Despite the growing use of serious educational games in preK-12 education, there are few research-driven guidelines for best practices in game and content design, particularly for mobile learning content. But, while additional research is needed, it is possible to synthesize the available research and draw useful conclusions for what might constitute best practices in mobile content applications in education.
Knowing what makes an educational game effective is of particular importance to educators today. The growth of formative assessment data in recent years has given teachers a great deal of information about students’ individual learning needs. But with so many choices and little time to research what’s best for each student, teachers might choose an app that doesn’t properly balance the elements of engagement and learning, or that doesn’t work to increase cognitive gains.

ARE DIGITAL TOOLS BEING USED FOR FORMATIVE ASSESSMENT IN YOUR SCHOOL?

Based on responses from 455 district and school leaders for 2015-2016.

- **32%** Yes, with general success
- **45%** Yes, with mixed results
- **6%** Yes, but we have not seen positive results
- **11%** No, we use paper-and-pencil means of generating formative assessments
- **6%** No, we don’t have standardized approaches for generating formative assessments

*Source: Education Week Research Center*
This Research Brief reviews the pertinent literature, which suggests factors serious educational game designers must consider in order for students to achieve positive learning outcomes.

These factors include the use of deliberate practice, intentionality, intrinsic motivation, specific instructional objectives, the proper integration of play and learning, and minimizing extraneous cognitive load, among others.

In summary, mobile learning applications anchored in this pedagogical model reflect current research-based best practices in education and technology, and are best positioned to have a positive impact on student learning gains.

### Key components of serious educational games

- Deliberate practice
- Intentionality
- Intrinsic motivation
- Specific instructional objectives
- Proper integration of play and learning
- Minimizing extraneous cognitive load
INTRODUCTION

Mobile learning content has the potential to address a wide variety of student needs. Despite the growing use of mobile content and educational games in preK-12 education, there are few research-driven guidelines for best practices in game and content design, particularly for mobile learning content. “Further study required” is a common phrase found in a quick search of the systematic literature reviews currently available on the subject of game-based learning. While additional research is needed to provide definitive evidence regarding best practices, it is possible to glean from the available research important components of well-crafted serious educational games and mobile content.

Games have been utilized as formal educational tools for decades. Jean Piaget commented in the 1960s on the ability of play to help children master their environment. In the same decade, the military, some medical schools, and the general academic community began to use video games for educational purposes. These games, called serious educational games, are designed with a purpose other than simple entertainment. With the advent of e-learning and mobile learning, the use of serious educational games continues to increase. Serious educational games have demonstrated efficacy for many aspects of learning. Researchers and practitioners continue to observe and innovate with the goal of increasing the cognitive gains of students across the spectrum.

As it pertains to screen time -- It is not the media itself that produces negative effects but the lack of intentionality that often accompanies media use.

In a discussion that includes serious educational games and the easy access to them afforded by mobile content, it is important to note concerns about increased screen time. While there is continued concern regarding the amount of time children spend in front of a screen, research concerning children and screen time (educational or entertainment-focused) supports the sensible use of electronic media for children and adolescents. It is not the media itself that produces negative effects but the lack of intentionality that often accompanies media use both in adults and children. If intentionality is a hallmark of responsible educational media use, mobile content must find a way to be intentional.

DELIBERATE PRACTICE AND GAME-BASED LEARNING

The use of deliberate practice (DP) — defined as intense practice or a regimen of effortful activities to achieve expert ability — is an observation-based innovation used across disciplines. It has produced achievement and cognitive gains in the fields of professional sports, music, and academic studies.

Deliberate Practice is, by definition, intentional, and mobile content that offers serious educational games within a DP framework meets the responsible media use criteria of intentionality.

A key benefit of DP is that it should lead to flow state, or a mental state in which a person is fully engaged, fully focused, and fully involved. The use of DP has long been a mainstay of skills-based gains in the art and athletic world. Skills-drilling, fact practice, memorization — all of these use pieces of the DP loop. However, while in the professional sports and arts arenas DP has been employed with intentionality, education has been less systematic.

Artists and athletes know from first-hand experience the benefits of focus, goal setting just outside of the comfort zone, and constructive feedback. Each of these elements can be applied within serious educational games as well. Additionally, research indicates that for a game to become educational, there must be debrief and review. Thus to maximize the effectiveness of DP in education, the following must occur: intentional goal setting, focus, feedback, coaching, and reflection. Mobile learning content is a natural and strategic access point to these aspects of DP. Essentially, the mobile content gives the student the opportunity and the means to take control of learning. This autonomy coupled with strategic elements of engagement can lead to a student’s emotional engagement in the learning outcomes. Emotional engagement can lead to better cognitive gains especially when the student is in flow state. There is an advantage, then, to designing game-based mobile content with the elements of DP in mind.

Deliberate practice is, by definition, intentional, and mobile content that offers serious educational games within a DP framework meets the responsible media use criteria of intentionality.

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GAMES AND MOTIVATION

Another intentional choice is a game well-designed around a specific instructional objective. When a strong objective is present, positive learning outcomes can occur. Not all games, however, are designed around specific instructional objectives and based in sound pedagogical theory. It is possible that the student will simply learn how to play the game and not achieve the desired cognitive gains.

One of the inherent values of games is their intrinsic motivation.

Additionally, the assumption that fun is what motivates students in the serious educational game sphere is not necessarily well-founded. The preponderance of serious educational games on the market present elaborate scenarios with bells and whistles designed to capture the interest and augment the enjoyment of the students who use them. Interestingly, a recent article concluded that fun is not paramount to learning success. Fun, or the anticipation of fun, actually had no effect on the tested learning gains or the self-assessed gains of the students who participated in the study. The factors that did seem to make a difference were explicit learning tasks, embedded support within the game, and supplemental support by a teacher. These all factored heavily into the students’ desire to play learning games. A recent study concluded that enjoyment of the game was less of a factor in children choosing to play an educational game. Instead, the children cared more about their expectation that the game would be easy to understand and that it would help them learn. It’s worth noting that these relevant factors also suggest a connection to the DP model.

Whether children wish to play the learning game depends less on their anticipated enjoyment of the game and more on their expectation that the game will be easy to comprehend and help them learn.

- Iten and Petko

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Playing and learning should be integrated rather than alternated within a game. It is crucial to keep the distracting or “extraneous” cognitive load to a minimum while simultaneously increasing the learning objective or “germane” cognitive load.\(^{13}\) Therefore, in designing mobile content with a serious educational game element, designers should carefully balance the elements of engagement (potentially extraneous) and learning (germane) while also providing support within and without the game.

### ADDITIONAL POTENTIAL CHALLENGES OF GAME-BASED LEARNING

Games in the learning environment can also produce emotions other than enjoyment. They can elicit frustration and irritation and the unproductive element of social comparison.\(^{14}\) Clearly these emotions are not conducive to learning. These challenges are particularly true when games are used without the support of an instructor. Additionally, while games may initially produce a stabilizing and focusing effect on children with sensory processing issues and other special needs, with incorrect usage the games can become an addiction that can make it difficult for the student to return to real-time learning.\(^{15}\) However, given the research on the positive effect of games that balance engagement and learning outcomes, adopting a mobile content design process with lower engagement impact that minimizes extraneous cognitive load while prioritizing germane cognitive load is a best practice that would benefit all students. This practice should result in content that engages students without distracting them, quickly invites students into targeted learning, and intentionally guides students into focused and deliberate practice.

To maximize the effectiveness of deliberate practice (DP) in education, the following must occur:

1. **Intentional Goal Setting**
2. **Focus**
3. **Feedback**
4. **Coaching**
5. **Reflection**

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BEST PRACTICE CONSIDERATIONS

Best practices are often determined by the goal of the content itself. The research seems to point to several practical design principles for skills-based mobile content. First, because discrete skills require focused practice, the deliberate practice model is an excellent fit. Instructional designers can design mobile content to follow the goal setting, focus, feedback, coaching, and reflection loop.

Additionally, designers can minimize extraneous cognitive load by adopting a simple model that offers a balance of engagement and learning outcomes. Reducing cognitive load addresses both the issue of stimulus sensitivity and new research that indicates student preference for factors other than fun within the context of serious educational games.

IMPLICATIONS FOR THE USE OF SMARTEDTECH

Because mobile learning is learner-centric, design decisions should reflect a constructivist approach emphasizing the learner’s role in constructing meaning. The experience should allow the learner to synthesize new information with prior experience. Given this pedagogical underpinning, serious educational games can contribute to increased cognitive gains.

SmartEdTech supports this pedagogical model with content demonstrating simplified engagement and clear learning outcomes. A simple reward system, clean design elements, and linear movement all contribute to a focus on germane cognitive load. The robust mobile learning platform allows for intentional use of DP through goal setting, in-activity feedback, coaching, and goal revision. Students who use SmartEdTech mobile content are presented with the opportunity to settle into flow state while practicing the micro-skills featured in each activity. SmartEdTech has made clear design choices that eliminate the potential for cognitive overload, emphasize clarity and ease of use, prioritize learning, integrate play, and provide for deliberate practice. SmartEdTech’s choices establish it as a company anchored in effective pedagogy and influenced by research-based best practices in education and technology.