**Review of Game-Based Learning’s Impact on Student and Teacher Learning Development, Learning Through Social Interaction, Technology, and Creativity in Colorado**

Bryan Westman

University of Northern Colorado

Education Technology 723

Dr. KU

Spring 2022

**Review of Game-Based Learning’s Impact on Student and Teacher Learning Development, Learning Through Social Interaction, Technology, and Creativity in Colorado**

Through the lens of educational technologies and teaching philosophies, there is a wide range of potential for the education system to explore. Of these forms of teaching in a classroom in the twenty-first century, there are quite a few that speak to the student’s interests. Many students in the twenty-first century are currently known as digital natives. They have grown up in a world of smartphones, tablets, computers, and the internet. “Technology has also been easily accessible through mobile devices, such as phones or tablets,” (Alfadil, et al., 2020). For these students using technology is very natural, and requires far less instruction than any previous generation. These individuals are more in tune with video games and social media than any other form of communication in human history. “Game-based learning also provides a constructivist learning environment in which students utilize existing skills to solve problems relating to the subject matter in question; game-based learning can also help students process and decode essential information for understanding learning materials,” (Adipat, et al., 2021). Education is looking toward game-based learning as a way of connecting the digital native’s natural learning skills to meet the needs of the twenty-first-century learning environment.

An important part of this process is the need for creativity. Creativity is the ability to produce ideas or solutions that are novel yet appropriate for the problem. This essential skill is needed to succeed in a complex interconnected world. Duncan (2020), states, “Creativity allows a student to think differently, which impacts the critical thinking skills.” Lee (2019) wrote, “creativity, is believed to be a critical skill that will enable members of younger generations to solve everyday problems.” Through the use of game-based learning and creativity, students are far more likely to be engaged, and learn new skills effectively. While many would argue against playing games, Lee (2019) argues “playing video games is related to multiple dimensions of creativity, regardless of the type of video game.” It is easy to apprehend that the enjoyment a person receives from playing a game can be transferred to learning, and thus improve the educational experience in schools.

Parts of the world enjoy a high degree of technological freedom and resources that can contribute to a better living environment. The state of Colorado in the United States of America is a region of the United States that has a wide-ranging level of technology, educational levels, and growing needs. In Colorado, the largest city is Denver. While the city itself is large, it is also surrounded by other cities and communities that give the impression of a much larger area. The Denver metro area is made up of a wide cultural makeup of individuals both born in Colorado and from around the world. It is a fast-growing location with a greater increase in technology usage. To demonstrate how strong technology is prevalent in Denver, the total population is 711,463, with the number of households with a computer, at 94.9 percent, from research gathered between 2016 and 2020, (Census.gov). While these numbers sound impressive, it is also important to note that Colorado is sparsely populated in rural and farming areas, as well as its mountain areas. Due to these challenges, it is worth noting that schools find it difficult to educate and find a teacher to instruct using the latest technologies. “Like most places in the country, our state (Colorado) is experiencing a shortage of highly qualified teachers in the STEM areas,” (Emerson, et al., 2020). One solution that can aid in the technology and educational divide is to utilize a teaching method that is easy for students to learn from and gain needed skills. “Many such environments are taking a constructivist approach, that is, promoting learning via an active process of the learner, and constructing knowledge,” (Israel-Fishelson et al., 2021). Game-Based Learning is an effective tool in this area of education as it can be taught from nearly anywhere to a wide range of subjects and technologies. “There is a strong need for a link between emergent technology combination and the Teaching and Learning / Pedagogical Frameworks” (Alfadil, et al., 2020). This paper looks to reflect on the connection between creativity and Game-Based Learning.

**Literature Review**

**What is Game-Based Learning and Creativity**

When discussing the importance of Game-Based Learning, the first thing that must be discussed is how to interpret it. (Scholz, et al.,2021) define it as “Game-based learning, then, is the integration of game-based principles into the design of a learning activity or assessment.” They further state, “game-based learning, encouraging play, agency, choice, social interaction, and an embedded narrative.” “The primary objective of the GBL system users is to acquire critical knowledge and skills from the courses offered by GBL systems, the key to encouraging them to continue to use GBL systems is the improvement in their learning effectiveness” (Liu, et al., 2021). This interpretation of game-based learning is important to education as it provides new methods of reasoning in terms of critical thinking. “Game-based learning is designed to balance theoretical content and learning through the use of games,” (Adipat, et al., 2021). This translates into the understanding that game-based learning is using the positive aspects of games to encourage students to learn through the process of playing games. “Game-based learning, then, is the integration of game-based principles into the design of a learning activity or assessment” (Scholz, et al., 2021). Through the process of playing games, students are given motivation as well as providing learning tools that make the learning process far easier for many. Lu, & Lien, (2020) have pointed out that “educational games could lower students’ cognitive load and enhance their playfulness; thus, it helps create an effective learning environment”. With the ability to spread the workload of learning out, students would be able to retain greater information and make stronger connections to the material. “Game-based learning also provides a constructionist learning environment in which students utilize existing skills to solve problems relating to the subject matter in question; game-based learning can also help students process and decode essential information for understanding learning materials,” (Adipat, et al., 2021). The use of technology and play can improve the learning outcomes for digital natives in the classroom when connected to game-based learning.

With game-based learning, the objective is to bring interest, excitement, and learning together in one form of reasoning. Critical thinking (problem-solving) is considered to be of high importance to the educational learning environment. Duncan (2020) shares that the 4C’s of communication, collaboration, creativity (innovative thinking), and critical thinking (problem thinking), are in much demand in education. By incorporating these skills into the learning environment of game-based learning, students can demonstrate a higher level of critical thinking. “21st-century skills include competencies such as problem-solving, creativity, and computational thinking.” (Israel-Fishelson et al., 2021). With the combination of all of these factors, an example of creativity can be addressed and assessed.

**Game-Based Learning, a New Educational Tool for Twenty-First Century Education**

**Playing to Learn**

When discussing the digital native, it is important to reflect on their natural desire and skill at playing video games. “Technology has been a convenient tool for engaging young adults with their peers and situating their conversations in authentic environments,” (Alfadil, et al.,). “The principal structure of many games is based on interchanging disappointment and victory,” (Adipat, et al., 2021). Students can be shown through playing games and learning to overcome many factors that tend to dissuade learning. “Game-based learning, encouraging play, agency, choice, social interaction, and an embedded narrative,” (Scholz, et al., 2021). With students being encouraged to continue playing regardless of setbacks, educational opportunities are provided in such a way that allows for better comprehension and growth. “For this reason, game-based learning can represent a practical tool for developing a growth mindset,” (Adipat, et al., 2021). The nature of play with a purpose has shown to be an effective way of scaffolding a learner’s understanding of materials in novel ways.

Emerson, et al., 2020). Stated “relevant learning material at key moments were indicative of problem-solving strategies or lack thereof. As such, representing granular traces of students’ gameplay behaviors have shown to contribute to a deeper understanding of gameplay or learning processes, during game-based learning that contribute to knowledge acquisition.”

Once a student has mastered a skill through game-based learning, the knowledge is taken in with a deeper understanding and notable retention of the information. It is through the act of play that the cognitive load has been lessened, enjoyment of the learning has been increased, and the outcome provides for an improved classroom experience. “Many such environments are taking a constructivist approach, that is, promoting learning via an active process of the learner, and constructing knowledge,” (Israel-Fishelson et al., 2021). Using the approach of learners building on previous experiences grants for the digital native the ability to learn materials in a far less stressful environment. “Cognitive engagement is required for the student to meet any learning objectives placed within the game and is also the most important aspect of reaching the “sweet spot” of challenge,” (Duncan, 2020). Through positive challenges, students are shown to develop better connections to the material they are presented with.

**Scaffolding the Learning**

Through the scaffolding of information, learners build on previous academic experiences as well as develop intuition, or creative assessment of potential outcomes. “Scaffolding informed by more than one modality has significant promise for providing real-time, individualized feedback that addresses the specific issues a student may be experiencing,” (Forte-Celaya, et al., 2021). This scaffolding of knowledge also plays into a student’s ability to learn and play other game-based learning tools in the classroom. Students build their game experience to help develop an understanding of topics. These learning events are constructed into one learning outcome, which then can be used for real-world connections.

The process of scaffolding is built on the theory of constructionism theory. By letting learners build their understanding of the world, their education, or their interactions with the material, they develop greater understandings. “Three theories are essential to the development of a game-based learning approach model: narrative-centered learning theory, problem-solving theory, and engagement theory,” (Adipat, et al., 2021). Students are supported to understand through this system but are encouraged to use multiple aspects of these methods of realization. “The characteristics of an educational game are essentially determined by its interactivity aspects, while others suggest that dynamic visuals, regulations, objectives, and interaction features are the defining characteristics of educational games,” (Adipat, et al., 2021). All of these tools provide both an engaging environment for entertainment purposes as well as for educational experiences.

**Social Learning**

Game-based learning is a natural method of social interaction, intellectual challenges, and creativity, and one that offers enjoyment for the majority of students. (Adipat, et al., 2021), Stated, “Collaborative learning involves students obtaining knowledge through sharing information with the class community, and the use of technology in learning is known to encourage students to be more interactive and less passive during learning sessions.” The current generation of learners has also developed their own form of social interaction. While most students need interaction, many find games as a better way to interact with each other in social activities.

”Among these varied examples of game-based learning is a recurring need to allow learners to discuss what they played, interact while playing the game, solve open-ended problems—and due to the very nature of these games—encourage agency and choice for the players,” (Scholz, et al., 2021).

In traditional classroom environments, it is expected for students to face forward and limit communication. The digital native learns better in an environment in which they can interact with both technologies and in a social manner with other learners. This method of instruction has also been shown to aid educators in their teaching of subjects. “Instructors found that technology has increased their communication with students, which was helpful in large introductory-level courses,” (Alfadil, et al., 2020). These interactions through the aid of technology are increasingly the natural and most comfortable method for digital natives to learn through.

**Creativity and Programming**

The creative aspect of game-based learning is an important feature of learning promotion. “Creativity is described as the ability to develop processes or achievements that are both new relevant and valuable while adjusting to the context in which they occur,” (Romero, et al., 2019). Digital natives are encouraged to develop creativity as it is a skill that is in high demand for twenty-first-century jobs. Through programs like Scratch which uses play to encourage learning, students are encouraged to develop new coding skills. “Scratch is a visual programming environment that lets users create interactive, media-rich projects,” (Maloney, et al., 2010). Programs like this encourage students to learn through play, which provides a rich environment for educational advancement. The developer of the program, Dr. Resnick, believes that creativity and the use of tinkering with hands-on activities is one of the best ways of discovering. “Tinkerability encourages hands-on learning and supports a bottom-up approach to writing scripts where small chunks of code are assembled and tested, then combined into larger units,” (Maloney, et al., 2010). It is the process of looking at new ways of learning and, incorporating creativity in game-based learning that will prove the most beneficial teaching tool for students.

Through the process of building games and then playing the games, students are encouraged to use their inspiration in the classroom. Using techniques that encourage creativity, scaffolding, project-based learning, and game-based learning, digital natives are provided d a learning environment that best suits their distinct ascertaining styles. It is important to note, “game-based learning is not superior to other learning approaches in terms of educational potential, but that it has a greater potential to enhance motivation and increase student interest in the subject matter,” (Adipat, et al., 2021). With the dropout rate of students increasing as they progress through each grade level, it is worthy to find new and novel methods to encourage their creativity and engagement in their learning.

**Educational Needs in Colorado**

For educators to put game-based learning into effect, it is important that they look at the process from a new viewpoint. In support of current educators to meet the educational needs of their students, a greater emphasis must be put on STEM programs. STEM stands for science, technology, engineering, and math. These programs are in high demand and, when combined, provide better hands-on opportunities for growth. Further, educators will also have to engage their students using creativity, project-based learning, and game-based learning to provide a beneficial learning experience. “Teaching creatively refers to teachers using imaginative approaches to make learning more interesting, exciting, and effective,” (Frossard, et al., 2012). It is important for educators to find and use methods that appeal to students, their notion of learning, and their interaction with the subjects. When developing a lesson for a STEM-based program, it is useful to keep hands-on learning in mind, as the action of teaching in this manner builds stronger connections to the material. “An important key of a game-based learning is how students’ informal notion of mathematics concepts is brought to a formal understanding of the concepts,” (Wijaya, Doorman, & Elmaini. 2021). It is through game-based learning that digital natives are able to make real connections between STEM learning and real-world connections. Wijaya, Doorman, & Elmaini. (2021) state, “It has been found that when a student has a higher acceptance of a new learning technology (environment), a learning behavior is more likely to form and be sustained.” With educators focusing on creative and interactive game-based learning, it is possible to provide a learning atmosphere that advances education outcomes.

“When designing game-based learning activities, instructional designers and teachers should attempt to enhance students’ feelings of learning, playing, and self-efficacy so that students who have a strong perception of playing but weak perception of learning may shift their perceptions toward learning and playing to the level of students for more effective learning to take place,” (Wijaya, et al., 2021).

They further state. “Helping students build knowledge means it is crucial for a teacher to understand students’ thinking for which conceptual analysis and conjectures of students’ actions and thoughts are required.” Across the use of game-based learning, it is evident that significant learning can be achieved as it functions well with digital natives’ preferred learning methods.

**Teachers Needs**

Among the demands of educators in the state of Colorado, there have been several programs put into operation. These programs are meant to both help educators understand the best methods of teaching using game-based learning and STEM programs.

“The learner-centered game design methodology appeared as a productive and creative approach to teaching and learning, along with difficulties, but worth to explore if we want to promote creative teaching and creative learners and, by extension, creative people. It implied a paradigm change in teachers’ practices, who risked their traditional methodologies for unknown teaching approaches, closer to their students’ cultural realities,” (Frossard, et al., 2012).

To effectively provide these training, both school districts and educators are in favor of Professional Developments that encourage these types of resource instruction. “Models of STEM-related content should be explored to determine the most effective and relevant mode of professional development content for current educators,” (Stevenson, et al., 2015). Aiding this approach to teaching requires multiple methods and philosophies that can be brought together in order to provide improved teacher instruction. From these combinations of technologies, and theories, educators can develop their own programs that are in tune with game-based learning. “To overcome the obstacles of introducing GBL informal learning settings, a constructivist approach is adopted, in which teachers designed their GBL scenarios, specially adapted to students’ characteristics,” (Frossard, et al., 2012). By supporting educators with the skills that connect their teaching methods, the current educational requirements of the state of Colorado build a growth mindset.

New forms of education based on constructionism, and game-based learning, provide educators with better classroom environments. “Supporting teachers with content-specific professional development in low population areas is complex, and providing opportunities for teachers in more remote locations, such as mountain communities, is even more difficult,” (Stevenson, et al., 2015). The state of Colorado is a diverse location of rural, mountain, and urban locations.

“Teachers who feel less prepared to lead a classroom are three times more likely to leave the profession than colleagues who feel better prepared, while novice teachers who participate in teacher induction programs are two times less likely to leave teaching,” (Banghart, 2021).

It is important that schools from a wide range of environments be provided the resources necessary for their educators to be able to be sustainable in their teaching practices. When surveyed, teachers from the Aurora Public School district believe that the need for professional development to provide them with technology training for the future is necessary. “The Aurora Public Schools district had 1,786 completed surveys that represented 79.6% of all the potential participants,” “the top three items were: social-emotional learning, differentiated instruction, and using technology in classroom instruction,” (Marle, 2019). With a clear priority of needs over the past few years, it is imperative to acknowledge that the methods of teaching in the past are not as effective for the current teacher needs. Banghart, (2021) states, “Colorado leveraged scholarships and a teacher immersion program to combat a 20 percent teacher turnover rate.” Educators are in need of their training through Professional Development to be a priority. With these programs, the state of Colorado hopes to improve the teaching environment and the outcomes for the students.

**Conclusion**

Game-Based Learning is a methodology of teaching that is quite effective for the current generation of students in grades kindergarten to twelfth grade. When digital native is asked to learn in a more traditional environment, they are not given the methods that best suit them. A constructionist philosophy of teaching is designed to scaffold a learner’s understanding of the subject matter. By building an understanding through the use of technologies, students are able to use multiple cognitive tools to provide for greater retention. Once students combine their learning with skills gained through project-based learning, they are provided an education that they can see the reasoning behind projects. The use of game-based learning gives an educational format that is in tune with the digital native’s preferred method of learning. By using these skills in a new way, students and educators alike are given the ability to provide a level of creativity in the educational environment that has not been seen before.

The state of Colorado, like many others, is facing a challenge in the educational field. It is facing challenges with engaging students in new ways that provide a real-world connection that they feel comfortable with. Educators feel they need greater training and are not prepared to teach technology. They all recognize that they are not prepared to teach game-based learning forms of education in their classrooms. Through professional development programs, it is possible to improve the instruction and quality of the teaching field. In order to improve the classroom environment, one of the best practices is to teach with a tool that engages the students in multiple ways. Combining multiple teaching means is a way of creating an outcome that gives both educator and learner a positive conclusion. It is through game-based learning, the digital natives feel that they are being properly engaged, challenged, given social connections, and shown technologies that relate to their understanding of the world.

**References**

Adipat, S., Laksana, K., Busayanon, K., Asawasowan, A., & Adipat, B. (2021). Engaging students in the learning process with game-based learning: The fundamental concepts.*International Journal of Technology in Education, 4*(3), 542-552. <https://unco.idm.oclc.org/login?url=https://www-proquest-com.unco.idm.oclc.org/scholarly-journals/engaging-students-learning-process-with-game/docview/2595809557/se-2?accountid=12832>

Alfadil, M., Anderson, D., & Green, A. (2020). Connecting to the digital age: Using emergent technology to enhance student learning.*Education and Information Technologies, 25*(3), 1625-1638. <http://dx.doi.org.unco.idm.oclc.org/10.1007/s10639-019-10035-z>

Banghart, K. (2021). Teacher recruitment and retention in rural Colorado.*State Education Standard, 21*(1), 29-32. <https://unco.idm.oclc.org/login?url=https://www-proquest-com.unco.idm.oclc.org/scholarly-journals/teacher-recruitment-retention-rural-colorado/docview/2527357398/se-2?accountid=12832>

Duncan, K. J. (2020). Examining the effects of immersive game-based learning on student engagement and the development of collaboration, communication, creativity and critical thinking.*TechTrends: Linking Research and Practice to Improve Learning, 64*(3), 514-524. <http://dx.doi.org.unco.idm.oclc.org/10.1007/s11528-020-00500-9>

Emerson, A., Cloude, E. B., Azevedo, R., & Lester, J. (2020). Multimodal learning analytics for game-based learning.*British Journal of Educational Technology, 51*(5), 1505-1526. <http://dx.doi.org.unco.idm.oclc.org/10.1111/bjet.12992>

Forte-Celaya, J., Ibarra, L., & Glasserman-Morales, L. (2021). Analysis of creative thinking skills development under active learning strategies.*Education Sciences, 11* <https://unco.idm.oclc.org/login?url=https://www-proquest-com.unco.idm.oclc.org/scholarly-journals/analysis-creative-thinking-skills-development/docview/2608864659/se-2?accountid=12832>

Frossard, F., Barajas, M., & Trifonova, A. (2012). A learner-centred game-design approach: Impacts on teachers' creativity.*Digital Education Review,*(21), 13-22. Retrieved from <https://unco.idm.oclc.org/login?url=https://www.proquest.com/scholarly-journals/learner-centred-game-design-approach-impacts-on/docview/1037908695/se-2?accountid=12832>

Israel-Fishelson, R., Hershkovitz, A., Eguíluz, A., Garaizar, P., & Guenaga, M. (2021). A log-based analysis of the associations between creativity and computational thinking.*Journal of Educational Computing Research, 59*(5), 926-959. <http://dx.doi.org.unco.idm.oclc.org/10.1177/0735633120973429>

Liu, Y. C., Wang, W., & Lee, T. (2021). An integrated view of information feedback, game quality, and autonomous motivation for evaluating game-based learning effectiveness.*Journal of Educational Computing Research, 59*(1), 3-40. <http://dx.doi.org/10.1177/0735633120952044>

Lu, Y., & Lien, C. (2020). Are they learning or playing? Students' perception traits and their learning self-efficacy in a game-based learning environment.*Journal of Educational Computing Research, 57*(8), 1879-1909. <http://dx.doi.org.unco.idm.oclc.org/10.1177/0735633118820684>

Maloney, J., Resnick, M., Rusk, N., Silverman, B., & Eastmond, E. (2010). The Scratch Programming Language and Environment.*ACM Transactions on Computing Education, 10*(4), 1-15. <http://dx.doi.org/10.1145/1868358.1868363>

Marle, P. D. Department of Accountability and Research 2018-19 Teaching and Learning Conditions of Colorado (TLCC) Report.

Romero, M., Arnab, S., De Smet, C., Mohamad, F., Minoi, J., & Morini, L. (2019). Assessment of co-creativity in the process of game design.*Electronic Journal of e-Learning, 17*(3), 199-206. <https://unco.idm.oclc.org/login?url=https://www.proquest.com/scholarly-journals/assessment-co-creativity-process-game-design/docview/2396840413/se-2>

Scholz, K. W., Komornicka, J. N., & Moore, A. (2021). Gamifying history: Designing and implementing a game-based learning course design framework.*Teaching & Learning Inquiry, 9*(1), 99-116. <https://unco.idm.oclc.org/login?url=https://www-proquest-com.unco.idm.oclc.org/scholarly-journals/gamifying-history-designing-implementing-game/docview/2540398193/se-2?accountid=12832>

Stevenson, M. Stevenson, C. Cooner, D.(2015). Improving teacher quality for Colorado science teachers in high need schools. *Journal of Education and Practice*, v6 n3 p42-50 <https://www.census.gov/quickfacts/denvercountycolorado>

Wijaya, A., Doorman, M., & Elmaini. (2021). A learning trajectory for probability: A case of game-based learning.*Journal on Mathematics Education, 12*(1), 1-16. <https://unco.idm.oclc.org/login?url=https://www-proquest-com.unco.idm.oclc.org/scholarly-journals/learning-trajectory-probability-case-game-based/docview/2540354011/se-2?accountid=12832>