

The Potential for Game-based Learning to Improve Outcomes for Nontraditional Students

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1. EXECUTIVE SUMMARY

This research project started with the goal of investigating how game-based learning can help improve outcomes for nontraditional students in higher education. To investigate the question, we conducted focus groups and an online survey with nontraditional students, and we interviewed school leaders and educators at community colleges and four-year institutions that serve them.

In the focus groups, we met students who are dedicated and hardworking, but also must balance school with work and family, making them vulnerable; one family emergency can knock them off track. We found that nontraditional students are taking more online classes than other students, with those working more than 30 hours taking the most. They appreciated the flexibility that online courses provide, but worried that they might not be developing the skills they would really need for jobs and certifications. They also asked for apps that fit their lives, work on their devices, make good use of their time, and could give them great feedback even at two in the morning.

There is a clear opportunity to help these students through improved digital materials, and game-based learning can be an important tool in this work. Research and meta-studies we reviewed support its effectiveness when design best practices are used. In our interviews, educators suggested many specific applications, which are detailed in this report. Five that stood out are:

1. **Auto-assessing whether students can apply what they have learned**
2. **Building employment skills in real-world contexts**
3. **Providing safe environments where students can learn through trial and error**
4. **Developing and assessing critical thinking skills**
5. **Study-strategy and student-success skills**

However, our interviews with Higher Education leaders (and our own experience) also show clearly that there are hurdles: Issues of cost, curriculum fit, usability, and control have limited the use and impact of game-based approaches. Most Game-Based Learning projects to date have been high-cost custom-development projects that many schools simply cannot afford. Upkeep is also expensive, as the development studio usually must be brought back to make changes. To explore ways to clear these and other hurdles, we developed concepts and prototypes and reviewed our work with educators and school leaders. This work yielded several promising directions:

- **Make game-based learning authorable and inexpensive, rather than custom-built and high-cost.** Enabling educators to author and maintain game-based learning resources can greatly reduce initial and ongoing costs. It also will tap into teachers' creativity, and enable instructional designers and others to build game-based learning to meet needs of specific student population, and to fit with their systems. We believe authoring will unlock tremendous growth in the field.
- **Fit flexibly into existing curriculums and students' lives.** Educators did not ask for big, disruptive game-based courses. They were looking for ways to meet students' needs, and saw many places where shorter, more flexible "learning moments" could help - IF they were easy for students and faculty to start and use.
- **Work intuitively on all devices, including phones.** Digital materials need to work everywhere, and students increasingly like to be able to study on their phones as screens get larger – especially if they can use engaging activities or games that they can pick up for a few minutes at a time.

This research suggests that game-based learning activities that address these hurdles and focus on clear student needs have the potential to impact nontraditional students today. Taking inspiration from these results, Muzzy Lane has made a strategic shift: We are creating a cloud-based authoring service that gives educators the power to develop and deploy dynamic game-based content. We look forward to seeing what educators create with the authoring tools, and working with them to meet the needs of students.

2. Introduction

Can game-based learning help nontraditional students?

Digital games have unique qualities that educators have drawn on for years to create successful active learning experiences for schools, the military, healthcare, business, and other areas. Research, though still limited, has shown the promise of game-based learning, and there have been successful implementations in many areas.

We began this research project with a question: Could game-based learning help nontraditional students, and more specifically, could full game-based courses improve outcomes? We started with a series of interviews with educators and school leaders, and what we heard from these experts was something different: They were not looking for “game-based courses”. It was not a priority.

What they were focused on was helping their students succeed. When they talked to us about specific ideas to meet students’ needs, they saw many ways in which game principles and mechanics could help them – if they could be affordable, flexible and fit into instructors’ workflow and students’ lives.



Flexible GBL modules can be used where they add value to a curriculum

They identified over a dozen areas where game-based activities could address needs now, and the list has grown over the course of the research. Five unmet needs consistently stood out as opportunities to really help students:

1. Auto-assessing whether students can apply what they have learned: While good digital options exist to help students develop knowledge and comprehension, educators are looking for engaging, scalable ways for students to apply what they are learning in ways that can be assessed at scale. Game-based approaches can help, providing mechanics where students can practice skills ranging from using language in a foreign country to carrying out a technical process to applying formulas. As students’ practice, a game can track their performance, providing them with useful feedback and teachers with information for assessment.

“You’re more likely to be able to transfer a skill to another real-world context if you learned it in a real-world context.”

- Mary Ann Perry, College for America

2. Building employment skills and competencies: Many nontraditional students are pursuing degrees and certifications in areas like healthcare, business and technology where they need to develop employment skills along with classroom learning. From professionalism to specific job skills, there are many places where learning-by-doing in a game scenario will be a powerful way for students to practice and prove their skills in real-world contexts.

“If you don’t get deliberate practice with good feedback, you’re not going to create a cycle of understanding what it takes to learn.”

- Karen Vignare, PhD, Vice Provost, Center for Innovation in Learning & Student Success, University of Maryland University College

3. Building academic skills in a positive way: For nontraditional students who start college sensitized to academic failure from difficult high-school experiences, the opportunity to build skills safely can be a lifesaver. With game-based learning, students can test and build their skills in a safe environment where “failing” is seen as a chance to level up and improve.

“Playing, practicing and making mistakes without fear of failing empowers students. They begin to believe in themselves, and maybe for the first time, they experience hope.”

– Dr. William Hoover, Bunker Hill Community College

4. Developing and assessing critical thinking skills: Educators are looking for ways to engage students in developing critical thinking and other 21st Century skills, and they especially need scalable methods to assess these skills for online and hybrid courses. Game-based approaches can present students with complex problems, and ask them to analyze information, strategize, defend decisions and adjust to consequences. These are all important parts of critical thinking practice.

“Nearly all those surveyed (93%) agree, “a candidate’s demonstrated capacity to think critically, communicate clearly, and solve complex problems is more important than their undergraduate major.”

-AAC&U Survey of survey on employer priorities for student success¹

5. Study strategy and student success skills: Many skills are required to successfully navigate the academic experience, and these are skills that nontraditional students may lack. Educators are asking for tools where students can build study-strategy skills, choose the right program, develop a growth mindset, and learn to manage their time. Game-based modules can provide engaging, effective experiences that students may be more likely to use than other materials.

In addition to expert interviews, we conducted focus groups and surveys with nontraditional students, to learn more about their lives and needs. The students we talked with were dedicated and optimistic, but also stretched thin as they balanced full work schedules, course loads, and family responsibilities. Data from our survey bears this out: 81% of the over-25 students are working, with 52% working more than 30 hours, and more than half have children to care for.

¹ It Takes More than a Major: Employer Priorities for College Learning and Student Success. 2013. Washington, DC: Association of American Colleges and Universities and Hart Research Associates.

"I have 2 jobs, I help run my cousin's company about 40 hours, and I bartend 12 hour shifts on the weekend. The plan is eventually get to my doctorate, but it's kind of a ten-year plan."

– Mark, *Returning student in Psychology*

Students are looking for faster ways to get credentials and build the skills they'll need to get new jobs. Many need online classes that fit their schedules, but they expressed worries that they might not be getting the skills they really need. The chance to practice skills via game-based modules can help, especially if the modules are flexible to use when students need them, on any device, with no learning curve.

"You are not going to learn the stuff you need to survive in nursing school in (her school's) online classes. The classes don't have enough challenge. A lab practical needs to have practice in it."

– Marie, *Community College Pre-Nursing student*

Revising how we think about game-based learning

Based on what we found, we felt we needed to look at the question differently. Instead of treating game-based learning as a general approach to apply to whole courses, we focused on specific unmet needs where the application of game mechanics could help students. We also explored approaches that addressed the issues of cost, flexibility, and workflow fit that have blocked many educators from adopting game-based solutions. To pursue this direction, we made several key changes to the research plan:

1. Instead of working toward a full game-enabled course, we would focus on **modular, flexible GBL experiences** that could address specific needs or gaps identified by educators, fit into curriculums more readily, and be scalable and authorable.
2. **We prioritized authoring capabilities** and focused on prototyping technology, templates and tools to enable educators to author the game-based prototypes we envisioned.

The results of the research and prototyping work have been very encouraging. We have been able to show the feasibility of cloud-based authoring of game-based learning activities and assessments. The early responses to the prototypes have been very favorable. Based on the insights from the research and feedback from the prototypes, we made the decision to focus the company on an authoring-based approach, and we are now working with partners who are authoring game-based learning activities to instruct and assess their students.

3. What Do Nontraditional Students Need?

We conducted focus groups and surveys of nontraditional students, with the aim of better understanding the students' learning journeys. How do they study and balance work and family? What challenges do

they face and what strategies and tools do they find helpful? This work has provided insight into where and how game-based approaches can be helpful to them.

Research with nontraditional students

Student Focus Groups

We conducted 11 in-person focus groups with nontraditional students in the New England area, working with a range of students from several different types of schools:

- **Northern Essex Community College:** a regional community college serving the diverse city of Lawrence and surrounding communities.
- **Bunker Hill Community College:** A large urban community college in Boston.
- **Becker Center for Accelerated and Professional Studies:** A center for adult learners serving the city of Worcester, MA and surrounding areas.
- **Endicott College Boston:** A program focused on supporting both younger and older nontraditional students from diverse cultural backgrounds.

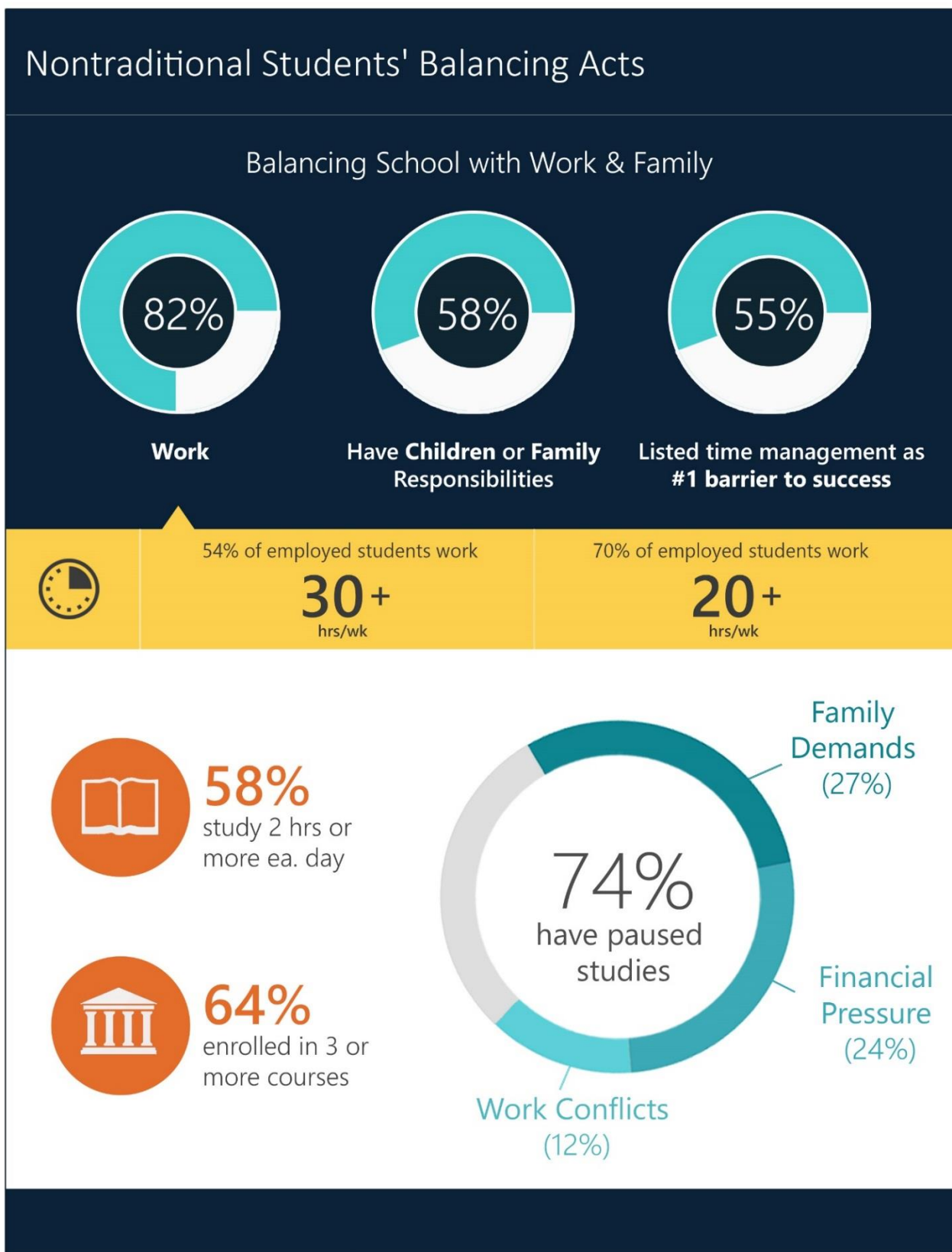
Survey of nontraditional students

We also conducted a student survey with 1,700 students, from over twenty different schools that serve nontraditional students across the country. The schools included community colleges, universities, and more specialized programs, and generally offered classroom, hybrid, and online course options.

How we defined “nontraditional”

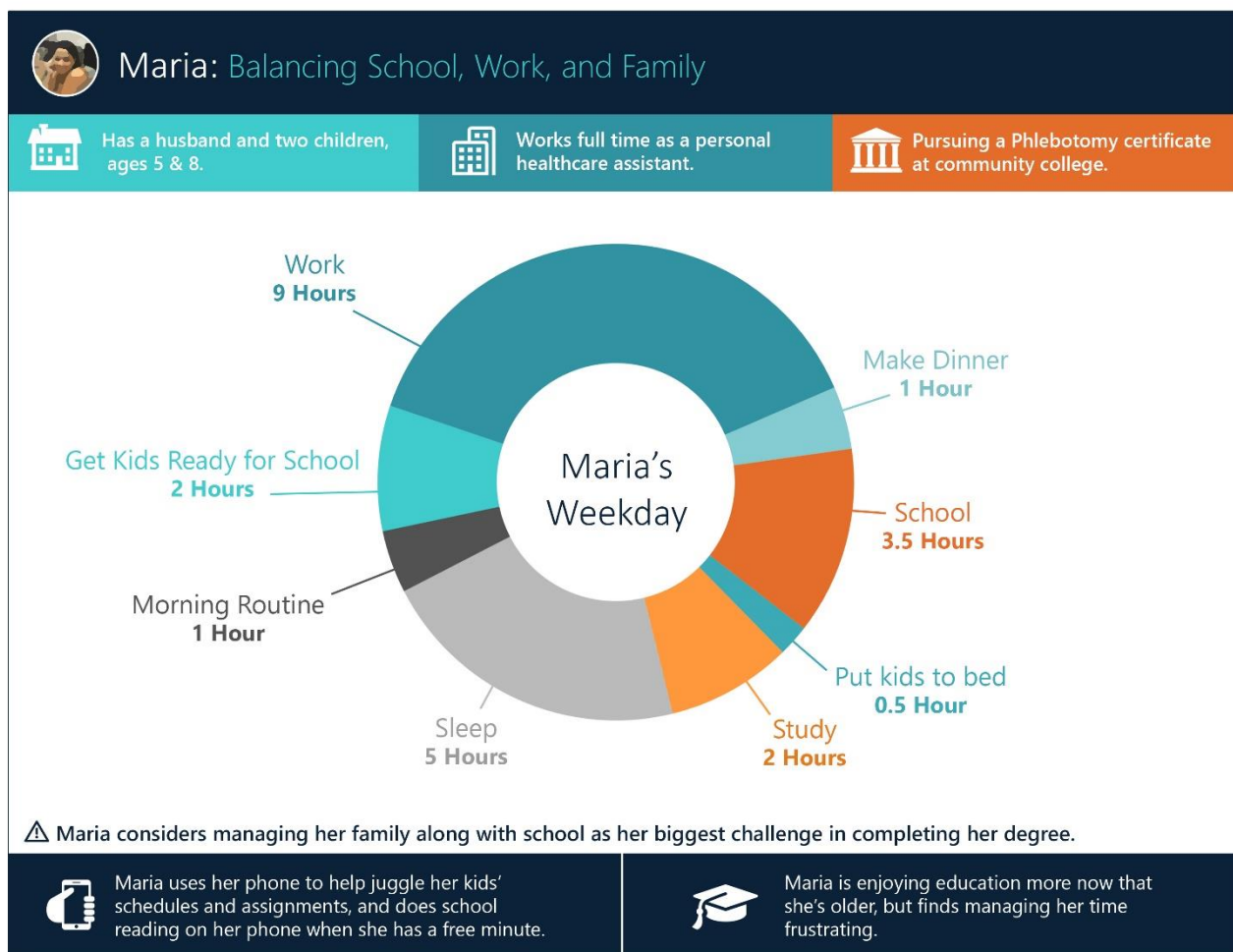
For this research, we defined nontraditional students as students who may be (a) returning to school after pausing their education; (b) working and balancing family and parenting responsibilities while going to school; (c) lower income; (d) English as a second language learners, and (e) the first members of their families to attend college. For our focus groups and surveys, we looked for students that met at least two of these criteria.

Insights from the research into students' journeys



Time is the #1 hurdle

Most of the nontraditional students we talked to work hard, juggling work, school, family and everything else, resulting in a packed schedule every day of the week. Of the over-25 students we surveyed, 81% are working, with 52% working more than 30 hours. In addition, more than half have children and families to care for. While these students are more likely to be going to school part-time (stretching out the time it will take to get their degree) they are still putting in a lot of time on schoolwork: 58% study more than two hours a day.



Time and school management skills are critical

With so much to juggle, time management and organization skills are critical. The successful students we spoke to used detailed schedules and other strategies, but still found it hard to keep on track. And teachers and student-support counsellors report that most students do not arrive with these skills.

"I didn't really go to high school, I stopped in 6th grade, then I got my GED. Now, it's been hard finding time to study as I'm not used to it, I have my seven-year-old daughter, I'm working as a waiter 30 hours, and taking 3 classes."

-Jenifer, Community College Medical Assisting student

The skills go beyond putting an assignment due date in a calendar. Students need to know how to get started early, how to allow extra time for revisions, and they also need to understand the relative importance of different assignments to their grades and success.

Caring for others, carving out time for their own futures

For many of the students we talked to, returning to school means carving out time to work on their own future as part of a life focused on caring for others. Many paused their education because children were born, or to care for a family member who needed it. Over half of the students we surveyed were women, and many of them are working in healthcare or other caregiving jobs while going to school. In the focus groups we met home-care attendants, disability counselors, night orderlies, and pre-school teachers among others. These students can get behind when they plan to get schoolwork done while they are with children or others they care for, and the caregiving takes precedence as it often does.

“I have to fit my studying in very specific times, because I’m taking care of my mother, who’s disabled, and my husband has diabetes too. My daughter, who’s seventeen, helps too some, but I got to take care of her too. If they need me, I’ve got to do that first, and school just has to fit in.”

- Liza, Community College student

Dedicated and optimistic, looking to pivot their lives, and vulnerable

Most of the students we met believed strongly in themselves and their ability to persevere and succeed. While 72% were trying again after having paused their education, 78% say they are likely or extremely likely to continue if they have to pause again. (Note: Our survey and focus groups were with enrolled students, so we did not talk to students who had left and not returned.) These students are largely returning to school to make a big change in their lives: The largest group listed “degree required to change jobs” as their main motivation. Often they were working in one field, while studying for credentials in another.

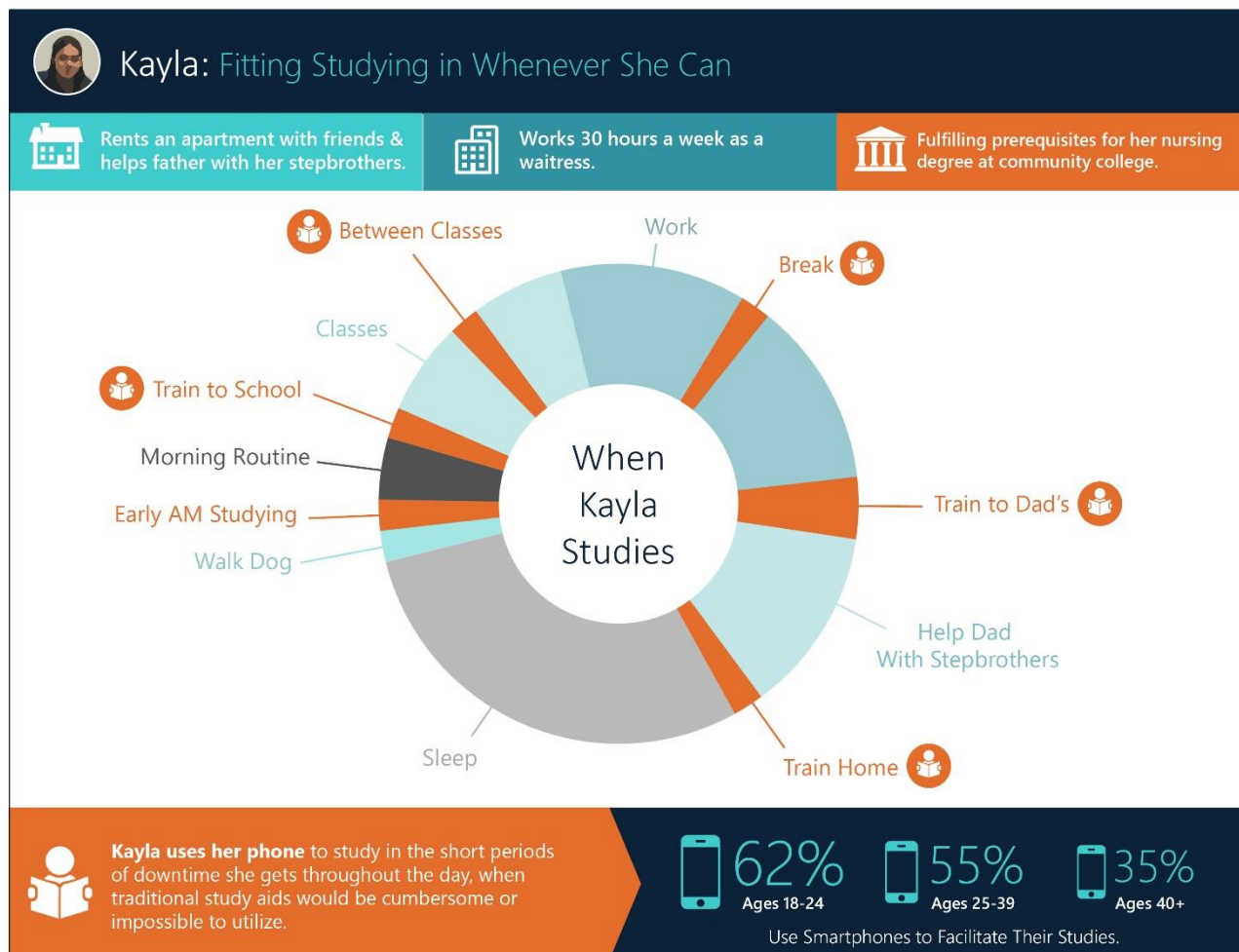
But with no slack in their schedules, and responsibilities for children and family, these students are at risk even with their drive and optimism. One health issue that causes them to miss work or classes can put them behind, and many may not know how to deal with the situation – how to talk to teachers, how to get caught up.

“Students come in without a clear idea of what it will take to balance classes and a job. They tend to over-commit and sometimes crash when work ramps up.”

- Lucy Snow, Instructor in Art, Los Medanos Community College

How nontraditional students fit studying into their lives

With complex days that include work shifts, picking up and caring for children, and travelling between work, school, home and family, students need to fit studying in wherever they can.



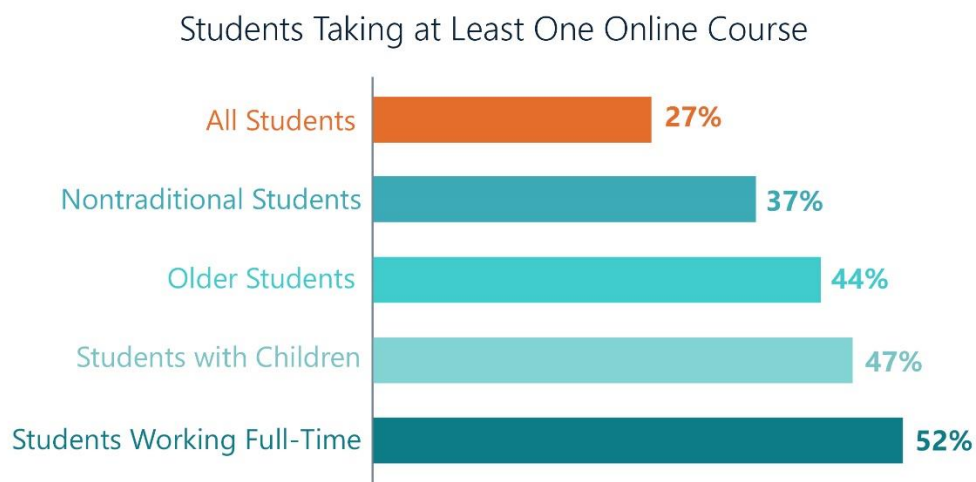
"I'd definitely do some studying on my work breaks. Especially if I had something I could pick up and get into on my phone and do for ten minutes."

- Vanesa, Community College student

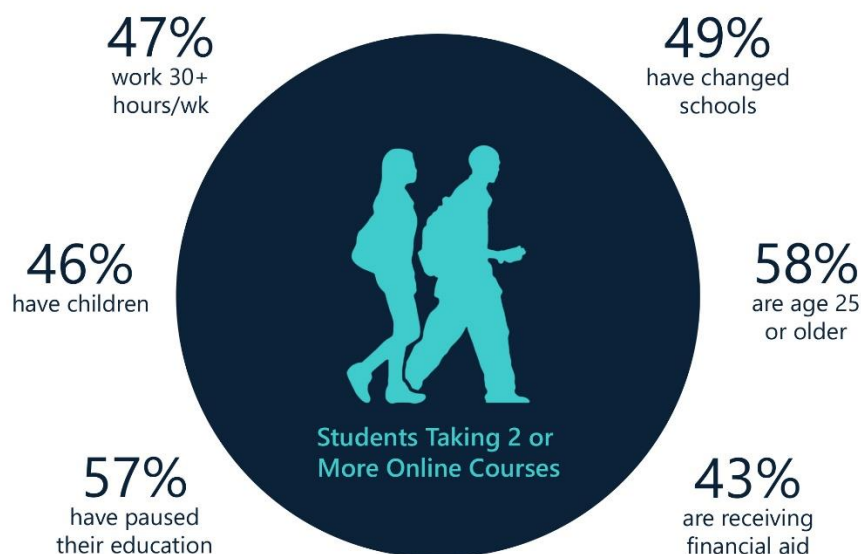
Many students told us that they used (or would like to have) study activities they could use on their phones while commuting, waiting for kids, or in work breaks. Students report using unassigned resources like Google search results and YouTube because they can get to them quickly on the fly, and they said they usually would ignore resources that require any startup time.

To help these students, materials need to work across mobile devices, be flexible so they can be used when students have a few minutes, and make good use of students' time. Students typically get larger blocks of time late at night after their long days, and tell us they appreciate materials that are engaging and help them stay focused. They also would like tools to give them quick feedback and help them when they get stuck, so they can keep making progress even at 2 in the morning.

Nontraditional Students in Online Classes



Sources ■ DOE IPEDS Survey, 2014 ■ Muzzy Lane Nontraditional Student Survey, 2015



Nontraditional students in online and hybrid courses

The Department of Education reported in their 2014 IPEDS survey that 27.1% of Higher Ed students were taking at least one online (distance education) course, with 12.5% enrolled exclusively in online courses.²

² U.S. Department of Education, National Center for Education Statistics. (2014). Enrollment in Distance Education Courses, by State: Fall 2012 (NCES 2014-023).

Our survey found that higher numbers of nontraditional students are studying online, with 37.3% reporting taking 1 or more online courses in addition to 24% taking one or more hybrid courses. Among students 25 and older, 44% are taking one or more online courses, and 29.5% in at least one hybrid course.

Students who are working full-time are even more likely to be taking online courses, with 52% taking at least one, and 12% taking three or more. And more students who have children are taking online courses than those who do not; 47% vs. 36%. Students taking two or more online courses are more likely to be older, to have paused their education, to have children, and to be working 30 or more hours. (Our survey includes 1,700 students from a range of community colleges and four-year institutions, most of which are not primarily online schools.)

Most students don't realize that if you're a part-time student, online classes still expect you to be in there more or less every day. It's not like coming in twice a week for class. For me, it's more time-consuming to do online classes.

- Anita, Community College student

Students opinions of their online courses.

In 2012, 77% of CIOs at institutions offering online courses rated the learning outcomes in online education as the same or superior to those in face-to-face courses. This is an increase from 66% with this opinion in 2010, but almost a quarter of academic leaders polled continue to feel online courses are inferior³

In our focus groups, we asked students what they thought of their online courses, and they had mixed feelings. The issues they expressed included lack of timely feedback, and worry that answering multiple-choice questions was not building their skills.

"Passing an easy multiple-choice test is not going to help me when I get to the job. I need real skills."

- Martina, Community College Business student

They also said they missed the guidance a good teacher could give them on how to approach material, feeling they had to depend more on "just the book" in their online classes. While these focus groups represent a very small sample, the issues they reported were consistent, and reflect issues identified in studies by Michael Herbert and others⁴.

Our professor...breaks down concepts in a way we can understand them, and he relates the terms to patients: He might say "a patient comes in with these conditions..." and this helps me learn it. Unlike when I'm at home, I don't get that just from the (online course) reading.

- Shona, Community College Nursing student

³ I.E. Allen and J. Seaman, Changing Course: Ten Years of Tracking Online Education in the United States, The Babson Research Group, 2013. Retrieved from <http://www.onlinelearningsurvey.com/reports/changingcourse.pdf>

⁴ Michael Herbert, Ph.D., "Staying the Course: A Study in Online Student, Satisfaction and Retention," *Online Journal of Distance Learning Administration*, Volume IX, Number IV, Winter 2006

The Noel-Levitz 2014-15 National Online Learners Priorities Report highlighted several “challenge areas” for online learning, which they defined as areas that students considered important, but where there was a gap between the level of importance and the students’ satisfaction. The key challenge areas identified included the quality of online instruction, clear definition of assignments, faculty responsiveness, and that tuition paid is a worthwhile investment.⁵

In our focus groups, students did have positive things to say about online courses as well. Most students told us they were taking online courses because they fit their schedules better, and in some cases this was critical to the students being able to stay in school at all.

I left because my sister got cancer. She was a single mother and I left school to help her, then time just got away. What’s great now is technology - it’s much better than when I was in school before. It’s helpful as a study aid, and with online courses, maybe I could have stayed in school back then.

- Maria, Community College student

Some students prefer their online courses, citing classes with digital courseware that let them practice and progress flexibly. Since nontraditional students need and use online courses more than other students, improvements in online course experiences and media have the potential to be especially helpful for these students.

This is my fourth attempt at going to school, and I try to take all online classes because I like the ability to make my own schedule, because I work 36 hours, and then I pick up extra shifts where I can.

-Alex, Community College student

What students told us they want

Students in our focus groups talked about where they felt they needed the most help. Requests we heard repeatedly included:

- **Courses that develop the skills they really need for credentials and jobs.**
- **Help with keeping on top of school: getting assignments done and preparing for tests.**
- **Quick feedback and help when they get stuck.**
- **Materials that are easy to use, that don’t waste their time.**
- **Better access to a community of students when taking online courses**

⁵ Noel-Levitz (2014). 2014-15 National online learners priorities report. Coralville, IA: Noel-Levitz. Retrieved from www.noellevitz.com/Benchmark.

I got into the Nursing program, but halfway through the semester, I found I had too many gaps. I told my professors "I can't go out there without skills— this isn't handling mail, it's handling people."

- Maria, Community College student

I'd like to have something to help me when I get stuck on a problem, and it's late, and the professor isn't available. Help me see where I'm off track.

- Leila, Community College student

4. How can GBL Help Nontraditional Students Now?

To explore how game-based learning can best aid students, we looked at existing research on the strength and effectiveness of game-based approaches, best practices in learning-game design, and current examples of implementations of game-based learning in Higher Ed. From our interviews with educators and research with students, we identified points in the students' academic journey where game-based learning might be most helpful. And we looked at what features of games might be most valuable to designers.

Research backs the strength of game-based approaches

While research into GBL effectiveness is a young field, over the past decade there has been considerable research into the effectiveness of game-based approaches. A recent series of meta-analyses show stronger learning results for students in game-based approaches than standard curriculums, including two recent meta-studies, one from SRI (2013) and one by Wouters et al (2009).

The SRI meta-analyses of game studies found that digital game conditions were more effective on average than non-game conditions. Overall, digital games were associated with a .33 standard deviation improvement over control conditions. The study found consistently significant outcomes across the different types of games tested in the studies.⁶ The Wouters analysis also found that serious games (another term for games-based learning) were more effective in terms of learning and retention.⁷ Value-Added Research (by Richard Mayer and others) that looks at the effectiveness of specific design features for learning, will be valuable to designers working on game-based approaches.

These studies are discussed in more detail later in the section [Research on the effectiveness of game-based learning](#). While these studies look at both K-12 and Post-secondary education, more of the research surveyed focused on K-12.

Design best practices

Based on our research, interviews with leading designers, and our own extensive work in GBL, we believe that strong design best practices now exist that can inform successful game-based learning projects in Higher Ed.

Leaders in both design and research have developed best-practice approaches to learning-game design, which are available in books, papers, presentations, and MOOC courses. Authors include Eric Klopfer, Scot Osterweil and their team at the MIT Education Arcade, simulation pioneer Clark Aldrich, David Shaffer and others involved in Epistemic design, Jen Groff of the Learning Games Network, and many others. At Muzzy Lane, we have developed best practice approaches which we share with the community through presentations and engagements. In the section [Best practice design approaches for game-based learning](#), we describe a small set of best practice examples in more detail.

⁶ Digital Games, Design, and Learning: A Systematic Review and Meta-Analysis, D.B. Clark, E. Tanner-Smith, S. Killingsworth, SRI Education, 2014

⁷ Wouters, P., van Nimwegen, C., van Oostendorp, H., & van der Spek, E. D. A Meta-Analysis of the Cognitive and Motivational Effects of Serious Games. Journal of Educational Psychology. 2013, February 4

Successful Higher Ed implementations are proving value

Game-based learning is being used in Higher Ed today to benefit students in a variety of areas including business, science, healthcare, language learning, engineering, and technology. These implementations provide valuable examples, both of the power of GBL, and of the hurdles that need to be overcome. These implementations are discussed in greater detail in the section [GBL implementations in Higher Ed](#), which covers a selection of current implementations, including Muzzy Lane's successful Practice series for McGraw-Hill Education.

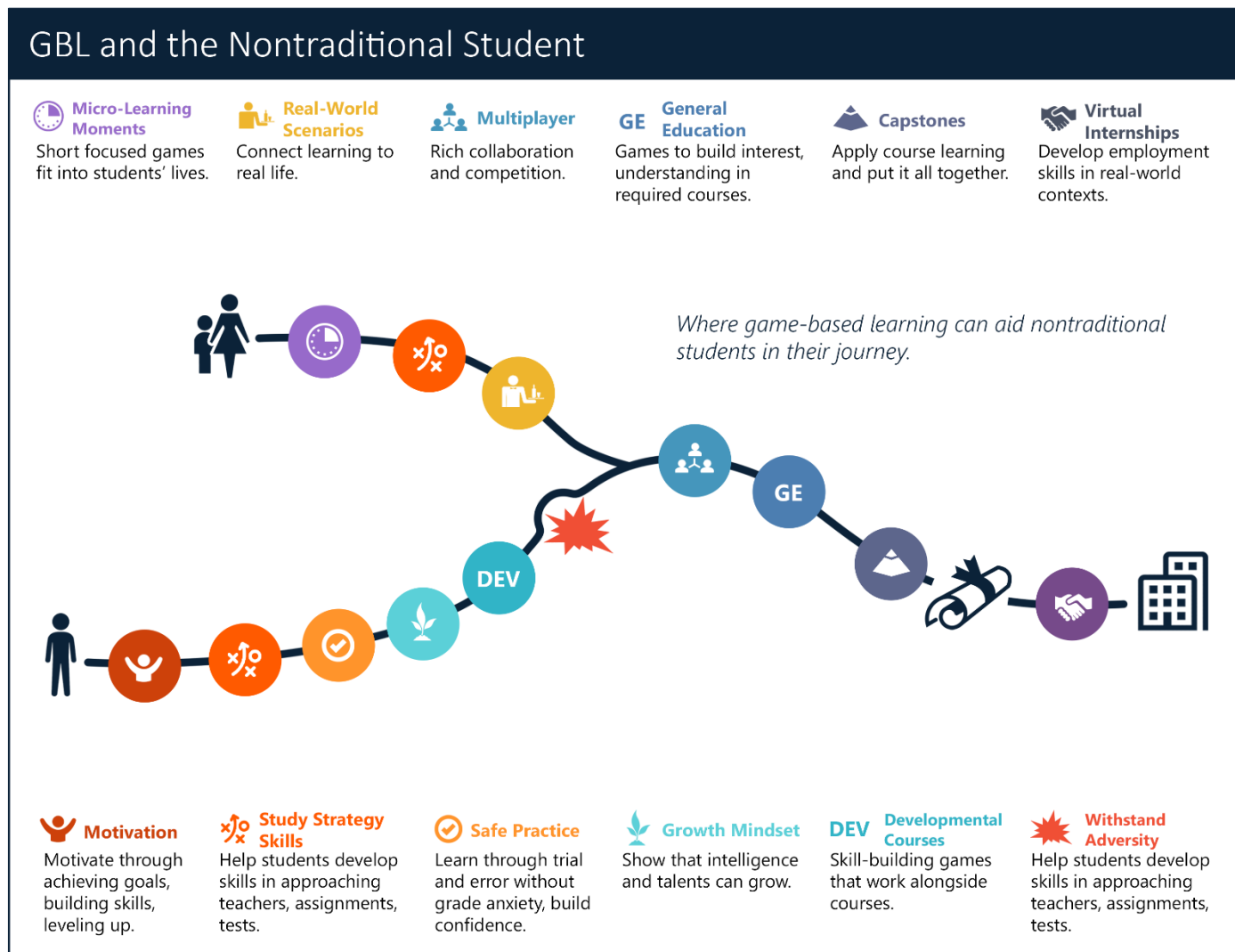
Game-based learning as one tool in the toolbox

Digital games engage players to take on active roles, solve problems, and develop and draw upon skills in ways that incorporate effective active learning practices. These kinds of active practices are especially valuable for nontraditional students, and frequently not found either in traditional classroom curriculum or in current online course curriculums, which can focus more on slide presentations, readings, videos, and multiple-choice assessments.

But that doesn't mean that a game-based activity is always for the right choice. We suggest that game-based activities should be used when they are the best tool: Teachers and course builders can find the points where a game-based approach is the strongest option; for instance, when "practice in context" is the best way for students to build needed skills, and create a module for that moment.

Areas where game-based learning can have impact today

In our interviews and collaborations, school leaders identified areas where GBL has the most potential to help nontraditional students. In some cases, schools have created partnerships with Muzzy Lane and are using the Author service (inspired by this research) to create GBL resources in these areas.



Student Success

Educators see opportunities for nontraditional students to develop skills with GBL that will help them succeed in their academic journey. Feedback from these activities can also aid counselors and other overburdened student support personnel.

- **Student self-knowledge and pathfinding:** Engaging ways for students to analyze their learning styles and strengths, and to explore options and requirements to help them make good decisions as they choose programs and courses. Outputs from these GBL units can also provide helpful insights to aid counselors working with students.

- **Academic strategies for success:** Students can practice strategies and develop skills in areas including working with teachers, approaching assignments, using resources, preparing for assignments, managing their time, and more.
- **Positive safe assessment for at risk learners:** For students that have not had earlier success in academic pursuits, GBL can assess their skills in a safe, nonjudgmental way, and provide them with opportunities to develop those skills in a positive way, without failure anxiety.
- **Developing a Growth Mindset:** Growth Mindset, a concept developed by psychologist Carol Dweck, is the self-understanding that attributes like intelligence and talent are not fixed, but can be developed and grow. Having a growth mindset can help students persevere when faced with challenging material. In game-based activities, students might be introduced to the concept and actively prove their own growth potential through “leveling up” in game-based challenges.

“Students have anxiety in areas where their skills are not strong. GBL lets them practice without worrying about failing.”

- Mary Ann Perry, CFA

Within the Curriculum

Within the curriculum, educators identified many areas where game-based learning could be helpful, often suggesting different types of game features for different disciplines and course topics. This aligns with what we have learned in our design practice. Game mechanics must match the activities students engage in naturally. Ask “What do you want the student to be *doing*?” to identify promising uses of GBL.

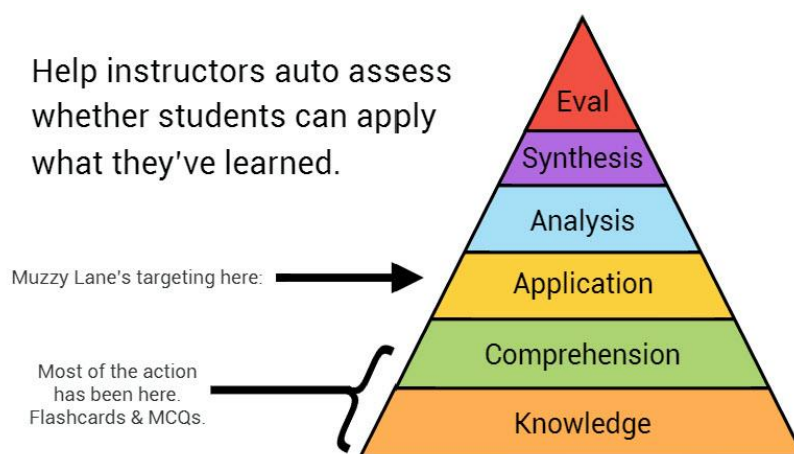
Developmental courses

Academic leaders see the potential for developmental skill-building units that students could use alongside of (instead of as a precursor to) the for-credit introductory courses. These GBL units could provide just-in-time practice and help, and provide useful data to counselors and teachers.

Application of learning in scalable, cost-effective ways

Game-based modules within courses can assess whether students can apply what they have been learning, and provide feedback to both students and teachers. Educators suggest that these experiences could be used early in courses as “capstone” experiences, or flexibly where needed.

Many current digital courseware solutions focus on knowledge and comprehension, with interactions based on multiple-choice and other simple interactions. There is a gap between these activities and more complex full simulations and games that focus on analysis and synthesis. (For example, the Practice Series of games). We believe that scalable game-based activities that address this gap will be valuable.



“Students can take formative GBL assessments at various points within a course to show applications of what they have learned.”

- *Dr. Jeffrey Braden, Professor of Psychology and Dean, College of Humanities and Social Sciences, NC State*

Modules to build and assess critical thinking skills

In our interviews, educators highlighted the value of developing and assessing critical thinking and other and other 21st Century skills. Strong rubrics and approaches to critical thinking have been developed and implemented in projects like the TH!NK Project at North Carolina State University.⁸ The TH!NK Project includes curriculum and faculty development work, and is proving successful, but it is currently classroom-based.

“Auto-assessing higher-order skills is a holy grail.”

- *Paul LeBlanc, President, SNHU.*

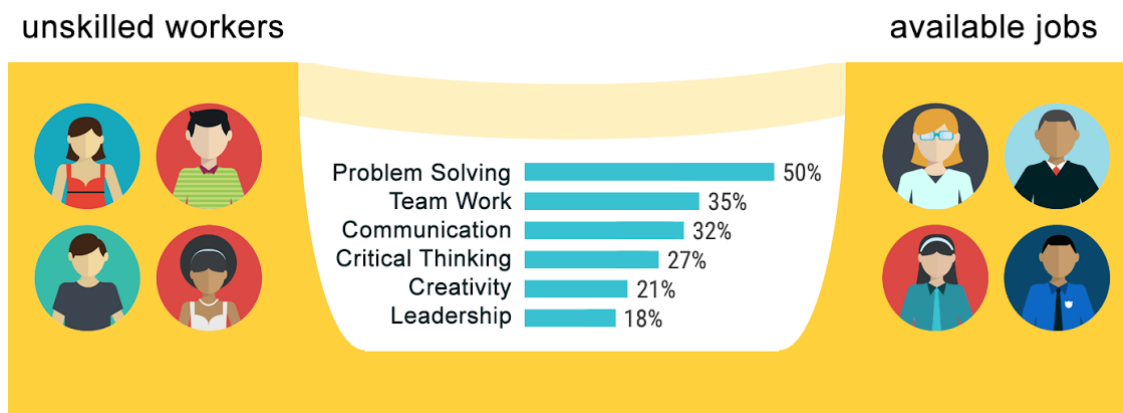
Leaders at NCSU and at other schools would like to have stronger methods to develop and assess these skills in online and blended courses, and tools that will make assessing critical thinking more scalable. Game-based scenarios are a strong way to address this. They can present students with complex problems where there are multiple paths to a solution, and ask students to analyze information, apply context, strategize, and respond to consequences of their actions. All of these are important elements of critical thinking.

“Game scenarios can challenge students to make their own decisions, reach their own conclusions, and go beyond received opinions.”

- *Lynn Carlson, Academic Advisor, USF School of Education*

⁸ NC State University, *Th!nk Program*, <https://think.dasa.ncsu.edu/>

Virtual internships and employment skill gaps



Source: The Economist Intelligence Unit⁹

Real-world simulation games give students chances to put knowledge into practice and also to develop employment and soft skills that may not be covered in a course. Educators commented that these are especially important because it is often not possible for students to find real-world internship experiences in their community.

Gateway courses that can be a roadblock for students

In areas like Health Sciences, students are often challenged to get through required courses like Organic Chemistry that must be completed to advance in the curriculum. Game-based units as part of the course could help students practice and develop skills and understanding in difficult areas.

General Education courses

Required general education courses can be challenging for nontraditional students who don't see how they are applicable to their goals. In game-based approaches, students can apply what they are learning in more real-world contexts, letting them see the connections with their lives and building motivation.

What features will be most valuable?

Based on our discussions with educators and students, as well as our review of research and our own experience, we suggest that the following game-based features may be most valuable for nontraditional learners now. Other features and approaches will also be important, but we feel these represent a promising place to start.

Complex problems to develop and assess higher order skills

Good tools exist for assessing student knowledge and understanding, but not for higher-order Bloom's skills like application and analysis. Game-based learning has great potential to close this gap. Games present students with compound problems that involve multiple variables with a range of solutions. Similar to problem-based learning, game scenarios allow for multiple paths to a solution. Players advance by experiencing success and failure while applying their own decision-making to solve problems. In this process, students use analysis, complex problem-solving, systems thinking, and other 21st Century Skills.

⁹ The Economist, *The Skills Agenda: Preparing Students for the Future*, (April 20, 2015)
<http://www.economistinsights.com/leadership-talent-education/opinion/skills-agenda-preparing-students-future>

We'd like to have applications to develop critical thinking skills, where students have to make decisions (they're not told what to do) and solve problems.

- Melissa Logue and Mary Hooker, CSCC

Trial-and-error learning in a safe environment

Game-based learning provides chances for students to test and build their skills in a safe environment where failure is not a problem. (Failing, even dying and being "reborn" is common in games and is seen as a chance to level up, rather than a sign of unworthiness.) For nontraditional students who start college sensitized to academic failure because of difficult high-school experiences, the chance to build skills safely could be a lifesaver.

Providing practice to build skills

In our focus groups, nontraditional students frequently told us they wanted chances to practice and build their skills, whether preparing for exams or building real-world skills for employment. Game-based learning provides practice with immediate feedback to motivate students to continue working and improving.

"Practice in problem-solving teaches students to go beyond 'What do I do next?' and gets them unstuck."

- Michelle Alvarez, Associate Dean of Social Sciences, College of Online and Continuing Education Academics, SNHU

Real-world roles and problems

Game-based learning engages students in real-world roles, placing them in scenarios and presenting them with missions to achieve. (For instance, putting a student in a business role to solve a marketing problem). Game-based experiences can function as "virtual internships" where students put what they are learning to use.

In a continuing review of research, Tobias and Fletcher found that that skills acquired through gameplay can effectively translate outside of the game into real life.¹⁰ Research from a study on science learning by the National Research Council¹¹ showed that developing proficiency in science goes beyond learning facts. It requires understanding how ideas relate to each other within conceptual frameworks. Engaging students in the role and habits of a scientist aids in developing the needed skills. Providing context is also valuable for adult learners, who prefer to know how what they are learning applies in the real world.¹²

¹⁰ Sigmund Tobias and Dexter Fletcher, "Learning from Computer Games: A Research Review," in DeWannemacker, Vandercruysse, and Clarebout, ed., *Serious Games: The Challenge* (ITEC/CIP and T 2011: Joint Conference of the Interdisciplinary Research Group on Technology, Education, and Communication, and the Scientific Network on Critical and Flexible Thinking Ghent, Belgium, October 19-21, 2011, Revised Selected Papers), 2012

¹¹ National Research Council. (2011). *Learning Science Through Computer Games and Simulations*. Committee on Science Learning: Computer Games, Simulations, and Education, Margaret A. Honey and Margaret L. Hilton, Eds. Board on Science Education, Division of Behavioral and Social Sciences and Education. Washington, DC: The National Academies Press.

¹² Malcolm S. Knowles, *Andragogy in Action*, (Jossey-Bass, 1984)

“My students want to do startups, but don’t have real-world experience. Games can help them develop the skills they’ll need.

- Dr. JoAnn Rolle, Dean, School of Business, Medgar Evers College, CUNY

Providing timely, helpful feedback to students

Well-designed games give players immediate feedback on the effects of their actions, so that players can see how they are doing and decide on what to do next. Students can quickly see where they have gone off track, try corrections, and see results while they engage deeply in the problem. This rich and immediate feedback helps students make progress when they are studying on the train or late at night when professors or fellow students may not be available.

“Games can provide students with high quality feedback when they need it, even at two in the morning.”

- Dr. Michael Berson, Professor of Social Science Education, USF

Multiplayer interaction to develop collaboration skills and build community

Multiplayer games let two or more players work together collaboratively or competitively to reach goals. Multiplayer capabilities also enable group projects in online settings, drawing on effective models for synchronous and asynchronous interaction that have been developed in the game-design community. Multiplayer interaction can help build community in online learning courses, and also presents opportunities for students to develop interpersonal employment skills. In addition, research by Gentile and others has shown that collaborative gameplay can increase prosocial (helping) behaviors.¹³

¹³ D.A. Gentile, C.A. Anderson et al, The Effects of Prosocial Video Games on Prosocial Behaviors: International Evidence from Correlational, Longitudinal, and Experimental Studies, Personal Social Psychology Bulletin, 2009. Accessed from <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2678173/>

5. Barriers to Adoption and Use

Barriers reported by school leaders

We spoke with educators and leaders in Higher Ed who have used (or have chosen not to use) game-based learning. We asked them what they feel the key obstacles are to wider implementation. We heard a consistent set of responses, and below we discuss the obstacles most often cited.

High Cost

The cost of creating custom GBL activities for individual courses is consistently seen as too high, making it difficult to meet cost/benefit requirements for wider adoption. Institutions want to keep costs of materials down for students, and they need costs of upkeep to be manageable if they are going to scale activities across courses. High cost also makes it difficult for educators to innovate, as they don't have budgets to try a new game-based approach if they are expensive.

"Gen Ed courses make a lot of sense for GBL, but we haven't been able to make the cost benefit work because of high cost of development."

*- Dr. Jeffrey Braden, Professor of Psychology and Dean,
College of Humanities and Social Sciences, NC State*

Too much change and disruption of curriculum required

Educators were interested in gaining the benefits GBL can bring, but not if it required replacing or revising too much of their curriculum. They would prefer to be able to take advantage of game-based features where they add value, without needing to replace other proven, successful elements of their courses.

Time and workflow fit

GBL is seen as requiring a lot of time from students and faculty. Educators said they wanted options that they could fit into how they are already working, and students need experiences that are efficient and fit their needs.

"With over 100 online degree programs, hundreds of faculty and hundreds of courses, we can't do custom development for every course and anything we add MUST be easy to maintain."

- Tahnja Wilson, Senior Manager, Strategic Design Initiatives at EdPlus, ASU

Inability to author and update GBL resources

Administrators, curriculum developers and faculty told us they wanted to have control over elements they added to their courses. To date, creating game-based resources has often involved hiring a developer to create and deliver a finished product, often with a requirement to return to the developer to make changes or updates going forward. (Muzzy Lane has created projects using this model.) Educators expressed the desire to author, improve and customize GBL resources, and be able to update the resources themselves.

Hard to assess at scale

Game-based learning can provide rich outputs for assessment, but it has often required a lot of extra work for faculty to analyze these outputs and integrate them with grading systems.

Difficult for faculty to integrate and use GBL

Some educators worry that complex GBL activities will require skills (in working with games) that many faculty do not have. Teachers need to be able to quickly get up to speed on how a GBL activity works, and be comfortable engaging students in using it.

“GBL shouldn’t make the course be about tech or gaming skills!”

- Michelle Alvarez, SNHU

Technical support hurdles

Faculty and administrators worry about tech support requirements for GBL: They need game-based activities to be intuitive and “just work” across different devices. Faculty should not have to become tech support.

Overcoming the barriers

We suggest that addressing these barriers will have a strong effect on the use and potential impact of game-based learning in Higher Ed. In fact, overcoming the barriers may be as important as any other factor in our ability to help nontraditional students.

Enable educators to author and maintain game-based learning resources

Provide tools and templates to enable to educators and instructional designers to create game-based learning experiences. This will also allow educators to refine and update the experiences based on feedback from students. Surround the tools with resources and support to help faculty develop proficiency with game-based learning.

“A platform that lets educators build and customize will have more impact than the next great game in, say, Psychology.”

- Tim Harrington, DeVry University

Fit into curriculums

Focus on brief learning experiences that can work with existing curriculums, and fit into teacher and student schedules. Our experience and early research point to brief game-based learning experiences being effective if designed with clear objectives and feedback.

Flexibility and mobility to fit into students’ lives and schedules

Game based learning experiences should enable students to study and make progress in short bursts of time, with brief game modules and levels that can be started and finished quickly or easily picked back up later. Game-based learning should also work across computers, tablets and phones, as students expect to access their materials from whatever device they have, and increasingly use phones for schoolwork.

“The key is flexibility; students face many challenges and they need to be able to continue the GBL experience in flexible ways if they get in trouble.”

*- Melissa Logue, Instructor, Spanish, and game-based curriculum designer,
Columbus State Community College*

Make good use of students' time

Game-based learning modules should be quick for students to start up and play, without requiring any training or instruction. They also must be efficient, avoiding lengthy navigation or other open-ended play that does not contribute to the learning.

Support multiple game types to support different objectives

Use game mechanics that align with the objectives for student learning.¹⁴ In many cases, game mechanics are developed by looking at the role and actions suggested by learning objectives. To support this, it will make sense to provide educators with an array of templates and tools to address different topics, objectives and purposes.

“GBL resources must serve a clear purpose, and be efficient and effective.”

- Phil Ice, APU

Integrate with existing and future learning environments

In April 2015, EDUCAUSE released a report proposing criteria for a “next generation digital learning environment” (NGDLE) to meet needs not met by current LMS systems. The report suggests that a NGDLE should be highly modular, enabling many different types of digital programs to work together.¹⁵ Game-based learning should be modular and flexible in this way. However, GBL activities will also need to integrate with current standards like LTI to enable their use with current systems.

Make assessment integral and scalable

Assessment should be an integral part of game-based materials, and authoring tools should enable educators to design and incorporate assessment as part of game-based experiences. Games also should give students timely formative feedback on their performance, and provide assessment information that lets teachers effectively manage their classes and help individual students.

Create proven models and build the evidence base

Authoring tools will enable more GBL interventions to be created and tested quickly and inexpensively, providing evidence to advance the field. Templates validated through testing will provide proven models that can be built upon by current and future GBL practitioners.

6. Concept and Prototype Development

Drawing on inspiration from the interviews and research, we developed concepts for creative and technical solutions. We focused on approaches that addressed student and educator needs today with the goal of overcoming hurdles nontraditional students face in current education systems. Questions we explored included:

¹⁴ Digital Games, Design, and Learning: A Systematic Review and Meta-Analysis, D.B. Clark, E. Tanner-Smith, S. Killingsworth, SRI Education, 2014

¹⁵ M. Brown, J. Dehoney and N. Millichap, The Next Generation Learning Environment, *Educause Learning Initiative*, 2015. Accessed from <http://www.educause.edu/library/resources/next-generation-digital-learning-environment-report-research>

- **Could we create a system/service that would support developing, editing, and publishing games all from the web by educators, without needing developers to compile, upload, or push things live?**
- **Could we deliver game experiences entirely with web-standard technologies, without requiring plug-ins or other technologies that would limit access?**
- **Would educators and instructional designers actually be interested in authoring game-based learning, given the opportunity? What kinds of things would they be interested in authoring?**
- **What would educators be able to author easily? What would be a good balance between simplicity and complexity/power?**
- **What kinds of game-based learning experiences will work best on mobile devices?**
- **What game mechanics and genres will be most valuable initially (for creators and students)?**

We did design and prototyping work, then reviewed concepts and prototypes with school leaders, teachers, instructional designers, student support personnel and others who work with nontraditional students. The results were encouraging. Many reviewers expressed enthusiasm for the opportunity to work with the tools. We found that simplicity was going to be important. With our initial prototypes (which we kept simple) a wide range of people were able to get up-to-speed quickly and create game experiences.

These discussions also helped develop our understanding of the areas where educators see potential to use game-based approaches (see [Areas where game-based learning can have impact today](#)). As educators build and experiment using templates, we expect the list of application areas to grow.

“Many tools that we hope faculty will use are actually too complex, and don’t get adopted. This (Author) is something faculty actually will be able to use.”

- Tahnja Wilson, Senior Manager, Strategic Design Initiatives at EdPlus, ASU

7. Potential for Effectiveness Research

While the scope of this project did not include effectiveness testing with students, we feel such research will be valuable. In this section we describe opportunities for testing that could be undertaken going forward.

Testing in collaboration with Author partners

Inspired by this research project, our recent work has focused on creating tools, templates, and a service to enable educators to more easily design and develop game-based learning experiences (Muzzy Lane Author). Given this, research into the effectiveness of these experiences will necessarily need to be carried out with partners who are working with the tools. The research designs and plans will need to take into account:

- **The partners' objectives:** The design of each test will need to be based on the learning objectives or other outcomes (such as for student-success initiatives) which the Author partner is pursuing.
- **The game-content the partner creates:** Effectiveness will be impacted by the content the partner creates as well as by the interfaces, options, and feedback provided by the tools.
- **The students that the partner serves:** Research designs will also depend on the students being served: how many might participate in a test? What characteristics do the students have? What kinds of selection and randomization might be possible?
- **What is the game-based experience being compared with?** Partners may be looking at the effectiveness of the intervention in comparison to a variety of conditions: to no intervention, to a different intervention, or to a different media.

Growing network of potential testing partners

In our work on this research project and our continuing work with the Author service, we are developing a strong list of schools that we can draw on to collaborate with us on efficacy testing with students. We have contacts with a wide range of institutions including two- and four-year programs and schools that offer classroom and online options as well as those that are primarily online. Because different partners will be creating different projects, we would work with partners on individual studies based on their goals and objectives.

Strong research design based on DOE's WWC design standards

Where possible, we would like to collaborate with partners to carry out experimental studies that would meet the Department of Education's WWC (What Works Clearinghouse) rating Group Design Standards with Reservations. (<http://ies.ed.gov/ncee/wwc/>). In general, this would mean a quasi-experimental design studies that would compare outcomes for students that had access to the game-based intervention to those who did not but were similar on observable characteristics. Studies of other factors (like the usage rates) could also be valuable. Many student-support resources are simply not used much by students, and increasing usage rates could help schools meet their goals.

Potential of Authoring tools to aid in GBL research

Authoring tools can also be valuable to the field of educational games research, by making it easier to both create and publish testable games. The ability to create or modify a test instance and make it available to test subjects across the web instantly will be especially helpful.

“Expanding the number of people who can build educational games will both increase students’ learning and advance research on game design.”

– Chris Dede, Harvard Graduate School of Education

8. Thoughts on Next Steps

This research project has provided several important lessons that are changing how we approach our own work. We feel they will also be valuable for anyone working to create engaging curricula for nontraditional learners, and for those involved in games for learning more generally.

We think it is useful to look at game-based learning as one tool in the toolbox, rather than as an all-encompassing approach where an entire course would be a game. This frees educators to focus on using game-based concepts where they are the strongest solution, and to integrate them with other media and experiences.

For many institutions, the high development cost of complex full-course simulations is simply not supportable. Our research suggests that lowering development and maintenance costs will increase the use of game-based activities, and lead to valuable applications that haven't been practical to date. Features like shorter play time and the flexibility to use modules where needed will help educators incorporate game-based activities into what they are already doing. Easy linking and embedding capabilities will help them integrate with learning management systems.

Based on inspiration from this research, Muzzy Lane has changed our own approach. We have pushed beyond the prototypes to create Muzzy Lane Author, a cloud-based authoring service with extensible tools that put the power of developing dynamic game-based content in educators' hands. We are actively working with initial partners on projects to directly impact nontraditional learners.

We are looking forward to seeing what educators create when empowered with Author's tools. We believe that their perspective, skills and creativity will result in valuable new activities and assessments that will benefit students. In addition, the ability to quickly build and iterate on game-based modules will help researchers determine what is most effective and make continual improvements. Altogether, we believe that these ideas (and the Muzzy Lane Author service) have strong potential to improve the learning experiences available for nontraditional students.

9. Supporting Material

Research on the effectiveness of game-based learning

Over the past decade, there has been considerable research into the effectiveness of game-based approaches. Overall, studies show stronger learning results for students in game-based approaches than in non-game conditions, and two recent meta-studies, one by SRI (2013) and one by Wouters et al (2009) provide a good view of what has been learned.

It's important to note that while these studies look at both K-12 and Post-secondary education, most of the studies focus on K12. The two studies are:

SRI meta-analysis of research into game-based learning ¹⁶

In 2014, SRI published a meta-analysis that synthesized research on digital games to systematically examine their efficacy for learning. They focused on research published between 2000 and 2012, with the aim of highlighting the recent evolution of digital games for learning. They started with over 3000 articles, and after screening with a set of criteria to identify studies that were applicable and had adequate research designs, they included 69 unique study samples in the final meta-analysis. These samples provided information from a total of 6,868 total participants.

Wouters: A Meta-Analysis of the Cognitive and Motivational Effects of Serious Games. ¹⁷

The goal of this study was to statistically summarize the research on the effects of serious games on learning and motivation. The meta-analysis used a media comparison approach, comparing serious games with conventional instruction methods including lectures, reading, drill and practice, or web content/hypertext. The study also looked at other instructional and contextual factors that could affect the effectiveness or appeal of the games.

Findings from the Studies

Game-based approaches are more effective

The SRI analysis showed that digital games conditions were more effective on average than non-game instructional conditions. Overall, digital games were associated with a .33 standard deviation improvement relative to control conditions, after adjusting for baseline differences in achievement between groups. The SRI study found consistently significant learning outcomes relative to non-game conditions across the different types of game interactions tested in the studies.

The Wouters analysis also found that serious games were more effective in terms of learning and retention:

¹⁶ Digital Games, Design, and Learning: A Systematic Review and Meta-Analysis, D.B. Clark, E. Tanner-Smith, S. Killingsworth, SRI Education, 2014

¹⁷ Wouters, P., van Nimwegen, C., van Oostendorp, H., & van der Spek, E. D. A Meta-Analysis of the Cognitive and Motivational Effects of Serious Games. *Journal of Educational Psychology*. 2013, February 4

“The results on knowledge and cognitive skills suggest that training with serious games is more effective than training with conventional instruction methods. In line with Sitzmann (2011), the retention outcome shows that the cognitive gains are not attributable to the “freshness” of the learning material but that these gains persist in the long term. This retention effect is important, because it supports what teachers and instructors deem important: that serious games lead to well-structured prior knowledge on which learners can build on during their learning career.”

GBL activities designed for specific learning objectives perform better

Twenty studies cited in the SRI analysis compared games that had specially designed (augmented) learning features vs. standard versions of those games, and the augmented version showed a .37 standard deviation improvement. This suggests that the design of an activity has as large an effect as the medium itself. These results parallel those of an NRC report on inquiry activities (Singer, Hilton, & Schweingruber, 2005).

“Design, rather than medium alone, predicts learning outcomes.”

- Clark et al, SRI 2014

The educators we interviewed also were focused on addressing specific objectives: They are looking for activities that are carefully designed to successfully address specific needs of their students, and are less concerned with whether they are “games” or not.

GBL is more effective when used with other instructional methods

In a study cited by Wouters, Tobias and Fletcher found that game-based approaches are more effective when they are supplemented with other instructional methods than when they are the sole instructional method. He theorizes that when games are used without other instruction, students “gain intuitive knowledge, but they are not prompted to verbalize the new knowledge and so do not anchor it more profoundly in their knowledge base.”¹⁸

Wouters comments that this is in line with other research showing that the active reflection or reviewing of experiences is beneficial for learning. For example, guided-discovery learning research has shown that learning by doing works best when supplemented with opportunities to reflect.¹⁹

Multiplayer interaction adds to learning

Wouters’ analysis found that games were more effective when played in groups than when played alone (in most studies, this was groups of two). He suggests this is because important additional learning activities like articulation of knowledge happen as part of the group interaction. The SRI study found that single-player games could be just as effective, but found competitive single-player games to be less effective than other types.

¹⁸ Leemkuil, H., De Jong, A.J.M.: Instructional support in games. In: Tobias, S., Fletcher, J.D. (eds.) *Computer Games and Instruction*, pp.353-369. IAP Inc., Scottsdale (2011)

¹⁹ R. Moreno and R.E. Mayer, “Role of Guidance, Reflection and Interactivity in Agent-Based Multimedia Game,” *Journal of Educational Psychology*, 2005, Vol. 97, No. 1, 117–128

Collaborative games develop social skills

Studies have shown positive learning effects for collaborative “prosocial” games in developing social skills outside the game. (Prosocial games are designed to encourage behaviors that help others.) A meta-study of research studies on prosocial games in three countries showed that prosocial gameplay predicted later increases in prosocial behavior (in Japan) and that undergraduates in the U.S. that played prosocial games behaved more prosocially toward other students in a test.²⁰

Games that encourage strategic re-thinking improve deep knowledge

Game experiences can present learners with a problem to solve, and then inject changes and events that require students to apply their knowledge and use analysis and strategic thinking. In a study by Eric van der Spek²¹ students played a game in which they learned to apply a medical procedure. During the game, specially designed surprising events were triggered, forcing the players to rethink the procedure they had used and develop another solution to perform that step. (For example, a failure in a power box caused students to no longer have enough light to perform a necessary step). The use of unexpected events improved deep knowledge without a decline in the reported engagement.

Value-added research identifies promising game features

Richard Mayer has been using the Value-Added approach to game research to compare the learning performance of students who learned by playing a game versus students who played that same game with one instructional feature added. This type of research tells us whether adding a specific feature does or does not improve learning.²² Features that Mayer studied and found to improve learning include:

- Personalization of language using conversational style
- Use of audio rather than printed screen text
- Providing coaching within the game context
- Providing prompts asking players to explain their actions.

Mayer and other game researchers are continuing work with the value-added approach, which will continue to provide designers with more extensive and detailed guidance on what features work for different goals and situations.

Adult education research and game-based approaches

Many nontraditional learners are also adult learners. There is a well-developed field of research into adult learning, and as we looked at this research, we saw connections between game-based learning and approaches that have found to be effective for adult learners. Because of these parallels, adult-education

²⁰ D.A. Gentile, C.A. Anderson et al, The Effects of Prosocial Video Games on Prosocial Behaviors: International Evidence from Correlational, Longitudinal, and Experimental Studies, *Personal Social Psychology Bulletin*, 2009. Accessed from <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2678173/>

²¹ van der Spek, Wouters and van Oostendorp, Code Red: Triage or Cognition-based Design Rules Enhancing Decision-making Training in a Game Environment, *British Journal of Educational Technology*, Volume 42, Issue 3, pages 441–455, May 2011

²² Richard E. Mayer, *Computer Games for Learning*, MIT Press, 2014 p. 140

research will be an important tool in the development of effective game-based activities for nontraditional learners.

Adult learning requirements and GBL affordances

The adult learning research field encompasses multiple theories, including Andragogy, Humanism, Behaviorism, and Problem-Based Learning. Each of these theories proposes requirements and best practices, and many of these correspond closely to affordances of game-based mechanics. The following table shows the connections, and each theory is described briefly below the table.

Adult Learning Recommendations	Game-based Learning Strengths
Andragogy	
Adults want to know why they are learning something.	GBL scenarios provide context for the topic being used, and the opportunity to apply the knowledge.
Adults need to learn experientially.	GBL scenarios create rich experiences where students experience a role within an environment and context.
Adults approach learning as problem-solving.	Can provide role-playing scenarios where the player experiences a problem in context and then works to solve it.
Adults learn better when the topic has immediate value.	Scenario-based game units enable students to apply learning in real-world contexts.
Humanistic Learning Theory	
Adults learn best in ways that are more natural, through real-life problem solving, active learning, and social interaction.	Game scenarios can provide real-life problems to be solved, and collaborative, social learning in multiplayer interactions. Multiplayer games.
Provide a structured environment with differentiated instruction where students have the chance to explore topics of interest to them.	Game interactions can provide rich data and feedback to provide appropriate new challenges based on the student's performance.
Adult learners should learn at their own pace.	GBL provides students the option to play and replay as much as needed, or continue and "level up" as they are ready.
Behaviorism	
Structure learning activities around measurable objectives.	Game mechanics and actions can be based on objectives; through playing, the learner engages with the objectives.
Provide learners with feedback on their success or failure in meeting objectives, to enable them to make changes to improve results.	GBL can track learner activity in detail and provide rich feedback on results of player actions, and then provide the chance to make changes and try again.

Problem-based Learning	
Students develop and apply learning through solving problems that mimic real-life situations.	GBL can place learners in roles and present complex problems for them to solve, and can automatically track actions and results, and provide feedback.
Learners collaborate to solve complex problems.	Digital game approaches can reduce logistical barriers to using PBL by managing multiplayer interaction and providing more scalable assessment approaches.

Adult learning theories (in brief)

Andragogy: The term refers to the entire area of adult learning (as opposed to pedagogy), but more specifically to Andragogy Theory (Knowles). Knowles believes that adult learners are more likely to be self-directed, and expect to take responsibility for their decisions. Following this, he suggests that designs should assume that; adults want to know why they are learning something, that they need to learn experientially, that they approach learning as problem-solving, and that adults learn better when the topic has immediate value.²³

Humanistic learning theory is concerned with personal growth and the full development of each human’s potential not on just intellectually, but also on an emotional, psychological, creative, social, and physical level (DeCarvalho, 1991; Maslow, 1971; Morris, 1978; Rogers, 1969; Patterson, 1973). Humanistic education focuses on the development of knowledgeable human beings who know and are able to nurture themselves, other humans, and their environments; to instill a joy of learning; to promote the discovery of each student’s passions and special talents; and to teach the knowledge and skills necessary for students to be good decision makers. Abraham Maslow (1968) used the term “self-actualization” to describe humans’ innate, natural progression to their highest state.

Behaviorism underlies much pedagogy and andragogy today. According to Merriam, behaviorists see human behavior as a response to particular stimuli, where if the stimuli rewards the behavior or not, it will continue or cease. Adult educators use behavioral, observable objectives to set learning outcomes, and according to Merriam, “the notions of competency-based curricula, instructional design models, and some program-planning models are behaviorist in nature” (Merriam). Evidence-based practices with quantifiable, observable outcomes prove learning has occurred. Learning activities are then structured around these objectives. Adult vocational education predominantly identifies skills needed for an occupation, teaches these skills, and then assesses learners on their levels of competency in performing those skills.

Problem-based Learning:

Problem-based learning (PBL) students work, often collaboratively, to solve specific problems and through that work to develop and apply knowledge and skills. PBL utilizes tactics that simulate real life experiences, emphasize agency, autonomy and self-reflection (Schmidt, 1983; Baroffio et al., 1997; Carlile

²³ Malcolm S. Knowles, *Andragogy in Action*, (Jossey-Bass, 1984)

et al., 1998). PBL has been shown to enhance retention, promote collaboration, increase motivation, and develop articulation skills through thinking, writing and communicating.²⁴

Best practice design approaches for game-based learning

Based on our research, interviews with leading designers, and our own extensive work in GBL design, we believe that strong best practices now exist that can inform successful game-based learning projects in Higher Ed.

Five best-practice approaches

Over the past few years, a variety of practitioners have developed and shared best practices in designing game-based learning. The most valuable of these are based on extensive experience creating and testing games with students, and many have also incorporated research into their work. We will discuss five strong examples here, all of which are useful resources for educators and designers.

Design and Development of Games for Learning:²⁵ This MITx project-based course was taught by Eric Klopfer, Jason Haas, Paul Medlock Walton and Scot Osterweil, all from MIT. It draws on more than a decade of research and development work at the Education Arcade at MIT, and covers the evolution of learning games, foundations of game design and learning theory, design and prototyping, assessment and other topics.

Better Learning in Games: A Balanced Design Lens:²⁶ This paper, written by Jen Groff et al. at the Learning Games Network, presents an approach based on Evidence-Centered Design. It introduces the framework of Balanced Design, which emphasizes helping designers align learning goals with game mechanics to produce engaging and effective learning game experiences.

Muzzy Lane's approach to Designing Games for Learning:²⁷ Muzzy Lane's design approach has been developed over a decade of work with teachers, subject matter experts, and students, developing games for use in classrooms and online. Key elements include analyzing objectives and using them to develop and choose game mechanics and genres, incorporating assessment into design, working with subject-matter experts, and providing useful feedback. To date, the approach has been shared in presentations, classes, and conference workshops.

Evidence-centered Design of Epistemic Games:²⁸ This paper, a collaboration between four leading learning-game researchers, focuses on epistemic games (Shaffer, 2006a), which are games designed

²⁴ Allen, D. E., R. S. Donham, and S. A. Bernhardt. "The Evidence for Problem-Based Learning." In Evidence-Based Teaching. Edited by William Buskist and James Groccia. Series: New Directions in Teaching and Learning. San Francisco: Jossey-Bass. Winter, 2011: 21-30.

²⁵ MITx: 11.127x Design and Development of Games for Learning, E. Klopfer et al. edX Inc. 2015

²⁶ Better Learning in Games: A Balanced Design Lens, J. Groff, J. Clarke-Midura, V.E. Owen, L. Rosenheck, The Learning Games Network, MIT, 2014

²⁷ Muzzy Lane's Approach to Learning Game Design, B. Snow, T. Vogel, Muzzy Lane Software, Presentation to Harvard Graduate School of Education, 2014

²⁸ Evidence-centered Design of Epistemic Games: A.A. Rupp, M. Gushta, R. Mislevy, D.W. Shaffer
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to give learners the experience of professional practice within a discipline. The paper provides guidance on how an evidence-centered design framework (along with other elements) can be used to structure the design and development of epistemic games as well as research on their functioning.

The Complete Guide to Simulations and Serious Games:²⁹ This book by experienced educational game/simulation designer Clark Aldrich covers all aspects of the design and development of more complex simulation-based games.

All of these best-practice resources are built on strong experience and research, and will be good resources supporting the development of effective game-based materials that will benefit students. There are many other strong resources not mentioned here, and we expect the literature to grow.

Selected GBL implementations in Higher Ed

Game-based learning is being implemented in Higher Ed in a variety of settings, mostly in small-or medium scale implementations. In this section, we present some example implementations, starting with our own work with the successful Practice series for McGraw-Hill Education.

The McGraw-Hill Practice Series

Practice is a series of 3D multiplayer learning games developed by Muzzy Lane for McGraw-Hill Education. They are designed to integrate with the core curriculum and deliver immersive learning experiences and rich assessment capabilities. The first of the Practice games was introduced in 2011, and there are now five products in the series, all delivered via a Practice website/service, and integrated from McGraw-Hill Education's Connect platform.

Muzzy Lane and McGraw-Hill Education have had the opportunity to improve all aspects of the games and technology based on feedback from students and teachers who are using them with in classes and courses. The most important lessons and improvements have been in the areas of:

- **Workflow:** Refining the time requirements and sequence of game experiences to work better for teachers and fit curriculums
- **Technology and ease of use:** The technology base has been completely rebuilt to work across mobile devices and computers seamlessly as a cloud service (using HTML5 and other native web technologies), without requiring web-browser plugins.
- **Assessment, Feedback and Reporting:** We have increased the sophistication of how student activity is assessed, and provided more useful feedback to students and teachers.

As the improved Practice titles have better met the needs of teachers and students, adoptions have increase year to year, with the rate of increase rising sharply this year.

Each of the Practice titles has addressed a different subject area, and set of objectives:

²⁹ The Complete Guide to Simulations and Serious Games, Clark Aldrich, Pfeiffer, 2009

Practice Marketing	Learn and apply the 4 Ps of marketing as a product manager in a backpack company.
Practice Operations	Learn operations and supply-chain management
Practice Medical Office	Train to be a medical office assistant
Practice Spanish	Immersive Spanish language learning in a virtual study abroad experience
Practice Government	Become a representative in the U.S. Congress

Impact and results as reported by teachers and students has been very strong. MHE has not done other effectiveness testing, but these results and the adoption do indicate that teachers are seeing the results they seek. Below we share feedback on three of the Practice titles.

Practice Marketing

In Practice Marketing, students practice marketing strategy by doing what it takes to be an effective marketing manager. Drawing on the framework of the "4 Ps" of marketing: (Product, Price, Placement, and Promotion), students must successfully launch a new product to market: a backpack of their own design. Practice Marketing supports single-player, multiplayer, and team multiplayer interaction.

Practice Marketing has been very successful, with a surge in adoptions this year to 18,000 students through October, and has been played by 45,000 students over the last 3 years.

"In my job interview, I drew on what I accomplished and learned in Practice Marketing. It was like I had a virtual internship, and it was really helpful.

- Student

"It was a really fun experience, you got to put your theoretical skills into a practical context where you could learn how it will work in real-life."

- Student

"Our marketing, merchandising and product team found it very instructive, as it gave them a good idea of the many aspects which our business includes."

*- Tina Debo, VP Product Management, Kipling
(a backpack maker that used the game)*

Practice Operations

Practice Operations is a game-based simulation where students manage operations of a clothing manufacturing and distribution company. It brings operations management to life, reinforcing key concepts in a way that promotes critical thinking and strategic decision making.

"My students need the experience that Practice Operations offers, and I believe it will benefit them greatly in the professional sphere."

- Angela Short, Faculty, School of Business, Dundalk Institute of Technology

Having worked in a factory setting myself, I realize that in the real world everything does not go according to plan and the game does an excellent job in mirroring this.

– *Student*

Incidentally, I attended a job interview last Friday, and my knowledge of this game got me through the interview.

– *Student*

“Despite my early setbacks which admittedly infuriated me, once I rectified my self-inflicted errors I really enjoyed this module. It gave an in depth account of the everyday decisions which face an operations manager. – *Student*

I have learned so much more from playing this game than I would have from reading a text. I'm eagerly anticipating the challenges that await me in module three. – *Student*

Practice Medical Office

In Practice Medical Office, students take on the role of a new Medical Assistant in a small practice. As they progress through the game's modules, students face realistic situations which test their mastery of critical job readiness skills and competencies such as professionalism, soft skills, office procedures, application of medical knowledge, and application of privacy and liability regulations.

Practice Medical Office is designed to address a critical gap in skills training. Dr. William Hoover describes the gap and solution:

“Traditionally, Medical Assistant students complete an internship at a local medical office. In theory, they are assigned a mentor who coaches them in three main areas: checking-in patients, checking-out patients, and assisting in the clinical environment. Each of these areas have specific regulatory competencies.

The challenge lies in securing sufficient clinical sites and mentors. Due to availability, oftentimes the student is not exposed to many core competencies. And, even if they are, they don't have adequate opportunity to "practice" and improve. The end result can be catastrophic for the student. They are underprepared, and they lack the skill set to obtain and secure employment.

PMO solves this dilemma by providing a virtual learning environment within a medical office setting. Students actively engage in “learning events.” These learning events were designed and built around specific competencies established by ABHES and CAAHEP. They require students to exercise the soft skills necessary to conduct business in a professional manner. The adaptive nature of the learning event permits multiple iterations and interactions, requiring the student to constantly respond to the unexpected. Therefore, the student truly has the opportunity to hone their skills in a real-world setting, without fear or negative consequence.

The grading in PMO is unprecedented. It is competency based. Students do not receive letter grades or percentages. Instead, assessments are based upon their performance in multiple categories, simultaneously, while they are completing the learning events. For example, they may receive high

marks for following the standard operating procedure for opening the office in the morning, average marks for courtesy, and low marks for not assisting a colleague. If the student scores low marks, they are provided feedback regarding the consequences of their poor decisions, and they are coached on better ways to handle the situation in the future.”

- Dr. William Hoover, Bunker Hill Community College

I really found this program to be outstanding. It was very informative, precise, and thoroughly detailed. It covered every aspect of the Health Care office environment. By providing multiple ways of communicating that would be ideal in the real world, the questioning was superb. It constantly had my attention, by the realism and functionality of the office and clinical areas. – *Student*

Other GBL implementations in business education

Simulations have long been used in business education – and these simulations have typically had game-based features like competition and goal-setting. There are many business simulations on the market, we will list just a few here.

The Business Strategy Game is an online competitive simulation where students operate an athletic footwear company and compete head-to-head against footwear companies run by other members of the class. The Business Strategy Game was used by 53,000 students over the last year, at 614 college/university campus locations in 53 different countries.

CapSim publishes a line of business simulations designed to develop business acumen that are used in academic and corporate settings, and cover multiple business topics. CapSim simulations are used by about 100,000 users yearly across corporate and academic uses. CapSim simulations are complex, and administered by the company, with facilitation and support provided at relatively high cost to the institution.

Harvard Business School publishes a series of business and management simulations that use real-world contexts to reinforce student learning in areas including entrepreneurship, finance, marketing, negotiation, and others.

GBL in science education

Simulations and games are being used in science education in multiple ways, including virtual labs and more immersive approaches. To date, there has been more work in game-based learning for secondary school than for Higher-Ed, with examples including the **EcoMUVE** immersive ecology education project and the **Quest Atlantis** game. Science GBL implementations include:

SimBio provides virtual labs with game-based features for courses in Biology, Ecology, Genetics, Environmental Science and Evolution. Students experiment with realistic simulations of natural systems

Arizona State University is piloting a series of **environmental science games** designed to challenge students to think critically about a series of real life environmental dilemmas. As in real life, there are no “right” or “wrong” answers, students must make choices that balance what’s best for the environment and the community. The games are developed by **Toolwire**, which develops immersive learning tools for online and blended learning courses.

GBL in engineering and technology

Northern Illinois University developed and has been using the game **NIU Torcs** for Mechanical Engineering education, beginning in 2005, and has published a report on engagement gains.³⁰ The game format is a racing game, with math and engineering problem-solving embedded. For instance, students learn how to code acceleration and steering with C++, or determine how to keep the car from skidding off the road, by calculating numerical roots, solving systems of linear equations, and doing curve fitting and simple optimization. The authors report that students are motivated to keep trying far more than when given these types of problems as meaningless homework exercises.

GBL in healthcare

Game-based approaches are being explored and used widely in healthcare, evidenced by projects like the Games for Health conferences. The Center for Digital Games Research at UC Santa Barbara has created a Health Games Database, listing hundreds of games in over 40 categories.³¹

Simulations have been widely used in nursing education, with journals including Clinical Simulations in Nursing dedicated to research into their use. Physical “patient simulators” don’t typically have game features, but other nursing simulations do. **VSIM for Nursing** is one leading series designed to simulate real nursing scenarios and allow patients to interact with patients in a safe, realistic environment. Muzzy Lane’s **Practice Medical Office** (described earlier) is another example in this area.

GBL in language learning

Language teachers have long used game-based activities in class, to create opportunities for students to practice language skills. Current approaches like task-based learning emphasize practicing language in real-world contexts, which is a good fit with game based approaches. Examples of digital language-learning games that are used in Higher Ed include **McGraw-Hill’s Practice Spanish** (developed with Muzzy Lane), and mobile-oriented games like **Busuu** and **DuoLingo**. **Rosetta Stone** has been producing digital language-learning software with game elements for years, and more recently has produced versions oriented toward classroom use. Other newer examples include **Fluency** and **Babbel**, and there are many others.

GBL in student support

In our interviews with school leaders, many mentioned student-support as an area where they saw a need for better tools, and where game-based approaches would be valuable. There have been successful implementations in this area, including work by **Kognito**, which specializes in conversation-based experiences with virtual humans, with a focus on conversations related to health and well-being. Medical or student-support personnel practice and role-play real life situations, building their skills in evidence-based communication techniques.

In Higher Ed, Kognito has produced simulations focusing on training to help at-risk students, LGBTQ students, and veterans on campus. In a 2015 study of a game-based virtual training simulation where users role-play with virtual student veterans, data showed significant ($p < .01$) and sustained increases in

³⁰B.D. Collier and D.J. Shernoff, Video Game-Based Education in Mechanical Engineering: A Look at Student Engagement, 2009 <http://www.niu.edu/assessment/committees/CAN/PresentationsPapersArticles/Brianno1.pdf>

³¹ Center for Digital Games Research, UC Santa Barbara, *Health Games Database*, 2015

learners' military cultural competency and preparedness to manage classroom discussions around sensitive issues, and if necessary to make a referral to the appropriate campus office.³²

³² C.A. Cate and G. Albright, "Supporting Student Veterans, Utilizing Game-Based Role-Plays with Virtual Humans to Build Military Cultural Competency and Helping Behaviors in Faculty and Staff," *Online Learning Journal*, (Jan 2015)

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