What are games?

There are no standard definitions of what are games and what is gaming however, the following have been suggested as a useful definition. Games:

- have a formal structure with rules and goals,
- they involve chance, challenge or competition,
- they have a mechanism for scoring or other forms of feedback,
- they have the potential to form a narrative,
- they are separated from normal conventions, space and time.

This makes them distinct from simply play, which is open-ended, rather than goal orientated. Dressing up is play, but it is not a game. Chance, challenge and competition have been merged here because they have very similar roles in creating engagement with a game; competing against an opponent, overcoming chance, or solving a challenge all ultimately produce the same result, to produce a situation in which one can win or lose, which ultimately is the defining characteristic of a game.

Educational gaming projects have found the distinction between "toy" and "game" a useful one. A toy in this definition is simply the artefact with which someone can play; without structure, rules and feedback it does not constitute a game. Thus, Lego on its own, is not a game, but a toy. However, set the task of building the tallest possible tower from Lego, and elements such as competition and the opportunity to win or lose are introduced and it becomes a game. Minecraft as a world, is just a toy, and can be played in two modes, either simply to explore and build within the world (when it is just play) or in survival mode when one must defend against monsters and do so within a time limit. It is by adding in this element of challenge that it then becomes a game.

Various sub-categories of games can be produced from taking or adding elements to the above categories. Thus a game fulfilling all of the criteria but with no narrative, and with challenge (rather than competition or chance) becomes a puzzle. Add the physical element to the above factors, and we arrive at a version of games called sport. Remove the element of competition or challenge from a role play game, and it becomes interactive fiction, and indeed some digital games (for example Mass Effect 3) now have a mode in which the challenge element can be removed, resulting in simply a branching storyline.

What is gamification?

Gamification is a recurrent buzzword in education at the moment as it tries to import one element of gaming to education, which is the competitive element. Gamification takes the extrinsic elements from games related to scoring (such as leaderboards, prizes, badges etc.) and adds them to other disengaging situations (such as those in work, education or household chores), but without considering other game design aspects.

Gamification has been around in education for decades, such as giving credits for good pieces of work, or attendance, and having leaderboards in schools. Where these marks are aggregated by class it can encourage teamwork and motivate through peer pressure. Advocates of this approach point to the quick development time, and the motivating aspects of particular game elements (such as the acknowledgement of an "achievement unlocked" through a badge system. Critics, however,

suggest that what results is nothing like a game - as the underlying design principles are eschewed - and that any motivation will therefore be short-lived and unlinked to the core task.

How do games relate to learning?

The advantage of games for learning are that they are motivating. Many games have elements that have been identified to encourage game play to continue beyond the point of it being fun, in that they generate flow; a concept proposed by Mihály Csíkszentmihályi to describe a person's mental state when they are fully immersed in an activity: they have focus, energy, total engagement and feel a sense of success. The concept is regularly used by game designers as the ultimate aim for their game: to adjust the gameplay so that it creates a state of *flow* in players. This persistence in game play is attractive to teachers/learning environments and promotes the development of '21st century skills', specifically as it may enable students to persist in a variety of tasks beyond games, and in their lives. Studies link 'reward' hormone response systems that release dopamine to the moments when particularly difficult goals are achieved. The sense of achievement and positive emotions leads to a continued pursuit of further goals. It is this motivation that teachers hope to harness in their learning environments when using games as a safe learning space for students, where they are aware that the goals set within the game are achievable, allowing them to tap into their intrinsic motivation to complete the game, and learn along the way.

For some students, games can also provide a better experience of learning that the classroom. Egenfeldt-Nielsen (2005) compares the difference in experience in arcades and classrooms and noting that the games played in arcades provide "clarity of task, choice in problem-solving strategy, possibility for self-improvement, balance between skills and challenges, clear feedback, enjoyment while learning and lack of fear of failure" the implication being that, for some, the classroom does not provide this kind of learning environment.
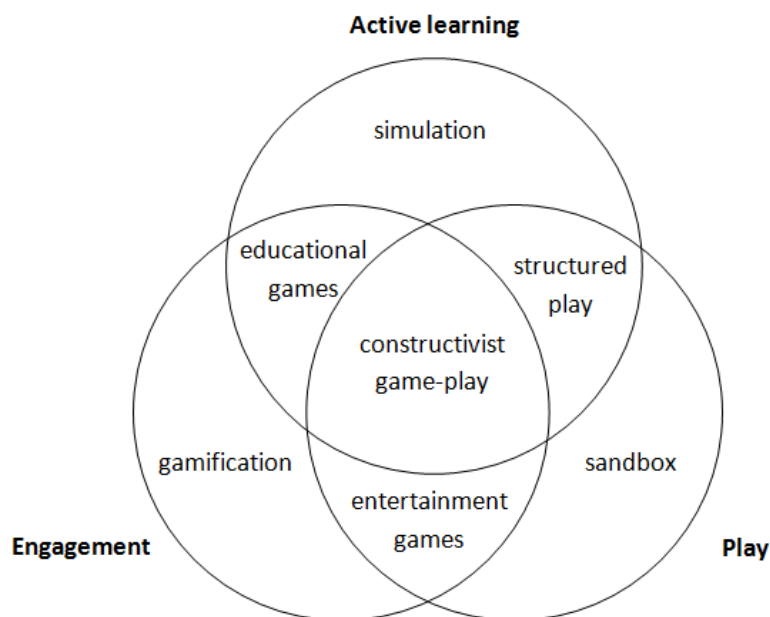

Figure 1. Engagement, play and active learning

McFarlane et al. identified three ways in which learning could be drawn from games:

- as a result of tasks stimulated by the content of the games,
- knowledge developed through the content of the game,
- skills arising as a result of playing the game. This last one could be subdivided into direct and indirect learning." (McFarlane et al., 2002).

To this could be added "knowledge learnt through creating the game". Other attempts to codify the various ways games and educational activities inter-relate is shown in figure 1.

So, examples of games that provide knowledge draw on the transmission model of learning - transferring knowledge from a person or system to a learner. Games using this approach include drill-and-practice games and tutoring systems in which users are given questions to answer and are supplied with feedback based on those answers. These types of games are limited in that they do not change the way in which the users interact with the subject content.

Games from which people acquire skills and understanding through from playing the game draw on constructivist models of learning; these place the internal thought processes of the learner at the centre of the activity and require the user to solve problems and explore the game environment, for example in a roleplay or similar activity. However, the learning and accuracy of the learning is then constrained by the learners' ability to create their own synthesis or identify the knowledge embedded within the game). This is a tendency noted by observers such as Egenfeldt-Nielsen (2005) and Squire (2005); which is that often the educational value of the game is failed to be achieved due to the learning elements of the game not being adequately placed within a learning context. In other words, the students may have acquired learning, but unless that learning is made explicit to the students, then they may not see the relevance of the knowledge acquired in relation to their curriculum

This leads us to the first of Angela MacFarlane's categories; that of learning being due to the result of tasks stimulated by the content of the games. In other words, the game is played and this becomes the motivation for further work in the classroom (for example). It is for this reason that some educators, such as Egenfeldt-Nielsen have stated that a **"game is just an excuse for a debrief"**, in that it is how the educator uses the game within the context of the rest of his/her teaching that is where the full benefit of the game is capitalised upon.

The final type of learning is through creating the game. As we've seen in the literature review, the highest order thinking skills in Bloom's taxonomy are those associated with creating. If we consider the "Top Trumps" idea from the Stoke workshop, we can see the opportunities for learning are within the creation of the game, though not in the playing of it.

In Top Trumps, the design choices are simplified, making the creation process simpler. The card can be created in a range of ways, digitally, using Paint or Photoshop, or physically on paper by drawing or as a collage. The key elements are always the same, however, a title, a picture and between four six characteristics, each characteristic accompanied by a number between 0 and 10. The cards can also contain a brief bit of descriptive text. There are 30 cards in each pack usually, though to play all that is required is that each player has the same number.

Once the basic design is decided, there then comes the task of deciding which characteristics should go on the cards. Taking the theme of Greek Gods, and Superheroes, means that the learners have to think of a number of characteristics that are important; bravery, honesty, power, strength, intelligence, speed – these are all qualities that can be opportunities to learn about how characters are represented in myth and fiction and also how the children personally consider these to be important. The selection process by which the preferred 4, 5 or 6 characteristics is a chance to learn decision-making and democratic processes. The need to combine these themes to play the packs against each other also makes additional demands on the learners – what are the qualities of the stories and characters of Gods and Superheroes which they have in common? A book on this subject, by Grant Morrison, MBE, called *Supergods* indicates that they have a similar archetypal role in our culture.

Once these characteristics have been decided, the learners must then select the 30 most suitable characters for the game, and then a design and some text to represent them. Then comes the task of assigning numbers to the 4, 5 or 6 characteristics. This cannot be done freely. To make a good game there must be a balance of low scoring characteristics and high scoring ones. Again the learners can use decision-making skills to assign these fairly. So how fast can the Flash run? Or Hermes fly? Are they the same speed? Should Zeus be as powerful as Superman or Galactus? If the Gods are all more powerful than the superheroes, then there won't be a fair game if Denmark is to play the UK, but if everyone is the same then the game won't be interesting. This is an opportunity to learn maths skills as well as literature ones.

Making the cards, choosing the short piece of descriptive text, and drawing the picture are all fun and engaging activities, but with the final goal being the creation of a set for everyone to play. Each child or group of children contribute a card to the set, but these can then be reproduced so everyone has a set. The game is played by each pack being dealt between the players, the first player picks a characteristic from the top card, and if that scores higher than his/her opponent, both cards go to the bottom of his/her deck. If they are the same they go into a pile between them, if it is lower, the opponent places both cards at the bottom of their deck. The winning player gets to call the next characteristic. Again, if both are the same they are added to the pile between them, until one player wins, at which point they collect all the cards on the pile. The game continues until one player has won all the cards. It therefore involves maths skills (what are the chances of a particular characteristic beating another) and memory (e.g. "Hephaestus is coming round soon and he scores high on intelligence but low on speed, so if I've got Ant Boy I'll pick speed not intelligence").

Also of course, if this is to be played across videoconferencing, and the game mechanics involves an exchange of cards, how can this be carried out? Again, another learning opportunity for the children.

This process reveals two important aspects of games-based learning. The first of these is to not leave the game to do the teaching, each step must be reflected upon and the learning made explicit for it to be made effective.

The second element is the essential problem with games-based learning, which is finding elements of the curriculum which can be made into games.

Issues with games-based learning

Gamification is ultimately unsatisfying because it is an externally, tacked-on scoring system, which does not intrinsically link content to game playing. The relationship between games' content and that of the curriculum can be described as either endogenous or exogenous "Exogenous games provide simple networks of generic, interactive strategies …Endogenous games connect game design and domain content by integrating relevant practices into the structure of the game." (Halverson, 2005). Research indicates that students display better recall of content when it is creatively embedded within the game endogenously, than simply added exogenously (Hostetter, 2006). In other words, games based learning works more effectively when the mechanics of the game have a structure that arises from the subject matter they are linked to. For example, health-based games are usually very effective, because in the simulation the goal is preserving the life of the patient. The role of being a medic is intrinsically score-based and this translates to the game very simply (the better the medic the fewer patients die). The Top Trumps game is linked to literary characters' characteristics, assigning them a value and then setting them against each other. Although the game itself does not represent actual aspects of the literature, the process of assigning characteristics does demand an understanding of the characters. Conversely, a game in which players play a first person shooter, and then in order to level up must answer a set of maths or physics questions, is not an effective example of games-based learning, since the maths questions and the game are not linked. Rodriguez (2006) encapsulates this need to align the course content and the game content by stating that educational games developers need to ask themselves the following questions:

- What aspects of the subject matter in question already exhibit ludic features?
- And how can a game designer exploit and highlight these aspects?

Another set of issues, though one usually associated with adults using games-based learning is that adult learners have a set of misconceptions about games in that they are:

- Frivolous and time-wasting.
- Only for young children.
- Not a respectable thing to do.
- Easy.
- Only able to provide inauthentic learning (Whitton and Hollis, 2008; 223).

Whitton and Hollins point out that the error in this presumption arises from the (largely refuted) concept of adult learning theory (or "andragogy"), which makes (unverified) assumptions regarding how adults learn differently from younger people.

The reality is that any learner may, or may not, have these reservations, irrespective of age, and so addressing these concerns is important with any learner. The potential danger of using games-based learning is that it is seen *only* as a game and therefore the opportunity to learn from it is overlooked. The debrief then becomes vitally important.

A further issue is one noted by Squire in Changing the Game in which he notes that learners who previously had an advantage in classrooms because of their academic ability can feel challenged by the introduction of games, since they encourage non-academic learners and introduce a skill set they may not have mastered to the same extent. Some research also indicates that gamers may resent the introduction of games, since it may be seen as the institution invading "their" territory.

Conclusions

So, in summary

- learning using games has a range of benefits: motivation, engagement, flow, fun.
- Games can be used for rote learning, role play and simulations, and especially to stimulate classroom discussions.
- Designing and creating games has even wider potential for learning.
- The game is just an excuse for the debrief, in other words, make explicit the learning that occurs because of the game.

However;

- The subject must relate to the game, and vice versa, otherwise the game will not be an effective learning tool.
- The learning may be missed in the fun, or the learner may not recognise the activity as a valid learning activity. "It's fun, so it's not learning".
- Introducing games-based learning is not without problems. Some students may feel threatened by it, so make explicit the specific learning outcomes from the game, and be on the look-out for those who are not adapting.