Good Learning and Good Games

Taking a Critical Look at Current Professional Practice and Possibilities

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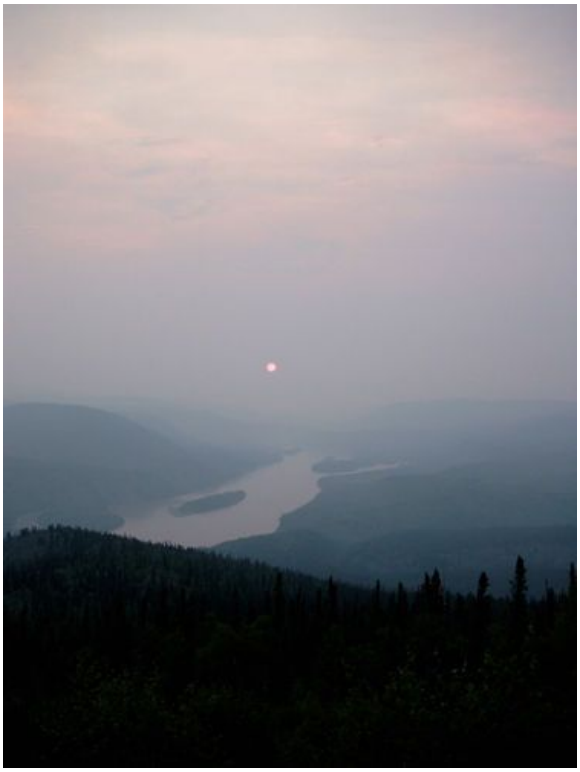
Gamification is, according to Tanya Logan (2019) in her presentation regarding gamification and motivation, the process of incorporating game-based elements into non-game circumstances. The use of such strategies as badges, leader boards and points can help to increase both engagement and motivation for participants.

I have included many examples of how to incorporate aspects of gamification, and the appeal of doing so, in the discussion regarding James Paul Gee's Principles of Good Learning that follows these definitions.

Game Based Learning is the process of incorporating game features as part of one's teaching strategy. Operating on a somewhat deeper level than gamification, game based learning can include such processes as the development of a story line around which a learning strand is developed, complete with the opportunity to level-up as increasingly more complex problems are resolved. According to the University of Waterloo Centre for Teaching Excellence: "game-based learning designs learning activities that are intrinsically game-like." (University of Waterloo, 2018)



After taking part in professional development opportunities related to game based learning and gamification, I began to build a role playing unit for my Workplace Math 10 class that would have them assuming the character of a person going north to take part in the Klondike Gold Rush. The math opportunities are huge, from calculating currency exchange for train

or steamer tickets, determining travel times, and creating budgets, through solving the problem of how to carry a year's worth of supplies over the Chilkoot pass to the goldfields. We can incorporate surface area by having students stake and "register" claims. I have maps from the Yukon Government showing the original gold fields on which students can stake those claims, and some of the original data regarding how much gold was taken from the various creeks. We can make the data more fine grained through the use of probability (the roll of a die). I have ideas for side quests, and alternate characters - shopkeepers, innkeepers, shysters, trappers, and Tr'ondek Hwech'in people. I lived in Dawson City, Yukon long enough to know a bit of the history, and still have friends and family there to draw on as resources. What a wonderful fun math class that would be!

The website 'trainingindustry.com' defines **serious games** as "games that are designed for educational, learning or product promotion purposes. [ ] not developed solely for fun or entertainment purposes". (trainingindustry.com, 2019). These are games with a hidden, or not so hidden agenda. The game Mindlight is designed to help children with anxiety to develop skills that will enable them to control their reaction to stressful situations, using techniques like breathing and self-talk.

In a math classroom, simple addition match games can be both entertaining and highly useful as they help learners to develop automaticity with basic math facts. Thus, young mathematicians can later focus on more complex concepts without having to devote brain cells to those early ideas. There is an old solitaire game that involves building a pyramid and then finding pairs of cards that add up to 13. Both cards must be unencumbered by other cards on the pyramid. When a pair is made, the cards are removed to release the cards beneath. Thirteens are removed until you can make no more matches. The game can be adapted to many different values and is a more enjoyable method to practice addition skills than is doing a worksheet.

Simulations are a specific type of serious game that tries to replicate real world activities. Sim City allowed players to design communities, citizens reacted

positively or negatively according to the organization of the city. Bad traffic would have your citizens move away eroding your tax base, natural disasters necessitated reallocation of funds from building a stadium or hospital to reinforcing a seawall. No university? Off go your citizens, tax dollars fall and your city starts to die. Simulations are frequently developed for training, such as programs used in the health care sector to allow medical workers to build skills to deal with emergencies, or flight training programs for pilots, or driver's training software to expose professional drivers to different situations before they actually go out on the highway.

I am working on developing a trajectory simulation game for senior mathematics, that would have participants calculate the necessary parabola to land in a specific spot from a predetermined starting point, much like the old PC game called Scorched Earth. In Scorched Earth, two tanks faced one another with an obstacle in between. The goal was to try to lob a shot over the obstacle and land a direct hit on the other tank. Every single shot was a quadratic equation but the math was neatly hidden. I would like to re-visit Scorched Earth and have my students do the math to take the shot rather than simply adjusting the angle of the barrel.

Commercial off the Shelf (COTS) products are exactly what it sounds like: a pre-packaged product that can be purchased ready to go. It will come completely developed with rules and all the parts included. COTS games such as Monopoly and Chess have been used in classrooms for a very long time. More recently, games like Minecraft and Civilization (which were originally created for the entertainment market) have become more common as educational applications.

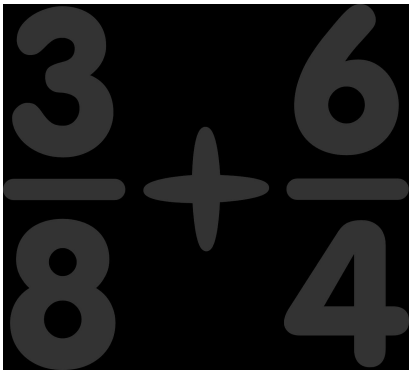
I have used Monopoly, Chess and Checkers with my students for years, though generally as a Free Friday or end of term diversion. The most frequently used games in my room tend to involve dice or playing cards as we have a probability component in the curriculum for all of my courses, and cards and dice lend themselves readily to explaining probability. I would very much like to learn more about Minecraft and see how I might incorporate it into my classes, and my grandson has offered to provide free tutoring.

Principles of Learning

1. The Well Ordered Problems Principle:

   The Well Ordered Problems Principle suggests that, if problems are posed that are too ill defined, or too challenging for that level of learner, creative individuals will 'discover' their own route to success, sometimes choosing methods that might work for that unique problem, but do not transfer to later applications.

   In senior maths, we encounter the result of not-so-very-well ordered problems regularly. Many of the creative solutions come in the form of "shortcuts" that learners have devised themselves, or have been learned as reasonable solutions in earlier classes. The problem is, these junior mathematicians don't have the understanding that was supposed to be developed alongside those earlier concepts; rather they have a memorized algorithm that "works every time". Except it doesn't. Then the challenge is to help young people to unlearn something with which they are confident and they feel has been successful, without damaging their confidence or interfering with their willingness to innovate.

   One of my favourite teaching opportunities is when I make my students review fractions as though they had never seen them before. The crackle of AHA! moments snapping like popcorn from table to table about midway through the lesson, is music to my ears. We have to start at the very beginning, defining what a "denominator" actually represents, and then build one concept at a time, allowing the learners to 'discover' and describe the changes as they

occur, and share their learning with their neighbours. Works almost every time - as long as the steps are not too easy, and not too hard. They have to be just right or learners resort to questionable techniques.

2. The Pleasantly Frustrating Principle:

   Problems need to be within a learner's ability, but not so easy that they become tedious. Learners need to be able to recognize progress in order to be motivated to continue moving forward.

   In my personal experience as a learner, I generate my own state of pleasantly frustrating problems by always starting where I know I am most likely to succeed, most of the time - but not so easy that it feels like work. Most math learning opportunities build on early skills, and if you can diagnose the point at which you consider yourself a master, you can move forward a little bit at a time, maintaining competence and confidence. People like to feel in control of what they are doing, and if there is a big leap between concepts, it can completely subvert previous success; in a world as complex as mathematics, being able to take small bites is the difference between satisfaction and choking.

   When I was in university, I had to take a course called "Introduction to Real Analysis", and I was actually pretty excited because I thought that I would finally learn how to do a proper proof. The instructor was brilliant. In fact, he was so clever that he wrote the text we used. Then when he taught a lesson, he used the sole example from the text in the lecture to demonstrate the topic. The questions in his assignments were orders of magnitude beyond what he showed us in class, and there were no other opportunities to progress within the proffered materials. When we asked for tutelage, he felt he could not "just tell us the answers…". Thus, there was no scaffolding, and no way to bridge the gap between demonstration and practice in order to achieve any level of competence or confidence. I learned a great deal about how not to teach mathematics and dropped my math major for a minor because my confidence was shattered (and I was already a fully functioning forty year old learner - imagine how the teenagers in my class felt - though they were much more forgiving.) The Pleasantly Frustrating Principle applies even when there is no game style approach to the lesson. It's just good teaching.

   In my gaming past, for several years I was an avid player of Diablo 2, a role playing game from Blizzard Entertainment. My partner and I had completed the

game and expansion packs many times and were working our way through the 'Hell' Level when a new update came out. We were actually in the process of defeating the last boss (Baal - a pretty seriously bad guy) when we installed the new release. Along with the patches and treasury of new features came an increase in difficulty, which would have been acceptable - even desirable - had it followed the 'pleasantly frustrating' principle. However, we were forced all the way back to the second 'dungeon' (just after beginner level) and would have had to repeat almost the entire game again. By that time the repetition of skill building and treasure hoarding had become tedious and we never finished the game on Hell level. Consequently, Baal still terrorizes the Diablo universe.

3. The Cycles of Expertise Principle

Cycles of expertise are the process by which a learner starts with a base skill and practices to mastery. Once the learner becomes a master, a more challenging facet is introduced and the learner begins again to acquire mastery until another hurdle is encountered, forcing the learner to adjust their thinking and learn something new.

The Expertise Principle is the point at which mathematics and gaming should become inextricably intertwined. All of basic mathematics, all the way to the end of grade 10, can be described as addition. Each grade level introduces a little irritant that makes the addition learned in the last grade a little bit harder, but it's really just a tweak from what you learned before.[1] If students were able to work their skills to near automaticity, then the next level would mean integrating one more small step, rather than adding an extra challenge before students have actually defeated the Big Boss of the last level. It is challenging as a teacher to watch as learners struggle with basic addition facts, and know they are afraid

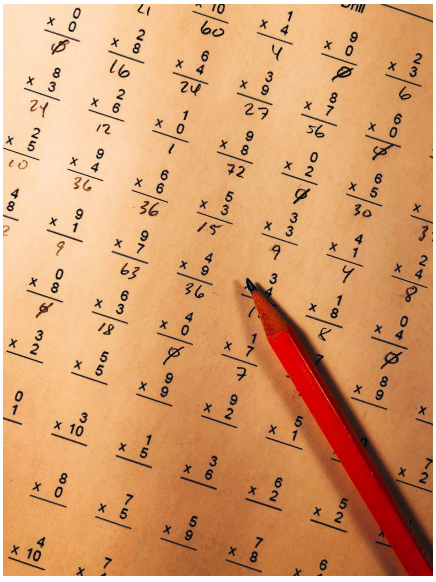
[1] Subtraction is adding negative numbers. Multiplication is FAST adding for big numbers. Division is FAST subtraction for big numbers. Fractions are adding parts of numbers. Even algebra is adding numbers when you don't know what the number actually IS. True story.

they will ‘get in trouble’ if they can’t do it fast enough - which makes them even less likely to succeed. On the other hand, if you take them all the way back to the beginning of addition, and let them practice until they feel quite smart, their attendance stops being an issue and they become less afraid to try something a little bit harder.

As a learner, the Cycles of Expertise and Pleasantly Frustrating principles determine my willingness to keep trying. Repetitive practice is not unbearable providing you can see that you are consistently doing better, and when you are given a clear indicator of having completed a cycle.

Conclusion

In my practice, I teach a class that is frequently populated by challenged learners of all sorts, behavioural, physical, academic, brought together by a single need: you can’t graduate until you have completed a math class. In this class, I take the students all the way back to single digit addition, which most of them can do. I use it to build their confidence and to help them to develop some more successful learning habits, like doing the practice and asking for help. We recognize completion through simple quizzes, and small celebrations (game days, puzzle days, problem solving opportunities, or their favourite one *popcorn day! With real butter, please, bowie).* The steps must be kept small, and steady. Just hard enough to keep the faster students going, and the less confident ones progressing. I provide opportunities for some to move ahead, and others to do enrichment. The work must be just barely challenging - pleasantly frustrating. I frequently provide different methods of performing basic skills and I provide ‘no surprises’ assessment opportunities. Coupled with helping them to develop better individual learning skills, we have a fairly Well-Ordered learning process. My goal is to find ways to



encourage them to practice to automaticity - through Cycles of Expertise - which is part of why I am in this program.

There are many game style applications that allow learners to practice basic facts, but most I have found assume that the player will be at grade level. The ideas are good, but the delivery is too often infantile. I must do more research to find match games, or target style games (for example), that will keep fifteen year old boys practicing basic addition until they can recognize math facts faster than I can - and then I need to do the same with subtraction, followed by multiplication, and so on. I have regular successes with my current approach, students who turn around after finishing grade 11 Apprenticeship Math and decide that they should go all the way back to grade 10 and try Pre-Calculus, finally graduating having completed 4 or 5 math courses. I am grateful for those opportunities, but I would really like to capture the interest of a few more of my truly reluctant learners. I think simple arcade style games would be an excellent hook.

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