The development of an educational game – Math Tennis

I first saw an educational computer game in January 1997 in Japan. I had been using games in the classroom for six years. That games helped learning had been an axiom for me since an intensive Welsh-language summer course; at the end of the first week, I was sat in a pub, speaking in Welsh, and realised that whereas traditional methods at school had taken five years to get us to the point where we could converse, it had taken five days using a games-based approach (that and alcohol). Games, I decided, might be a means of replacing ways of teaching that were tedious for both teachers and the taught.

The game running on a staff-room computer at Sendai Senior High School was, therefore, immediately interesting. The aim was to guide a car around some city streets by typing in left, right, or straight on. Within seconds, it became clear to us that it had no intrinsic play value, and we wandered off, back to our desks. As the game developer Raph Koster put it: "boredom is always the signal to let you know you have failed".[1]

Although I had used plenty of games photocopied from books and developed my own, I had never considered in depth what it is that makes a person wander off rather than remain engaged, or whether a game activity actually is more productive than written exercises - in fact I'm still not convinced that games are necessarily a more effective means of teaching than traditional written exercises. Games were regarded as being useful because they raised energy levels, but for most teachers in Japan, that was as far as their contribution went. The next morning, sitting in a train, I suddenly thought of a way that a computer game could contribute to helping one learn (it was finally released in October 2018, which must be something of a record, and is currently available for Android, via Google Play, and Kindle, via Amazon).

In this brief essay, I will describe that game – Math Tennis, by Blinking Lizard Software – and some reasons for considering games to be intrinsically engaging, and why this makes them useful in teaching.

Math Tennis is a simple game, based on the classic arcade game Pong. In Pong, one guides a bat left and right to hit a ball that bounces off bricks, destroying them to gain points. In Math Tennis, the bat is moved not by using left and right buttons, but by typing in numbers corresponding to the spaces beneath the bat.

Screenshot 1 shows a game in progress. The coloured bricks are at the top, the small blue ball is in flight, and the bat is beneath it. Underneath the bat, there is

a line of grey boxes, each containing a number. We called these baseboxes. Underneath the baseboxes, you can see '*x 2 = ?*', and beneath that, nine orange calculator buttons and a 'solve' button.

To make the bat move, the player makes two calculations. Firstly, she decides where she thinks the ball is going. In this case, the ball is moving up and to the right, and after bouncing off the bricks is likely going to hit the grey basebox containing the number 5. Having made this calculation, the player then makes another. This game is practising the two times table, so she multiplies five by two, types in '10' using the orange calculator buttons, and presses the 'solve' button. This causes the bat to move over and position itself above the grey basebox containing the number '5', hopefully in time to meet the ball. This action is shown in screenshot 2. A video can be seen on our website (www.blinkinglizard.com).

Screenshot 1

Screenshot 2

The game shown in the screenshot is for the two times table: if the player wished to move the bat over the grey basebox containing the number '12', she would

type in ‘24’; if she wanted the bat to move over the basebox containing the number ‘8’, she would type in ‘16’, and so on. The app, in addition to the multiplication tables, also practises number bonds, division and free addition and subtraction. Although children usually think that they know their times tables, we find in practice that they do not know them well enough to play Math Tennis without further practice. In this, I think that Math Tennis resembles the communication games used in TEFL classrooms – it forces you to develop an instant ability to recall and use the material, rather than the general more-or-less knowledge that is adequate to perform a written exercise.

The game is designed so that the bat shifts slightly left or right depending on how the player tilts the device in her hand. For desktop use, the left and right arrow buttons are used. This allows the player to aim the ball and, more importantly, brings in an element that I think is essential to gaming; combining thought with movement, even if only in the fingertips.

This was probably the first observation that struck me as a result of using games in the classroom: that considered movement, whether in the form of walking around the classroom or snatching a card from a desk, made a game more fun - and the students less likely to wander back to their desks.

This leads me into theories behind games development.

The first theory that struck me as relating to classroom games was Howard Gardner’s ‘Multiple Intelligences’; physical movement is a form of intelligence and must be involved, along with others, if the player is to remain interested over time. At the time, I also thought that games’ ability to allow a change in interpersonal dynamics (that is, the passive role of listening to the teacher and doing written exercises v. the active role of interacting with other students) reflected a separate form of intelligence, that of interpersonal relationships. By using different intelligences, I figured, games reduced the fatigue that sets in when one uses only one aspect of one’s mind.

As has been noted, Howard Gardner’s work was not particularly well evidenced. A later, research-based, book made me see games in a different light, in particular the issue of changing interpersonal dynamics. This was ‘Glued to Games’ by Scott Rigby and Richard Ryan.[2] ‘Glued to Games’ argues that part of the appeal of well-designed games is that they bring people together and thus promote relatedness - the human need to relate to others. With traditional classroom activities, it is noticeable that the better a game enables players to

relate to each other, the less likely they are to wander off or otherwise disengage.

One finds also that games that enable players to accumulate items reflecting their success in the game, and thus to establish how they are in relation to other participants, engage players better. For example, as one progresses in Uno (a game which is supremely easy to adapt for teaching languages: simply print cards with varying images and challenge the users to make sentences for the images on the cards they play), the collection of cards in one's hand grows. In Math Tennis, relatedness is facilitated by two features: the score, which allows players to compare themselves, and the multiplayer function, allowing direct competition.

Rigby and Ryan also argue that another human drive behind games' success is the innate need to establish competence - and that this is accomplished through various forms of feedback. One's score, for instance, evidences one's growing competence in a visible and rewarding way - referred to as 'representational feedback' (in Math Tennis, for instance, when the player completes a level without missing the ball once, she gains three golden stars). Another confirmation of one's competence is 'granular feedback', the second-to-second feedback reflecting actions as they occur. In Mario Kart, an example of granular feedback is the orange-blue-white sparks that appear around a kart's wheels as the player skids deeper into a curve. In a classroom game, the granular feedback comes from the reactions of one's co-players.

The last of the major human needs identified in Glued to Games is autonomy. Does the player have choices? In a language game, at least once she has reached intermediate level, a player can choose the language she uses to achieve a goal. A judo player can choose her techniques, and a player of Math Tennis can choose whether to hit the ball in the centre (safe) or with the edge of the bat, and whether to move the bat early or wait until the last micro-second, which is risky but results in greater ability to aim the ball and therefore a higher score.

The issue of autonomy brings me to a final thought about computer gaming's contribution to improving learning, involving time. In a typical game on Math Tennis, lasting two minutes, the player performs over twenty sums. In a small class competition, involving a number of games, significant practice is happening, comparing favourably with written exercises. One can also compare the fun of playing the game with the tedium of spending considerable time chorusing times tables until they stick (to a certain extent for some of the

children). A further advantage is that a game installed on a mobile device such as a tablet or smart phone allows the owner to make use of a great many otherwise unusable opportunities for learning.

If one were to travel back in a time machine to Japan, circa 1997, one would be struck that only the keenest of students engaged in mobile learning. These were the ones who made vocabulary cards and studied them on the school bus. My first (and last) educational experiment with a control group involved vocabulary cards. I printed sheets of paper featuring grids on each side. On one side of the sheet were words in English, and on the other, the corresponding words in Japanese. We handed them out to one of the English classes (the worse-performing one) and waited for the next vocabulary exam. The group's grades were better than the control group's.

Providing effective tools for learning, particularly m-learning, gives a helping hand to students who, for whatever reason, do not or cannot make their own. We help the students twice over if we make these tools fun.

References:

1. Koster, R. "A Theory of Fun for Game Design" (2005). Scottsdale: Paraglyph Press.
2. Rigby, S., and Ryan, R. (2011). "Glued to Games – How video games draw us in and hold us spellbound". Santa Barbara: Praeger.