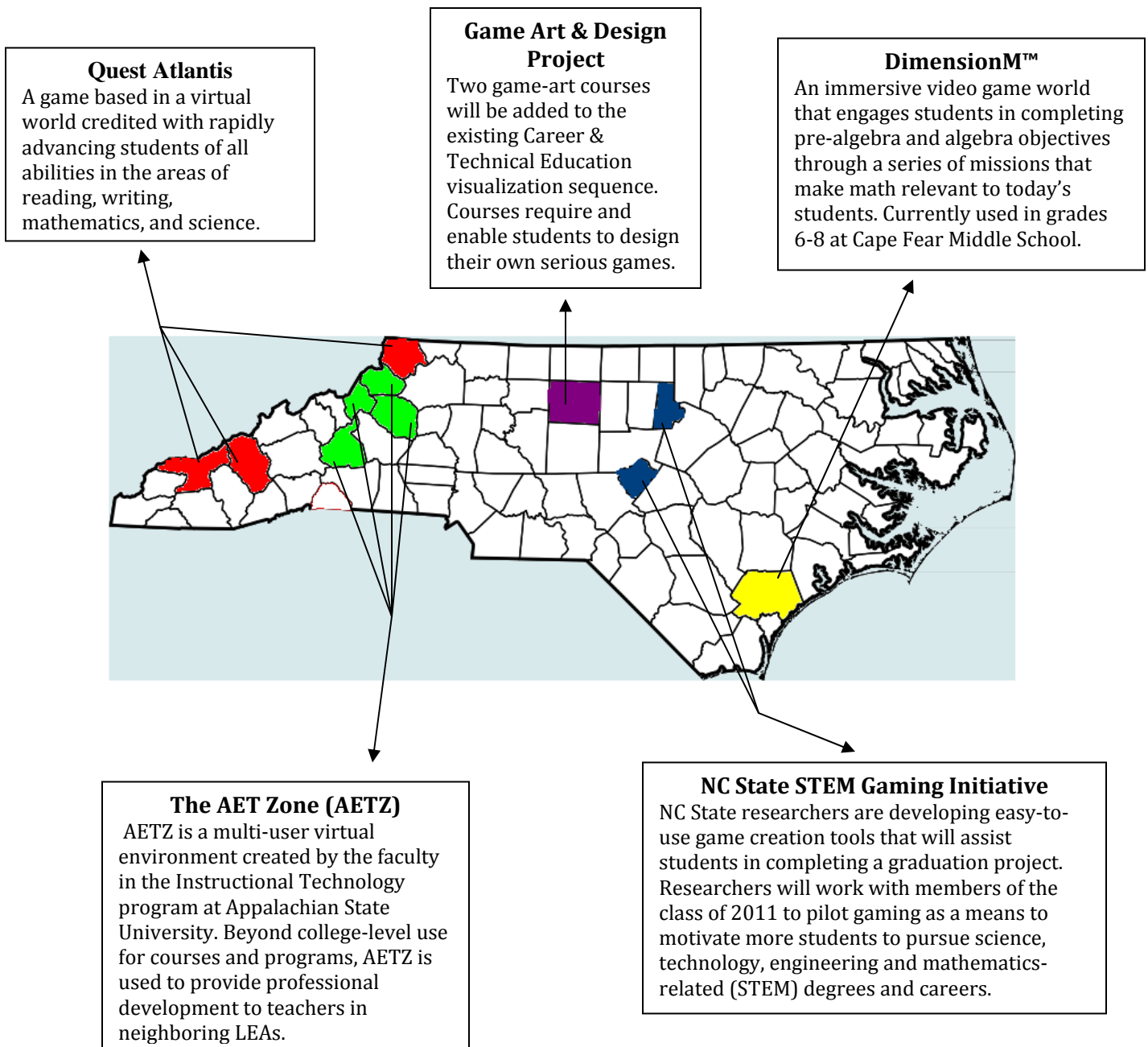
Financial Challenges

In order to roll out a statewide initiative using innovative assessment, NCDPI will need to secure significant financial resources to address the challenges listed above. The states’ ability to access funding for the initiative will determine the feasibility of implementation and the subsequent extent and timeline for roll-out.



North Carolina's Islands of Innovation

North Carolina hosts a variety of "islands of innovation," where districts or schools effectively implement immersive technology for instruction and assessment purposes (Dede, 1999). These local initiatives help highlight benefits of using immersive technology and also suggest potential partnerships, model districts, and possible starting points for a statewide program. Below are just a few examples of immersive technology used in North Carolina.



The National Scene: Scaling Up

Several states have begun statewide initiatives to use immersive technology for instruction and assessment. Examples of states' efforts are highlighted below.

National Trends in Instructional Use of Immersive Technology

Instructional use of immersive technology is implemented to a greater degree at local levels than as state-sponsored initiatives. States have, however, emphasized the value of using immersive technology as an instructional delivery method with their promotion of virtual schools and distance learning programs.

- Florida, Georgia, North Carolina, and Michigan have implemented state-led online education programs. Twenty-nine states in all have established some type of school using virtual environments.
- Nevada has partnered with an educational software development company to provide standards-aligned serious games for math and science content.

National Trends in the Use of Immersive Technology for Assessment

State sponsored use of immersive technology is primarily targeted toward its use as an authentic assessment tool. Nationally, simulation-based science assessments are the furthest along in development and implementation (NCDPI & CCSSO, 2009).

- The National Assessment of Educational Progress (NAEP) will implement some simulation-based assessment items with the 2010 8th and 12th grade science exams.
- Beginning in the 2008-09 school year, Minnesota began full implementation of summative, simulation-based assessments for the 5th, 8th, and 10th grade science.
- Nevada is the lead state on a 2007 Enhanced Assessment Grant (EAG) from the U.S. Department of Education (USED) to study the use of simulation-based science assessments for formative, benchmark, and summative assessments.
- In a national survey of state test directors in May 2009, the Council of Chief State School Officers (CCSSO) at the request of NCDPI, found that 43% of the 28 responding states were interested in exploring the potential use of immersive technology as an assessment tool.

North Carolina's National Involvement

As part of Nevada's 2007 EAG grant award, four states, including North Carolina, have agreed to pilot simulation-based science assessments during the 2009-10 school year. The assessments use media rich environments, interactive simulations of phenomena, a variety of response formats, and provide several accommodations for students with disabilities and English language learners. In North Carolina, approximately 30 middle school teachers will pilot the assessments. Assessments will be piloted as formative and benchmark tests (S. McManus, personal communication, June 29, 2009).

Conclusions

Immersive technology has significant potential to reach and retain students in an unprecedented way. Still, the extent of the investment recommended for the use of these new technologies has yet to be determined. Further work needs to be done to determine the resources and time that North Carolina will be able to dedicate to the integration of immersive technologies.

Choosing the Right Tool for the Right Task

For instruction or assessment, immersive technology requires careful planning and thoughtful action to ensure that it is the right tool for the right task. As with any other instructional resource, the teacher is the key determining factor in the effective implementation of immersive technology into the curriculum. Immersive technology will not work in every situation, nor will it work for every student. The teacher's ability to integrate serious gaming and virtual environments effectively into instruction will determine the true impact immersive technology has on student learning.

Statewide Use for Assessment, Not Instruction

Innovative use of immersive technology in instruction is already occurring within North Carolina at the school/LEA level, and decisions about its future use as an instructional tool may be better left in local hands. Nationally, state sponsored initiatives with immersive technology focus heavily on its use for assessment. For assessment purposes, immersive technologies, particularly simulation-based programs, are a growing trend in the movement for authentic assessments that offer a viable alternative to the traditional paper and pencil method of assessment.

Challenges Inherent in Scaling Up

Moving toward a statewide program that uses immersive technology as a key component has challenges different from those related to implementing local initiatives with a similar focus. Among the most significant challenges are technological barriers, the extent of professional development required, and finally, the cost of funding each piece of the project. These challenges will need to be carefully considered and must be addressed prior to implementing a large-scale immersive technology program.

Recommendations

Based on the initial research detailed in this report, the committee recommends that the North Carolina's State Board of Education should:

Continue to support and encourage local initiatives while actively pursuing additional information regarding the effectiveness and feasibility of using immersive technologies as part of a statewide assessment program.

Guiding questions for continued research should include:

- How is immersive technology best used for assessment: formative, benchmark, summative, or a combination?
- What are the suggested timelines and resources needed for effective implementation?

Establish and maintain partnerships and collaborations in order to leverage the resources and human capital available outside NCDPI to strengthen community support and involvement and employ possible cost-cutting measures.

Relationships with the following groups should be actively pursued:

- LEAs
- Institutions of higher education
- Businesses, particularly the gaming industry
- Microelectronics Center of North Carolina (MCNC)

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Appendices

Appendix A: Rigor & Relevance Framework

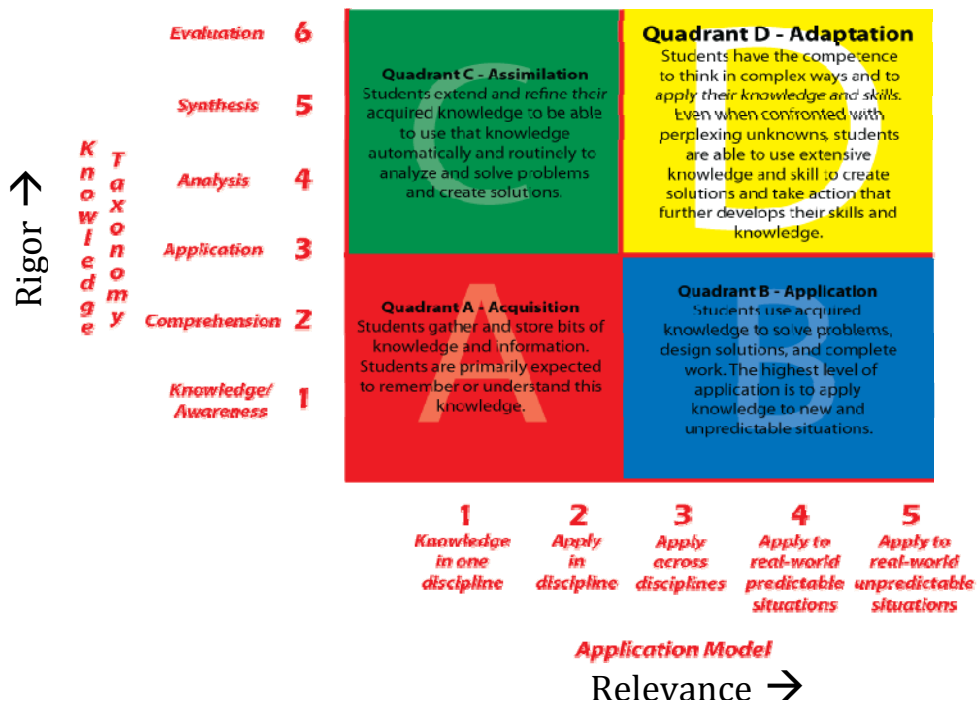
The *Rigor & Relevance Framework* was a guiding principle in the committee’s evaluation of the teaching and assessment methods that use immersive technology.

Rigor

When instruction is academically rigorous, students actively explore, research, and solve complex problems to develop a deep understanding of core academic principles.

Relevance

When content is presented in a way that allows students to relate that information to real-world experiences it strengthens their grasp of the knowledge and allows for greater retention of material taught. In addressing relevance, students are more engaged because they see purpose in learning.



Application with Instructional use of Immersive Technology

Many activities using immersive technology will regularly fall in Quadrant D on the framework, which emphasizes the highest level of thinking and transfer of information. When used for instruction and assessment, immersive technology is multidisciplinary in nature and emphasizes an application-based approach to learning. This attitude toward knowledge ensures that using immersive technology in an educational setting is both *highly rigorous* and *highly relevant*.

Appendix B: Report Contributors

DPI would like to acknowledge those who researched and wrote this report. Thanks to the following members of the Innovative Assessment Research Team (IART).

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In addition, a special thanks to Meagan Staffiere, intern for Policy & Strategic Planning, for compiling and editing, verifying facts, developing graphics, and ensuring the publication of the report in an extremely brief timeframe.

Appendix C: Research Timeline

| Date | Meeting & Outcomes |
|---------------|--|
| January 2009 | IART Committee convened. IART Committee goal established: to investigate alternative ways to assess learning that leads to better assessment data or allows teachers to use data to guide and adapt instruction. Sub-committees are established. |
| February 2009 | IART Sub Committee 5: Immersive Technologies meets. Determined objective of sub-committee's investigation: to research the use of simulations, gaming, and virtual environments in the area of assessment. Timeline established and research tasks assigned to members. |
| March 2009 | IART sub-committee five meeting convened. Review of collected research. |
| April 2009 | IART sub-committee five meeting convened. Review of collected research. |
| June 2009 | IART sub-committee five meeting convened to review Draft 1.0 of SBE Report |

| Date | Interviews & Professional Development completed by committee |
|---------------|---|
| January 2009 | Tour of Virtual Heroes, Inc & interview with CEO Edweek Webinar - Computerized Testing: Adapting Assessments to 21 st century Learners |
| February 2009 | Interview with Dr. Raymond Yeagley of Northwest Evaluation Association NC Virtual Public School Second Life Meet and Greet CTE Gaming Course Development. Presentation by Thom Shown of NCDPI Evaluating Indicators of Learning in K-20 Game-Based Science. Presentation by Dr. Len Annetta of NCSU. |
| March 2009 | Second Life Training at NCDPI State of the Arts Conference, Gaming presentation by Jack Lew. |
| April 2009 | Presentation of ECU Virtual Early College High School Pilot Program |