

Digital-Game Based Learning in Elementary School

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Play is a state that occurs when individuals find themselves fully engrossed in an activity that they are intrinsically motivated to participate in, that encourages risk taking and exploration and that allows an individual to lose sense of themselves in time and space (Reisner & Dempsey, 2018, p. 278). Jean Piaget believed that play is a necessary component of cognitive development, as it allows children to rehearse new information and integrate it with knowledge and skills they already possess (Reisner & Dempsey, 2018, p. 278). David Elkind takes Piaget's theory a step further and correlates play and work, stating that play must come into alignment with the love (of a topic) and work in order to develop into a well-adjusted adult (Reiser & Dempsey, 2018, p. 278). Many twenty-first century skills are supported by Elkind's theory of play, such as working as a team, creative problem solving, critical thinking and effective communication (Reisner & Dempsey, 2018, p. 278). Unfortunately, play is looked down upon in our society and its value in the learning process is disregarded. My ideal classroom would take advantage of the desire to exist in a state of play, not only in the learning process but also during assessments, through Digital Game-Based Learning (DGBL).

Learning Theories and DGBL

Situated and constructivist theories best harness the advantages of play in learning. In situated learning environments, the gap between knowing about something and knowing how to do something are integrated through meaningful and relevant activities (Marone, 2016). In constructivism, learners make meaning of their learning through interaction with objects, people and situations used in the learning process (Marone, 2016). Learning is not about the teacher passing the knowledge onto the learner, but rather, the teacher facilitates and guides experiences to help the learner discover and reflect on knowledge gained (Marone, 2016). Digital game-based learning satisfies criteria for both these learning theories through its ability to generate

simulations in which learners are presented with meaningful problems that need to be solved while at the same time engaging individuals in the learning process and allowing them to construct meaning of their learning through interactions within the game, as well as with their teacher and peers.

Benefits of DGBL

Aside from being an interactive and engaging way for students to practice new skills and knowledge, there are several other benefits to using DGBL. One of the advantages of game-based learning and assessment is the ability to revisit lessons for mastery while still maintaining the motivation and interactivity of the platform (van Rensburg et. al, 2017). As the game play would be adaptive, students could play through the same level multiple times without becoming as bored as they would with a worksheet. The adaptability of the challenges also ensure that the student must continually evaluate their knowledge and skills to correctly complete the tasks, as the levels would become harder or easier depending on the student's performance. Digital game-based learning also encourages students to be more effective and enhances the development of critical thinking (van Rensburg et. al., 2017). Educational games can also assess skills that are not easily measured using traditional assessment methods, such as creativity, problem solving and process thinking (Klerk & Kato, 2017).

Evidence-centered design (ECD) in an educational game improves the teacher's ability to assess performance during game play and use that information to deliver targeted feedback to the student about their progress (Reisner & Dempsey, 2018, p. 281). Because the feedback is recorded in real-time, teachers can quickly discover the student's weak points and determine which interventions should be put immediately into place to improve the student's mastery over the material (Reisner & Dempsey, 2018, p. 281). The teacher does not need to be involved in the

actual assessment but can rather review the data generated by the game afterwards. Data such as correct clicks, number of clicks it took to get to a correct answer, time to complete task, which tasks take longer and which tasks are completed quickly are all examples of data that can be generated during game play and used by the teacher to better customize the students learning experience and keep them moving towards the learning objective.

Another benefit of DGBL is that it allows the teacher to assess each student in an efficient yet unobtrusive manner as they progress through the game. Standardized tests are a stressful experience for many students, and Klerk & Kato point out that this stress can have negative effects on a student's performance if they experience significant test anxiety (2017). Game-based assessment allows a student to become immersed in the simulated world created by the game environment, thereby inducing the play phenomenon and allowing the student to forget that they are even being assessed. The students' ability to lose themselves in the fun yet challenging environment of a game-based assessment will allow the student to relax more than they would for a paper-based assessment, creating better psychological conditions for the test-taker to prove their knowledge because they would experience reduced stress. Because a larger number of tasks can be assessed in a shorter amount of time as compared to paper-based assessments, educational games may also increase the validity and reliability of tests (Klerk & Kato, 2017).

Limitations of DGBL

One of the limitations regarding game-based assessment is the time that it would take to educate the teachers on how best to use the systems for assessment. Training teachers to use new technology and software takes time. However, once the proper game-based assessments are in place and the teachers have become familiar with how to use them, their overall time and effort

managing the students might, in fact, be reduced (Reiser & Dempsey, 2018). Cost is another limitation to using DGBL. Procuring the technology to run the games is an expensive endeavor (Klerk & Kato, 2017). Particularly when attempting a one-to-one ratio of students to devices. Finding relevant game-based assessments built on the best practices and sound principles of Evidence-centered Design can also be expensive. Games used for education and assessment must be carefully designed to include game elements, but must also provide adaptive challenge, support and feedback (Reiser & Dempsey, 2018). Such games must be thoughtfully designed by someone who is knowledgeable about the science of motivation and learning, as well as the topic being assessed.

First-Grade Math Quest: My Ideal DGBL Classroom Activity

In my DGBL classroom, the teacher would introduce a topic to the students, but practice and assessment would be accomplished through an educational game designed specifically to address the topic of their lesson. Let us take a first-grade classroom where students are learning how to do simple addition. In this situation, the teacher would use manipulatives to teach students how to add single-digit numbers. Time will be spent on helping the students master addition using manipulatives before moving onto the DGBL portion of the lesson. Once students have a grasp on how addition is performed, the students would move onto a computer where they would play a simple addition game in order to practice their new skills. Letting the first graders choose a customizable avatar would be the first step in engaging the students in the game. The avatar would motivate students to persevere and perform by giving them access to new equipment or outfits as they meet certain goals. The game would be set up to be a number quest in which the students are given a total, which is displayed in the top right corner of the screen as an equation. For example, $____ + ____ = 7$. In each level, students must explore and collect the

different number pairs that complete the equation. Various number pairs would be placed throughout the game world, some of which would equal the target number while others would not. The goal of this game is to help the students identify which numbers add together to create the totals and to collect the pairs that correctly complete the equation. In-line with best practices for creating educational games, this goal (or learning objective), will also be displayed on the screen. This will help students remain on task as they proceed through the quest. Each correct answer would provide the student with progress feedback in the form of experience points. Villagers would also be placed throughout the game world for the students to interact with should the student find themselves in need of a hint to help them add up various pairs and determine if they meet the collection criteria. Continuous game play would be encouraged by awarding badges for improvements made for each play through. Badges could be awarded for faster time collecting correct items, collecting more correct items and perfect scores, where the student collected the correct number pairs without clicking on an incorrect number of pairs through the course of the level. Social constructivist concepts can also be integrated into the game play by allowing the students opportunities to challenge each other for extra experience points and badges.

Recommendations

There is great benefit to using evidence-centered designed games in education. My recommendation to move classrooms more towards this model has less to do with the teachers and administrators and more to do with the creators of educational games. We need more game designers to create evidence-centered digital games for learning and assessment. Well-designed digital games are highly engaging for the students and directs them through their learning objectives through attainable challenges and provides constant feedback about the players

achievements, knowledge, skills and abilities (Marone, 2016). Marone also states that well-designed educational games create an immersive experience while also eliciting performance as proof of knowledge (2016). There is more to creating an effective educational game than simply building one and putting it into an educational setting. Kafai & Burke state that the effectiveness of an educational game directly relies on how well the game engages the learner (2015).

Another recommendation would be to design programs that allow students to create their own games to demonstrate their knowledge. Such creative demonstrations of knowledge are not limited to subjects in science, technology, engineering and math (STEM). In studies involving learners who create their own digital games, there have been positive correlations between game-making activities and improved literacy scores (Kafai & Burke, 2015). Other studies have shown that, regardless of the subject, when students are involved in designing their own game while learning content and coding, they become even more engaged with the educational material (Kafai & Burke, 2015). Increasing the availability of evidence-centered designed educational games and encouraging students to create their own games as a part of their curriculum could truly revolutionize public education as we know it.

References

de Klerk, S. & Kato, P.M. (2017). The future value of serious games for assessment: Where do we go now? *Journal of Applied Testing Technology*, vol 18(S1), 32-37.

Kafai, Y.B. & Burke, Q. (2015). Constructionist gaming: Understanding the benefits of making games for learning. *Educational Psychologist*, 50(4). DOI: 10.1080/00461520.2015.1124022.

Reiser, R.A. & Dempsey, J.V. (2018) Trends and issues in instructional design and technology. New York, NY: Pearson.

van Rensburg, H.E., Foulds, H., Botha, L. (2017). The role of gaming in education and effect on academic performance. *8th Annual International Conference on Computer Science*.