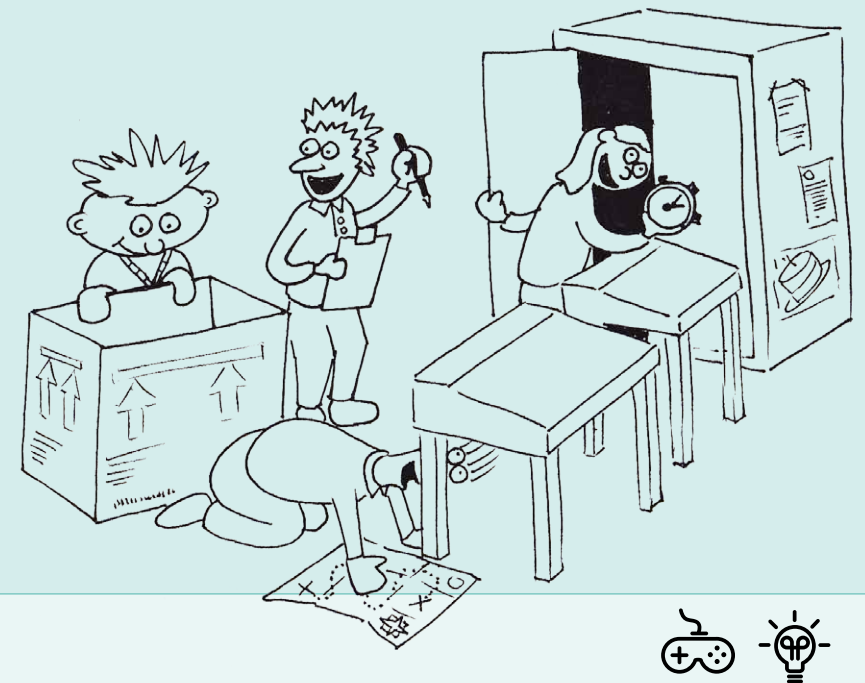


Games-Based Learning Experiences:

Testing the principles with teachers and students

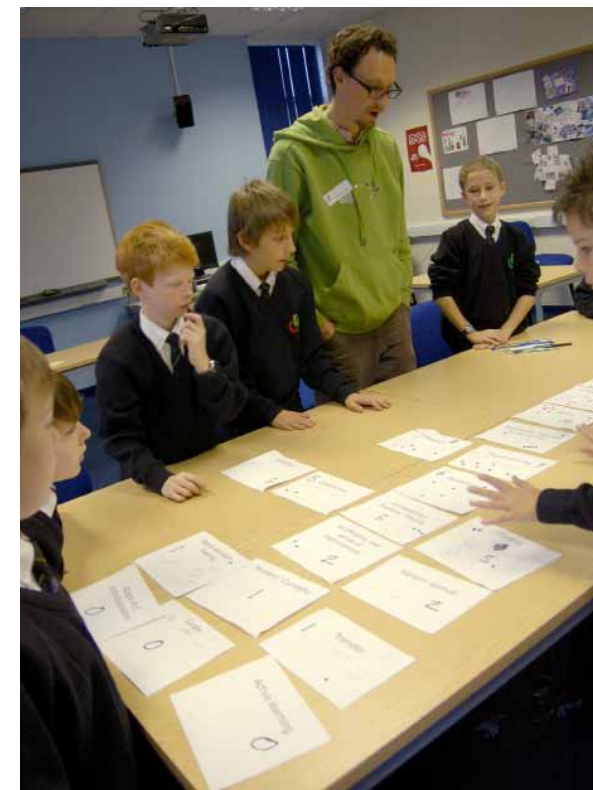


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Key findings

Many academics have analysed games in order to identify the key learning principles required to create games-based learning experiences¹. In this research we have investigated not only whether their descriptions of principles are shared by educators and students but whether they are viewed as important in creating an effective games-based learning experience in the classroom by these groups.

Many teachers see a value in games as a place for practising skills or revising content, but often have not yet explored the possibilities for learning through games, that is teaching content or skills through game play. This highlights a need to identify and develop pedagogical techniques that can be contained in games. The list of prioritised principles in this report suggests an approach for doing this by identifying which can be seen as:

- _ teacher tools for designing and enacting games based learning experiences
- _ student activities which can be undertaken in games based learning experiences
- _ possible learning goals that are appropriate for games based learning experiences.

However it is noted that further work is needed to develop these into a structured toolkit.

The teachers stated that the three most important principles were: active learning, transfer and goals. These were near the bottom of the student's list. However, in the post-prioritisation discussion the students reflected that both active learning and goals should have been higher up the scale and near the top.

The students believed the most important principles were: rules, roles and rewards, which they still felt were important in the post-prioritisation discussion. This was markedly different from the teachers who placed both role and rewards near the bottom of their list.

There were some commonalities between the teachers' and students' prioritisations and the findings of the literature review. Both groups rated highly: goals, challenge, rules, and social aspects of gaming. One marked difference between the ages is around role, that is, the role that a student takes on when playing a game. The students saw this as a crucial part of the game experience which formed a context for the entire gaming activity - this resonates with the findings of the literature review. However, the teachers did not believe role was as important and for them was seen as a teaching tool to leverage participation and engagement.



¹ The principles were identified in a previous stage in this project (see Bober 2010). In this there was a literature review and eight expert interviews to identify learning elements of digital games - see Appendix 1 for a list.

Introduction

This paper outlines the findings from three workshops with teachers and students in which they:

- _ give feedback on the relative importance of key learning elements identified in digital games
- _ explore how these elements could be used to support the creation of games-based learning experiences in formal education settings.

The workshops were designed to explore how the previous research within this project which identified learning elements from digital games (Bober 2010) could be applied in formal education settings and used as the basis for games-based learning experiences that did not have to include digital games. The teacher workshops identified tools through which these principles could be applied. However, teacher availability meant they did not use these tools to create a games-based experience.

The paper describes: the participants, the workshop activities, the findings of the workshops, and in particular teacher and student attitudes towards each of the key learning elements and which they felt were most important to include if creating games-based learning experiences for the classroom.

This report draws on the following definition of digital games-based learning experience to create a definition for both digital and non-digital games (Bober 2010, p5):

"Digital games-based learning experiences will be defined as based on activities that:

- _ have a digital game [...] at their core, either as the main activity or as a stimulus for other related activities.
- _ can take place in a formal (eg school) or informal (eg home) learning environment
- _ have learning as a desired or incidental outcome."

As such, for this purposes of this paper, games-based learning experiences are seen as activities that:

- _ have a game (digital or non-digital) at their core, either as the main activity or as a stimulus for other related activities
- _ take place in a formal (eg school) or informal (eg youth club) learning environment
- _ have learning as a desired intentional outcome.



Participants

Educators' workshop

The workshop was conducted with education professionals, all of who had some experience using games in learning. The five participants comprised of: one primary school teacher, two secondary school teachers, one sixth form teacher who was currently working as a member of support staff in the school IT department, and an informal educator who worked with excluded young people as part of the Connexions services.

All four teachers who worked in formal school environment had experience using games as 'starters' to introduce topics in lessons or as a means to revise existing learning, for example using games as a way of revising for exams. The informal educator reported games as a way of developing social skills among students.

A full list of the games mentioned by teacher's as part of a workshop activity is given in Appendix 2.

Students' workshop

Thirteen Year 7 (11-12 years) students participated in two 50 minute workshops. They were selected by their tutors because of their interest in games or as a reward for working well. Eleven students participated in each workshop; nine students attended both. In both cases the majority of the group were boys (ten in the first and nine in the second).

All the student participants reported an interest in games. All played games on a console or a computer and all reported having easy access to these devices for playing games. They were also familiar with the use of games in school and reported having frequently used games in primary and secondary education. Again these were mostly as part of 'starter' activities or to revise work.

Method

A three hour workshop was conducted by two researchers with the five educators. The workshop consisted of:

- _ a brainstorm of games they had used or seen used in school
- _ an analysis of what the principles meant to them
- _ a prioritisation exercise where they individually prioritised the principles by assigning stickers, each had a total of 21, according to their own opinion of the principles importance
- _ a reflection exercise to investigate whether the results of this prioritisation matched up to their conceptions
- _ an exploration of what practical tools they had at their disposal to realise the principles in the classroom.

The students participated in two hour long workshops with two researchers and engaged in similar activities to the teachers.

Workshop 1 consisted of:

- _ a brainstorming of games they had used in class
- _ a brief overview and exploration of what the principles meant
- _ the same prioritisation exercise the educators undertook.

Workshop 2 involved the students:

- _ reflecting on whether the results of the prioritisation gave an accurate portrayal of the relative importance of the principles and if any adjustments needed to be made to make the list more representatives of their views
- _ creating the concept for a game that could be used to teach a specific learning objective in school, and identifying which principles their game used.

Findings

Student and educator prioritisation

The students and teachers prioritised the full list of the principles identified in Bober 2010. These principles included a range of elements that were seen to make digital games an engaging and motivating experience. As shown in Table 1, there were some marked differences between the perceived importance of the principles between the educators and students – these results are those from the initial prioritisation.

Table 1: Students and Educators ranking of learning elements from digital games

Principle	Teachers' Rank	Students' Rank
Active learning	1	24
Transfer	2	19
Goal	3	23
Social aspects	4	4
Relevance interest	5	9
Rules	6	1
Safety	7	8
Assessment	8	12
Creativity	9	6
Competition	10	13
Scaffolding and sense of improvement	11	18

Rapid decision making	12	20
Sensory stimuli	13	17
Feedback	14	10
Refection space	15	14
Realism	16	15
Adaptivity	17	22
Fantasy / narrative	18	7
Reward	19	3
Challenge	20	5
Role	21	2
Puzzle solving	22	11
Control	23	16
Mystery	24	21

The teachers' top three principles of active learning, transfer and goals were near the bottom of the students list. However, in the post-prioritisation discussion the students reflected that both active learning and goals should have been higher up the scale and near the top.

The students' top three principles were rules, roles and rewards, which they still felt were important in the post-prioritisation discussion. This was markedly different from the teachers who placed both role and rewards near the bottom of the list in positions 19 and 21 respectively.

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Discussion of principles

The following is a summary of the elaboration of the principles of both educators and students. The principle definitions were not discussed with either group in advance. This gave each group the freedom to interpret the principle rather than feeling limited by the academic viewpoint. The aim of this exercise was to:

- determine if the academics view and descriptions of important principles was held by teachers and students
- whether the understanding of the 24 principles was shared by teachers and students. This is important if engaging games-based experiences are to be created as, for example, teachers need to consider how students view roles and feedback if they are to be successfully incorporated.

Goals²

Although the students did not prioritise goals during the prioritisation exercise – they did reflect that ‘it was key’ when reflecting on the results. Both educators and students had a similar understanding of goals when playing a game, such as it expressed the purpose of the game and how game achievements are identified. While the students focused on a more game-play oriented understanding of goals, the educators also reflected on wider goals of using games. They noted games may be used to support the development of specific skills or knowledge, but also that the goal may be to engage students in the learning process. For the educators, articulating the goals of a game was crucial as it led to a shared understanding between teachers and students of the purpose of the exercise. The process of achieving goals was also seen to build resilience in students.

² As the aim of the workshops was to explore the different understandings of the principles held by teachers and students, it is not possible to give a definitive definition of the principles here. For an explanation of findings from the literature review and expert interviews please see Bober 2010.

Rewards

Rewards were seen as important by the students. They were viewed as motivational prior to game play as well as at the end. The teachers articulated the value of rewards and brainstormed a variety of ways that rewards could be offered to students, nevertheless they did not prioritise them highly in the construction of games-based learning experiences.

Role

Role was another area that was prioritised differently by students and teachers. For the students, role was an integral part of the game play and drew on many different elements such as identity, goal and competition. They were necessary to describe the players ‘job’ in the game. This applied to story-led digital games, for example, war games like Call of Duty, and physical games like football. Educators linked role more to the notion of a student’s perception of themselves in a game environment and viewed it as one of the least important factors in games-based learning. For them role was seen to be a way to support students to work outside of the social constraints that may normally inhibit their participation in education activities, and the use of role gave students permission to try out different ways of doing things. This was particularly the case with role play.

Active learning

Active learning was the top principle from the educators’ prioritisation exercise but the students gave it 0 points. For the educators active learning was heavily related to competition – puzzle solving as part of wider strategies to motivate students. In discussion the students noted that active learning should have been ‘near the top’ of the list and wanted to move it. It is possible that during the prioritisation exercise students focused on principles that they felt most related to them, and the use of the educational term ‘active learning’ was less accessible for them which resulted in them not prioritising it. Equally, it may be that for the students active learning was seen to be more of an umbrella term for lots of the other elements, such as challenge and puzzle solving, and so not prioritised in itself.

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Transfer

Teachers saw transfer, in particular enabling the transfer of skills, as a key purpose for using a game as an educational activity. In this way games were seen to be an arena where students can practice skills in order that they can be applied in real life. This was not limited to subject specific skills, but also social skills and higher order skills such as planning. Students equally recognised the role of games in practising both subject specific skills, such as spelling, but also higher level skills like strategy and planning. Nevertheless they did not prioritise it highly as a principle.

Social aspects and community

Social aspects and community were both equally placed in position number 4 and teachers and students understood these in similar ways - the idea that through game play you may learn through interaction with fellow players.

Safety and rules

Both sets viewed safety and rules as interlinked. For the students, safety related to the notion of rules and ensuring the integrity of the game, as well as basic health and safety rules to ensure the physical well being of game players. For teachers this principle related to the notion of games being a 'safe space' which supported players to take risks in a learning situation and where failing was acceptable. A part of supporting students to take risks was being clear on the goals, in this way students knew what was required. A further aspect to creating this 'safe space' was the idea that players were able to receive feedback more easily from a game or an avatar without taking it personally or reacting negatively to it, as may be the case with a teacher. Teachers also recognised the importance of having rules that were open and allowed creative approaches, but still remained within school rules, and noted that rules created collaboratively between students and teachers were often more powerful than those imposed by teachers alone.

Challenge

There was a marked difference in where the students and teachers placed challenge, with the students placing it in 5th position in

comparison to the teachers 20th. Both groups shared a common understanding that to be engaging, a game had to have an appropriate level of challenge that would be achievable but only with effort. The teachers identified challenge as tool they would use to control students progress through a games experience and linked it to scaffolding as part of a structured approach to develop students learning. However, the students also linked this principle to competition and wanting to overcome something, either internally or through competition with others.

Creativity

Creativity was placed in similar positions by the teachers and students (9th and 6th respectively) and understood in similar ways. The teachers noted and linked the importance of linking creativity to safety in order that students feel secure enough to take creative risks. They also noted that there has to be sufficient time for students to develop and finish work that is created in creative exercises, as often students may be rushed to finish their work. This can result in the personal investment students make in work not being recognised by teachers or the structure of the activity.

Fantasy / Story / Narrative

Fantasy / Story / Narrative was rated significantly differently between the teachers and students. Although teachers recognised the importance of students being able to be absorbed in something, it was not heavily prioritised by them. Rather they saw it as a tool to engage students in the exercise. For the students it was 7th on the list and noted as being important in that it gave the game a point and meaning.

Relevance

Relevance and interest to the learner, was seen as relatively important by both the groups. For students this was understood as something that the learner enjoys and finds absorbing and attractive. For teachers this linked to the value that the students saw in playing the game, for example the perceived value of the skills or content presented in the game, or the benefits playing the game would provide for students.

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Assessment

Again assessment was seen as relatively important by both groups. Teachers noted this was a tool that helped them to understand students' progress, through whatever mechanism was present in the game. They felt it linked to rewards. Equally the teachers saw that in-game assessment mechanisms had a role to play in letting the teacher know that there was a reason to play the game and 'legitimising' a game as an educational activity.

Reflection space

Reflection space was seen as moderately important by both groups, and teachers noted its value, particularly when integrated into the game.

Authenticity

Authenticity was seen as moderately important for both groups. For teachers in particular, an experience had to have an element of realism in order that it could provide an authentic environment to practice skills in. They noted, however, that often the key to this was making it psychologically real for students, rather than necessarily having to use a constructed realistic environment. In this way effective role play was seen to be authentic as it could provide psychologically realistic experience for students.

Sensory stimuli

Both groups saw sensory stimuli as having value. The teachers noted that it was both valuable as a means to help create an immersive environment, eg using a sound to tell part of a story, but equally that it could support psychological realism, eg adding a countdown to increase the feeling of time running out in a game.

Adaptivity

Adaptivity was seen as of moderate importance by both groups, as part of wider notion of having the game providing appropriate differentiated challenges for players.

Feedback

Feedback was again seen as of moderate importance by both educators and students. Teachers recognised both the possibilities of offering 'in game' ongoing feedback as well as 'end of game' summary feedback through scores that the like. Students had a more game orientated understanding of feedback and related it to the ability of the game to provide ongoing challenges.

Puzzle solving

Puzzle solving was an element seen differently by the groups. The teachers did not rate it very highly as an element, giving it no points in the prioritisation exercise. Conversely the students rated it in position 11, and linked it with the core activities of a game, and the challenge of a game. Teachers associated puzzle and problem solving as means of engagement and way to practice skills. They also noted gender differences in attitudes to puzzles and challenges, suggesting that boys preferred these more.

Control

There was a small difference in the perceived importance of control between students and teachers, though they also understood it differently as a term. Students had a much more game-focused understanding and saw it both as the game actions (eg rolling a dice) and the relative power you had in a game and your capacity for action. For teachers, it related much more to overall class control.

Scaffolding and sense of improvement

Perhaps unsurprisingly teachers placed more emphasis on the importance of scaffolding and sense of improvement than the students. Though for the students, much of the sense of development a player gets when game playing featured as part of an appropriate level of challenge. As with active learning, it is possible that the students did not prioritise this term as it was in 'education speak' and so not accessible for them.

Rapid decision making

There was a difference in perceived importance of rapid decision making. Students perceived this in a game like notion of making quick decisions under pressure. Again perhaps unsurprisingly, the teachers reflected on this more in terms of it as a tool to support the delivery of education aims. As such they saw the value of students having to make quick decisions in order to keep the exercise snappy. But equally they noted that this can place unwanted pressure on students and increase the fear of getting something wrong. They also noted that making quick decisions is not always positive and in fact they often encourage students to make more reflective decisions.

Mystery and curiosity

Mystery and curiosity were ranked lowly by both teachers and students. Teachers linked it to puzzle solving and both groups recognised it as a ‘hook’ to engage students and keep them involved in a game. The students saw that it could be valuable, but did not rate it highly.

An analysis of principles within a student created games-based learning experience

Students were asked to create a concept for a learning game in their second workshop, and afterwards reflect on which principles they had incorporated. The results are displayed below. Four games, one per group, were created³. The score is the number of times the principle was described as appearing in a game by the students, if it was mentioned in all games it scored four, if it appeared in three it scored three, etc. This student analysis, along with the elements original rank from the student prioritisation exercise, is shown in Table 2.

Table 2: Elements used in student game creation

Element	Identified as being in the games by the students	Original student rank
Role	4	2
Reward	4	3
Competition	4	13
Rapid decision making	4	20
Challenge	3	5
Puzzle solving	3	11
Control	3	16
Goals	3	23
Rules	2	1
Creativity	2	6
Safety	2	8
Active learning	2	24
Social aspects/ community	1	4
Fantasy	1	7
Relevance	1	9
Assessment	1	12
Mystery	1	21

³ For a description of the games see Appendix 3.

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While both role and reward are consistently high, competition, rapid decision making, challenge, puzzle solving, control and goals also feature highly on the list, being in three of four of the games. However the first nine elements from the student prioritisation exercise are also present in this list, illustrating a consistency between the student prioritisation exercise and their actual use of the principles in learning game design.

Relation to key principles

Dr Bober identified six key learning elements of digital games out of the 24 principles: challenge, fantasy/narrative, feedback, goals, sensory stimuli and social aspects/community (2010). However, this is not reflected in the opinion of the educators and students who participated.

Only the students rated challenge highly in their prioritisation. However, from the educators' discussions on other principles, in particular scaffolding and sense of improvement and active learning, it is clear that they viewed setting appropriate challenges as key to creating an engaging and motivating games-based experience.

Again the students rated fantasy/narrative highly, while the educators ranked this low in the scores. There is a consistency between the students' view of story as being key to a game and linking with game-player identity, and the literature review's notion that a story gives a game a context.

Educators and students note the importance of feedback but rank it outside of the top principles. This is also the case with sensory stimuli. However, this might be expected considering that the literature review focused exclusively on digital games which often rely on audio-visual interaction to engage players.

All groups identified the importance of goals in game playing, although the students did this in discussion after the prioritisation exercise.

All agree on the value of social aspects and community in game playing. While digital games may focus more heavily on online forums for this, both on-line and offline communities highlight similar behaviours of learning from other players and the skill development associated with this.

Teacher categories

During discussion the educators spontaneously divided the principles into three categories: teacher tool, student activity, and aim of exercise.

- A **teacher tool** means that the element is a mechanism that the teacher uses to design or facilitate an engaging and effective games-like learning experience, for example active learning.
- **Student activity** means the element is an activity students engage in during the games-like learning experience, for example puzzle solving.
- The **aim of the exercise** means the element is a desired outcome, for example transferring skills.

The results of this are displayed in Table 3. These three categories help describe how the principles can be formulated into a practical guide for teachers and structure the design and delivery of games-based learning experiences in the classroom. It is evident that while many of the elements can fit into several categories, the vast majority (21) can be considered as prompts or tools for teachers to use when designing and delivering the activities. There are seven principles which can be seen as activities for students to undertake, when participating in a games-based learning experience. Eight of the principles can be seen as aims of the activities themselves; these aims could help teachers identify where and how these experiences might be used to support the delivery of curricula.

As part of this discussion around the role of each of the elements in the learning process, educators identified a range of low tech elements, such as cards, dice and timers, that could be used to support student activity. This highlights that there already exists in many classrooms tools that can support games-based learning, although as yet they are not necessarily used in a game context (see appendix 4 for a full list of tools).

Further, while the educators began the workshop considering the ways that games could be used to revise existing learning, as the workshop continued participants were increasingly articulating ways in which principles of game design could support learning new content or skills through the gaming experience.

Table 3: Elements used in student game creation

Rank	Principle	Teacher tool	Student activity	Aim
1	Active learning	y	y	y
2	Transfer			y
3	Goal			y
4	Social aspects			y
5	Relevance interest	y		
6	Rules	y		
7	Safety	y		
8	Assessment	y		
9	Creativity	y	y	y
10	Competition	y	y	y

11	Scaffolding and sense of improvement	y		
12	Rapid decision making	y	y	
13	Sensory stimuli	y		
14	Feedback	y	y	
15	Reflection space	y	y	y
16	Realism	y		
17	Adaptivity	y		y
18	Fantasy / narrative	y		
19	Reward	y		
20	Challenge	y		
21	Role	y		
22	Puzzle solving	y	y	
23	Control	y		
24	Mystery	y		

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Overall, as might be expected, teachers focused more heavily on the how the games related to their own teaching strategies and which of the principles offer more opportunities to extend or support this process. Conversely, the students focused more heavily on the game-play elements of the games themselves. This may well be because of their existing preconceptions and experiences with games, much of which was related to digital gaming.

There were clearly commonalities between the teachers' and students' ideas on core elements in educational experiences. These being: goals, challenge, rules, and social aspects of gaming. One marked difference is in the place of role. The students saw this as a crucial part of the game experience - which resonates with the findings of the literature review. Whereas the teachers were more concerned with how role could allow the students to step outside their own perceived boundaries to try new behaviours, or to avoid feeling that if they did not achieve a goal they would be a failure. As such here role for teachers become more of a teaching tool to leverage participation and engagement, whereas for students and the findings from the literature review, it formed a context for the entire gaming activities.

Safety and rules both featured highly in the students' and teachers' priorities, for slightly differing reasons. Teachers heavily focused on the possibilities provided as an alternative frame for learning; allowing students to participate in, and receive feedback on, educational experiences in a different way. For students, the notion of 'fair play' came across very strongly and that without rules any kind of game wouldn't work. While this is an important factor in game design, it is also possible to question whether the participants being younger students working in a school environment may have impacted on their advocacy of rules. Older students may, for example, have not prioritised rules so highly.

In terms of the place of games in learning and teaching, the educators evidently had an existing belief that games could function well as starter or revision activities, but used them less, if at all, as a part of the learning process. The students' smaller game designs also focused on games taking this role of practising existing skills or content, rather

than learning new ones. As the educators' workshop continued however, participants were increasingly articulating ways in which principles of game design could support learning new content or skills through the gaming experience.

There are also some subtle distinctions in how elements that are seen to be key for digital games will be less important in the classroom. For example, the place of sensory stimuli will be more important in digital games as this is one method to engage with the players, whereas this has less value in a school context. One element that was seen to be important for digital games, but did not feature highly for students and teachers, was feedback. For teachers, it seemed that getting and responding to students' feedback was an implicit part of their role in the classroom, both 'in game' and as part of wider notions of assessment. Students focused on the ability of the game to respond to their actions as part of offering dynamic and fitting challenges, and so saw feedback as implicit in the game offering appropriate challenges, rather than as a key element in its own right. This also highlights a difference in the perception of the role of the games between the teachers and students. Students often saw the game as a self-contained activity, whereas teachers seemed to see themselves as a mechanism by which the game developed, as such, they were in control of the game.

A theme that emerged from the discussions was that games seemed to be particularly valuable for teaching disengaged students. They offered a non-threatening frame to explore issues within, for example by removing the threat of failure, or being able to offer feedback through a non-threatening mechanism built into the game. Games were also seen to be a strong vehicle by which to develop social and collaborative skills.

Conclusion

Overall, there are clearly different priorities from the teacher and students in the elements they consider important in creating games-based learning experiences. Students focused more on game-play, teachers on using games tools to structure learning. Nevertheless, there was a broad consistency in the types of activities that games-like learning experiences may contain.

Teachers often use games as a stimulus or revision activity. They see a value in games as a place for practising skills, but have not yet explored the possibilities for learning **through** games, that is teaching content or skills through game play. This perhaps suggests a need for pedagogical techniques that can be contained in games, which the prioritised elements go some way to identify. As part of this, educators identified a range of low-tech elements, such as cards, dice and timers, which could be used to support the creation of games that were accessible to them. Equally they noted that to incorporate games-based approaches they would need to be based on accessible and reliable resources and not necessarily high tech hardware or software.

Both teachers and students felt that game playing provides a frame by which students can be encouraged to engage in activities, provided they are set up with clear rules. A core part of this encouragement is that games can remove a fear of failure, allow individuals to experiment with alternative roles, and receive feedback in different, and possibly less confrontational, ways.

Lastly there is a degree of consistency about the elements from the literature review that are seen as important in creating games-based learning experiences in the classroom. These are: challenge, fantasy/narrative, role, goals, social aspects/community and rules.

References

Bober, M (2010) Games-Based Experiences For Learning, Futurelab



Appendices

Appendix 1 - List of principles and sub principles from Bober, 2010

Table 4: Learning elements of digital games – six key elements

Element	Description based on literature	Description based on expert interviews
Challenge	<p>"Tasks require effort and are non-trivial" (Whitton, 2010, p23)</p> <p>"Optimal level of difficulty and uncertain goal attainment" (Garris et al, 2002, p447)</p> <p>"The learner gets ample opportunity to operate within, but at the outer edge, of his or her resources, so that [...] things are felt as challenging but not 'undoable'" (Gee, 2003, p223)</p> <p>"Always being kept in a narrow zone between the game's being too hard ('I give up') and too easy ('I'm not challenged at all!)" (Prensky, 2006, p59)</p> <p>"Does the program have a variable difficult level?", "Does the program include randomness?", "Does the program include hidden information selectively revealed?" (Malone, 1984, p32)</p> <p>"Games should be sufficiently challenging, match the player's skill level, vary the level of difficulty, and keep an appropriate pace" (Sweetser and Wyeth, 2005, p6)</p>	<p>"As human beings we like challenge, and the best engineered challenges are set at a level that engages, involves, gets us frustrated." (Rylands)</p> <p>"Students found it engaging mostly because of the game tasks which were difficult enough, not too easy but not too difficult." (Oksanen)</p>
Fantasy/ Narrative	<p>"Existence of a make-believe environment, characters or narrative" (Whitton, 2010, p23)</p> <p>"Imaginary or fantasy context, themes, or characters" (Garris et al, 2002, p447)</p> <p>"Does the program include an emotionally appealing fantasy?", "Does the fantasy provide a useful metaphor?" (Malone, 1984, p32)</p>	<p>"Although it's a fantasy world, it does in many ways replicate the real world. The Spirit Channels [...], they are in fact roads really, and all of the monsters in the Spirit Channels are based on car designs [...] because it would be quite dull otherwise. It makes the narrative a bit more interesting." (Seymour on Code of Everand)</p> <p>"There is a plot, there's an antagonist, you're the protagonist." (Star)</p> <p>"People wanted to see how the story carried out. [...] It's based around sort of a story that emerges as the game carries on [...], it held everything together. Without a story line there wasn't a context." (Whitton)</p>

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Element	Description based on literature	Description based on expert interviews
Fantasy/ Narrative cont'd		<p>"If you can get learners to suspend their disbelief, then the teacher can take children places." (Robertson)</p> <p>"The richness of the text and the images and the story got them." (Hallybone)</p>
Feedback	<p>Games provide "immediate, relevant and clear" feedback, "enabling players to learn from their successes and mistakes" (Douch et al, 2010, p17)</p> <p>"Performance feedback should be presented in a way that minimizes the possibility of damage to one's self-esteem" (Malone, 1984, p33)</p> <p>"Players should receive feedback on progress toward their goals, [...] immediate feedback on their actions [...] and] should always know their status or score" (Sweetser and Wyeth, 2005, p6)</p> <p>"Feedback lets us know immediately whether what we have done is positive or negative for us in the game, whether we are staying within or breaking the rules [...], moving closer to the goal or further away [...], and how we are doing versus the competition" (Prensky, 2001, p121)</p>	<p>"They love the immediacy of the response. When they get a sum correct, bang, another one comes in [...] and there was no kind of negative feedback, it was always encouraging always something that was kind of supportive." (Robertson on Dr Kawashima's Brain Training)</p> <p>"[Feedback is] always kind of automatic when it's in the game because the game can't really read the minds or react to the players, and it's also a matter of resource when developing the game, like building a large enough feedback system, it's a really, really big job." (Oksanen)</p>
Goals	<p>"There are explicit aims and objectives" (Whitton, 2010, p23)</p> <p>"Games should provide the player with clear goals at appropriate times" (Sweetser and Wyeth, 2005, p6)</p> <p>"Good goals are [...] personally meaningful. For example, the best are often practical or fantasy goals (like reaching the moon in a rocket [...]) rather than simply goals of using a skill (like solving arithmetic problems)" (Malone, 1984, p32)</p> <p>"Worthwhile goals, i.e. goals the players really want to achieve [...], goals kids can relate to personally and emotionally [...], making sure the player's goals are clear and compelling" (Prensky, 2006, p60)</p>	<p>"Children became focused on mental maths. It became a cool aspiration [...] for you to have a low 'brain age'." (Robertson on Dr Kawashima's Brain Training)</p>

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Element	Description based on literature	Description based on expert interviews
Goals cont'd	<p>"The goal is often stated at the beginning of the rules: Your goal is to get the highest score, to reach the end, to beat the big boss, to capture the flag, to get the best hand, and so on" (Prensky, 2001, p120)</p> <p>"Clear, specific, and difficult goals lead to enhanced performance" (Garris et al, 2002, p449)</p>	
Sensori stimuli	<p>"Dramatic or novel visual and auditory stimuli" (Garris et al, 2002, p447)</p> <p>"Sensory curiosity: audio and visual effects" (Malone, 1984, p32)</p> <p>"Graphics – the stunning visual representations of what the game is about and the increasingly lifelike representations of the game's characters. This lush world of 3D animation and video is known in the games business as 'eye candy'" (Prensky, 2006, p86)</p>	<p>"We go for really high quality graphics [...]. If they can create something relatively quickly that looks professional, that looks good, it gives them the confidence and the determination to persevere with that." (Burton-Wilcock on MissionMaker)</p> <p>"You can speak to [your dog], you can control it with your voice, you can touch it with the stylus, you can blow on the pressure sensitive mic. The aesthetics are beautiful." (Robertson on Nintendogs)</p>
Social aspects/ community	<p>"Games should support and create opportunities for social interaction", including "competition and cooperation", "social interaction between the players (chat, etc.)" and "social communities inside and outside the game" (Sweetser and Wyeth, 2005, p6)</p> <p>"People: Other individuals take part" (Whitton, 2010, p23)</p> <p>"The inherently social aspect of games – you do them with other people" (Prensky, 2001, p123)</p> <p>"Community: Supporting play outwith the game and encouraging players to talk to one another and work collaboratively [... eg in] forums or other online community space, and tasks that require collaboration" (Whitton, 2010, p146)</p>	<p>Social aspects in general:</p> <p>"The catalyst for somebody wanting to engage in something becomes a lot, lot stronger if their friends are doing it or if in some way they can involve their friends." (Star)</p> <p>"It's so much more rewarding, knowing that there's another person, that you're interacting with a real person, even if you can't see them [...] and that's so much more rewarding than playing against the computer." (Star)</p> <p>Audience:</p> <p>"To see somebody actually using something that you've made, and enjoying using something that you've made, it's giving it authentic purpose [...] and some recognition for what they're doing." (Burton-Wilcock on MissionMaker)</p>

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Element	Description based on literature	Description based on expert interviews
Social aspects/ community cont'd	<p>"Games can be played in multiplayer mode [...]. Some online games rely on large communities of players who work together to achieve goals" (Douch et al, 2010, p18)</p> <p>"Knowledge is dispersed in the sense that the learner shares it with others outside the domain/game" (Gee, 2003, p227)</p> <p>"Learners constitute an 'affinity group', that is, a group that is bonded primarily through shared endeavors, goals, and practices" (Gee, 2003, p227)</p>	<p>Collaboration:</p> <p>"When we're using the Wild Earth game and the children are researching, they take notes into [PrimaryPad] and [...] they can be adding to the same text and correcting and chipping in, contributing." (Rylands)</p> <p>"[The students] also liked the opportunity to play the game with their friends." (Oksanen)</p> <p>"They'll easily support their colleagues, their peers, to help them move forward and learn from each other, [...] children are becoming very collegiate, very supportive, encouraging, [...] they share knowledge and [...] expertise and experiences." (Robertson)</p> <p>"If someone found out the puzzle, we'd say, 'Well, you might want to go and ask them to give [you] clues'. So they were all working with each other and learning from each other instead of us [...], the teacher, being that fountain of knowledge." (Hallybone)</p> <p>Discussion:</p> <p>"When students have played the game, there are in many cases reasons for having some kind of feedback conversation afterwards with the teacher. [...] Just playing the game is not enough." (Oksanen)</p> <p>"[The discussions were] about the decisions that were made, about what it means, what some of the role play means, really opening up the underlying attitudes [...]. But it isn't one that needs to be lead by the teacher because the students are all discussing between [themselves]." (Star)</p> <p>"They will be learning a lot more when they go on the internet and they read around the discussion forums or when they go on the cheat sites and look at alternative ways of doing it." (Whitton)</p>

Table 5: Learning elements of digital games – additional elements

Element	Description based on literature	Description based on expert interviews
Authenticity/ Realism/ Fidelity	<p>“Rich 3D worlds, sound effects and dynamic action – even simple haptic (force and tactile) effects, such as ‘rumble’ forces in joysticks and gamepads, all contribute to today’s game players’ immersive experiences” (Stone, 2008, p14)</p> <p>“Task Fidelity - the design of appropriate sensory and behavioural features into the end user’s task that support the delivery of the desired learning effect</p> <p>Interactive Technology ‘Fidelity’ – [...] the degree to which input (control) and display technologies need to be representative of real life human-system interfaces [...]</p> <p>Context Fidelity - the design of appropriate ‘background’ sensory and behavioural detail (including avatar/agent styles and behaviours) to complement – and not interfere with – the task being performed and the learning outcomes” (Stone, 2008, p28)</p>	<p>“It’s not about some random world of aliens that have got nothing [to do] with reality or lots of cutesy, happy [characters] that are just jumping around. The reality is actually it’s a bit dirty, it’s a bit grimey and people say, ‘That’s a bit whack’.” (Star on Choices and Voices)</p> <p>“[The dog] rolls on its back, it reacts to wherever you touch it. So it’s such a beautifully engaging, tactile experience. You’re touching it, it’s almost as if it’s part of you, and so for the children, it’s almost as if they believe it’s a dog.” (Robertson on Nintendogs)</p>
Active learning	<p>“Games require the player to interact in order to progress [...], the skills and knowledge base is developed through participation in the game’s tasks” (Douch et al, 2010, p17)</p> <p>Games “encourage active and critical, not passive, learning” (Gee, 2003, p221)</p>	<p>“They say the learning is in their hands, [...] they work at their own pace.” (Hallybone)</p>
Adaptivity/ Individualisation	<p>A “game continually adjusts itself to each player’s skills and abilities” (Prensky, 2006, p60)</p> <p>The ability “to tailor [...] challenges to each player’s ability, almost always without ever letting the player know it’s happening” (Prensky, 2006, p91)</p> <p>“The level of difficulty goes up or down automatically depending on what you do” (Prensky, 2001, p121)</p>	<p>“When you’re a class teacher, children do have different abilities, [...] so you differentiate in terms of the level of task and demand that’s placed on the learner, depending on how you perceive their abilities and their needs. [Games] have it built in.” (Robertson)</p>

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Element	Description based on literature	Description based on expert interviews
Adaptivity/ Individualisation cont'd	"Games are tailored to the individual through content and pre-set levels; [...] the game-play can adapt to the individual's skills and knowledge by making tasks easier/ more difficult or by providing/ withdrawing support" (Douch et al, 2010, p17)	
Assessment	"Gamers can assess their progress within a game" and "compare their achievements with other players" (Douch et al, 2010, p17)	"We ask [the children] to keep a note of their scores [...], and we evaluate that at the end of every six week block." (Hallybone)
Competition	"The goal is to achieve an outcome that is superior to others" (Whitton, 2010, p23) "Conflict, competition, challenge, and opposition are the problems in a game you are trying to solve. [...] It does not necessarily have to be against another opponent, real or AI (artificial intelligence). It can be a puzzle to solve, or anything that stands in the way of your progress" (Prensky, 2001, p122)	"For the groups [of students] that were doing really well, competition was highly motivating, but for those that weren't, it was demotivating." (Whitton) "Kids aren't really that bothered about having the highest score and beating people, [...] children are more concerned with self-improvement than they were with beating their peers [...]. The competition was with yourself." (Robertson)
Control	"Players should feel a sense of control over their actions in the game" (Sweetser and Wyeth, 2005, p5) "Active learner control" (Garris et al, 2002, p447)	"It really felt like [...] the learning had been given back to them. [...] The children actually said the learning is in our hands now, they're in charge of the console, they're in charge of the games." (Hallybone) "This idea of 'being good', [...] that's the perception of seeing yourself as an expert, so the pleasure you get from a feeling of being in control, of being good, of mastery." (Whitton)
Creativity	"The opportunity for players to be creative, either through lateral thinking and creative problem-solving or through the creation of their own artefacts within the game (eg creating posters, video, or stories)" (Whitton, 2010, p146) "The ability to create, and to share (and even sell) one's creations" (Prensky, 2006, p63)	Creativity and sharing: "It would be a sort of social networking, they could share backgrounds [and characters], so you could have a primary school working with a college." (Burton-Wilcock) "Part of the ARG is going out and creating artefacts and using digital photography, video, etc." (Whitton)

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Element	Description based on literature	Description based on expert interviews
Mystery/ Curiosity	<p>"Mystery is enhanced by [...] complexity, novelty, surprise and violation of expectations [...] and information that is incomplete or inconsistent" (Garri et al, 2002, p450)</p> <p>"Cognitive curiosity: Does the program include surprises?" (Malone, 1984, p32)</p> <p>Games "stimulate and satisfy curiosity [...] by providing an optimal level of informational complexity [...], the environments should be neither too complicated nor too simple" (Malone, 1984, p34)</p>	<p>"It's kind of the mystery, the curiosity angle, I want to find out what happened next." (Whitton)</p> <p>"Then you saw the rest of [the games] with the question marks, 'I wonder what they are?', so that kind of intrinsic curiosity that's in us all, inquisitiveness, it's whetted." (Robertson on Dr Kawashima's Brain Training)</p>
Puzzle-solving	<p>"Ongoing puzzles, riddles and problems that need to be solved [...]. These should start relatively easy [...], but can then get gradually more difficult" (Whitton, 2010, p146)</p>	<p>"It was very satisfying to be working on a puzzle for a long time and talking about it and thinking about lots of things, trial and error, thinking about possible solutions." (Whitton)</p>
Rapid decision-making	<p>"Complex computer and videogames [...] are] all about making decisions [...]. When kids play complex games, they are making decisions rapidly and continuously [...], once every half-second" (Prensky, 2006, p61)</p>	<p>"You have to make a decision every 20 seconds or less, [...] it's continuously getting you to interact with it." (Star)</p>
Relevance/ Interest to the learner	<p>"Goals kids can relate to personally and emotionally", decisions "that are meaningful to the player" (Prensky, 2006, p60f)</p>	<p>"If you construct something for a specific group of people, and I mean really specific group of people, you have a very good chance of engaging them. [...] The feedback we got, 'I really like it, it's like round here, it's about me, [...] my people, my community, I recognize that'." (Star)</p> <p>"[A] demotivating factor was just lack of interest in either the game [...] or [lack of] interest in subject matter." (Whitton)</p>
Reward	<p>"For learners of all levels of skill there are intrinsic rewards from the beginning, customized to each learner's level, effort, and growing mastery and signaling the learner's ongoing achievements" (Gee, 2003, p223)</p>	<p>"The more adventure games you play, the more self-references you get from newer adventure games to older adventure games." (Whitton)</p> <p>"Easter eggs hidden in the game" (Robertson)</p>

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Element	Description based on literature	Description based on expert interviews
Role	<p>"A system in which students learn to work (and thus to think) as doctors, lawyers, architects, engineers, journalists, and other valued reflective practitioners—not in order to train for these pursuits in the traditional sense of vocational education, but rather because developing those epistemic frames provides students with an opportunity to see the world in a variety of ways that are fundamentally grounded in meaningful activity and well aligned with the core skills, habits, and understandings of a postindustrial society" (Shaffer, 2005, p2)</p>	<p>"The players were doing up an apartment, they were supposed to paint the walls, chose the paint colour – decorating. And the collaborative tasks were, for example, one player could see the prices for the paints and another player could see the size of the wall and maybe the third one had a calculator, so only he can calculate the area." (Oksanen)</p>
Rules	<p>"The activity is bounded by artificial constraints" (Whitton, 2010, p23)</p> <p>"Game activity [...] occurs in a fixed space and time period with precise rules governing game play" (Garris et al, 2002, p448)</p> <p>"Rules impose limits – they force us to take specific paths to reach goals and ensure that all players take the same paths. They put us inside the game world by letting us know what is in and out of bounds" (Prensky, 2001, p119)</p>	<p>"They all had to learn together, so we went through the introduction together [...] and we talked through it and then [...] they have to do it as teams." (Hallybone)</p>
Safety	<p>"The activity has no consequence in the real world" (Whitton, 2010, p23)</p> <p>"Learners can take risks in a space where real-world consequences are lowered" (Gee, 2003, p222)</p>	<p>"[In real life] the cost of failure is high. So if you make a mistake, you might kill somebody [...] or] you lose a lot of money [...] or] you might lose your credibility [...], so if the consequence of that is a loss in some way, then the game becomes serious." (Star)</p>
Scaffolding and sense of improvement	<p>"Scaffolding": Games get "gradually more challenging as the learner progresses [...]. [They] include a number of levels through which a player moves as their knowledge and skills improve" (Douch et al, 2010, p18)</p> <p>"Learning situations are ordered in the early stages so that earlier cases lead to generalizations that are fruitful for later cases" (Gee, 2003, p225)</p>	<p>"Swift and steady improvement – for instance, being able to complete the first few levels really, really quickly or playing a role playing game and being able to [...] join a new guild very quickly." (Whitton)</p> <p>"They don't necessarily want to have the highest score. They'd like it, but they just want to get better." (Robertson)</p>

Element	Description based on literature	Description based on expert interviews
Scaffolding and sense of improvement cont'd	"Leveling-up means feeling yourself getting better at the game, and achieving mastery over something difficult and complex" (Prensky, 2006, p59)	
Transfer	"Gamers use knowledge and skills learnt through playing a game in other games and in real world contexts" (Douch et al, 2010, p18) "Learners are given ample opportunity to practice, and support for, transferring what they have learned earlier to later problems" (Gee, 2003, p226)	"When they as a real child rather than their avatar get to the curb, that they then automatically do what they've been trained to do as an avatar in the game." (Seymour on road safety behaviour and Code of Everand)

Appendix 2 - Games used by teachers participating in the workshop

Game	Description (if necessary) – for example subject and task
Student created board games	Students create their own board games to support learning / revision about a particular topic.
Role play	For example, taking a particular professional role such as an architect.
Key word bingo	To revise language skills.
Splat the teacher	A PowerPoint game where the students have to answer quiz style questions correctly, answering a set amount of questions correctly results in a digital image of the teacher being 'splatted'. www.tes.co.uk/teaching-resource/Splat-the-teacher-6009566
Trading game	A game which explores global trading relationships learn.christianaid.org.uk/YouthLeaderResources/trading_game.aspx
Jeopardy	Using subject related questions in the format of the TV show.
Subnetting	An educational game designed to help make the technical topic of subnetting easier for students to learn https://learningnetwork.cisco.com/docs/DOC-1802
Scrabble	
Post the Creme Egg	A problem solving game using a Creme Egg and envelope, the aims is to be able to find a way to post a Creme Egg.
Space invaders	
Dominos	

Card games, eg switch / Uno	Used to develop social skills.
"people to people" and other ice breakers	Warm up games designed to get people to interact www.ultimatecampresource.com/site/camp-activity/people-to-people.html
Photo treasure hunt	
Parachute games	Parachute games – using a real parachute as a tool for group games www.woodlands-junior.kent.sch.uk/parachute.html
Who wants to be a millionaire (on computer)	
Challenges, eg murder mystery / solve the crime	Use to support the development of students' individual and collaborative problem solving skills.
Kerplunk	
BBC bite size games	Interactive quizzes to revise learning
Mission Maker	Mission Maker – a platform for students to create their own 3D games www.immersiveeducation.eu/missionmaker
Hangman	
Word search	
Snap	
Countdown	
Bulldog	
Monopoly	
Crosswords	
The lemonade business game	A business skills development game where players create a successful lemonade selling game www.lemonadegame.com
The Sims	

Appendix 3 - Student’s games created during students’ workshop 2

Group 1 created a digital ‘Who Wants to be a Millionaire’ history revision game. If you got a question right it resulted in a reward, eg points or sweets. An incorrect question resulted in a forfeit. There were also options for extra points, eg if a king’s head came up with a target you could shoot it for points.

Group 2 created a board game based on nature called ‘Nature Rumble Run’. The game was set in a scary, old and gloomy forest. Players progressed by rolling a dice and moving through squares. There were cards with challenges and questions which had to be answered if the player landed on these squares.

Group 3 created an adversarial battle game set using an army narrative. Players controlled jet planes and engaged in battle with other players using cards. They moved around a board based on the successes.

Group 4 created ‘Sonic’s fury’ - a digital game in which players had to spell words correctly in order to progress through the racing track. The game involved different characters from the Sonic stories and had a loop-the-loop which had to be overcome.

Appendix 4 - List of ways for educators to realise elements in class generated during educators workshop

Table 6: Methods to enact learning elements

Principle	Ways to enact
Active learning	<p>Create a reference area for the game where students can find information themselves.</p> <p>Use role cards to give students different activities, eg a chair person, timekeeper.</p> <p>Use time limits and timers.</p> <p>Create a bank of resource that can be used as part of games, eg dice, game cards, flip chart, sticky notes, mystery bag (that has different artefacts inside), spinner.</p> <p>Create a list of good resources that could be used to help you plan games eg from TES site. Store this list locally so you’re not reliant on a network connection.</p> <p>Create Scamper cubes and cards – with letters on which could be used for multiple purposes in a game, eg allocating roles.</p> <p>Set up the classroom in a changeable layout so it can be flexible depending on the activity.</p>
Rules and safety	<p>Ensure they are fair.</p> <p>Consider creating them with the group to increase ownership.</p> <p>Students could take a role in the game to keep things safe, eg to ‘police’ the game.</p>

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Scaffolding and sense of improvement	<p>Through achieving certain goals students 'unlock' or gain access to further levels of the game. This may be more activities or more game resources .</p> <p>Students get feedback in different ways that are sometimes in 'code', eg being told they are a triangle today and a circle yesterday, and having to work over what each shape actually means.</p> <p>Offering students differentiated challenges by giving them different roles in the game.</p>
Sensory stimuli	<p>Using cartoons/animation/picture resource to deliver the story of the game, eg on an interactive whiteboard.</p> <p>Using a timer or loud buzzer to signal the start and end of activities.</p> <p>Use audio feedback on activities, eg music when they are running out of time.</p> <p>Use music to create atmosphere or mood.</p> <p>Make resources and text colourful. This could be by changing the font type, size or colour, or printing on different coloured papers.</p> <p>Use free existing software tools: eg Vokis for making speaking avatars, Alice for making 3D digital characters and animation, Kodu for making digital games.</p> <p>Get students to use artefacts and objects related to the topic eg historic objects, wigs.</p>

Feedback	<p>Verbal.</p> <p>Build in achievement points, so when students achieve something in the game it translates into real world rewards.</p> <p>Sticky notes – teacher gives students feedback on sticky notes during the activity so they don't interrupt the flow.</p> <p>Create feedback mechanisms in the games, which means that the teacher has to feed back less.</p> <p>Offer rewards.</p> <p>Offer points for particular skills demonstrated.</p> <p>In groups have one observer scoring people, could relate to Assessment For Learning.</p> <p>Build in timed achievements and time constraints.</p> <p>Could display each groups points on a screen, eg on an interactive whiteboard.</p> <p>Use avatars or digital means to give feedback sometimes. Students can be more accepting of receiving feedback this way.</p>
Fantasy / narrative	<p>Explore ways to immerse the students in the experience.</p> <p>Use music or sound effects to enhance the atmosphere.</p> <p>Use of an avatar/voice to set out some of the story or feedback.</p> <p>Role play.</p>

Fantasy / narrative	Costume. Virtual environments.
cont'd	Props or artefacts to engage with. Using masks.
Challenge	Allocate different roles to students to challenge them more. Add elements of mystery/puzzles to challenge them. Having a range of activities or versions of activities that could be used which are appropriate for different skill levels.
Reward	Stickers. Score boards, leagues. Individual achievements get allocated to the team. Students are given points for achievements which translate to rewards in class, eg to choose the music in class, to go off and study independently, get an early lunch, get to choose where they sit. Students get post cards sent home for positive achievements. Certificates for achievements. Golden time. They get bits of stationary.

	Have a 'funny thing' rewards box with small presents (cheap ones). Students get a raffle ticket – the raffle goes on over a period of time and students get a ticket for each good achievement, the final prize is awarded perhaps once a year and is something substantial (eg an iPod etc.)
Puzzle solving	Setting up a scenario or narrative with clues for the students to explore, eg like mystery to solve, or a treasure hunt. Offering different elements that students have to group together and find the links between. Multiple choice answers to make things easier. Use an interactive white board and displaying a covered image on it. Students have to guess what it is. Bits of the image are gradually revealed to help them guess. Use images from digital cameras to make photo stories, these could then be reordered or constructed by the students.

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Reflection space	<p>Find different ways to create a reflection space both during and after the game:</p> <p>Using 'feedback cards' as part of the game. Some of the cards that are used in a game ask the students questions to promote reflection.</p> <p>Teacher asks prompt questions at certain times in the activities or during breaks.</p> <p>Getting characters in the game to ask, eg avatars that are shown on the interactive whiteboard.</p> <p>Make a dice with reflective questions on each side, students role this at certain points to get a question to reflect on.</p> <p>At the end of the game there is an 'envoy exchange' where some students swap groups to discuss and learn what other groups have been doing.</p> <p>Offer (higher) points – for students if they reflect on their work as part of the game.</p> <p>Create questions and answers which students have to match as part of a reflection process at the end of the game.</p> <p>Create ways for students to record their reflections as they go through the game.</p>
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	<p>Have a shared space where students put their points of reflections so that students can reflect on other groups' thoughts. Could do this physically with a reflection wall, or digitally, eg using Wallwisher or a collaborative software.</p> <p>Create a bank of generic questions that you can ask at any time.</p> <p>Get one student to receive feedback from you, they then have to share this with the rest of the group.</p> <p>As a feedback exercise – arrange the students in two concentric circles and facing each other. They feedback to the student they are facing. Then rotate the inner circle by one student, meaning each student is now facing someone different. They now feedback, and the circle rotates again, etc.</p>
Rapid decision making	<p>Use a clock and buzzer to add time pressure.</p> <p>Get a CD of music clips and use music as a timer.</p> <p>Have a character or avatar displayed on an interactive whiteboard and they start to move off the screen when the timer starts. They timer runs out when the character has left the screen.</p> <p>Have a collection of video clips which can be used as a timer, eg a countdown, or something disappearing.</p>

About Futurelab

Futurelab is an independent not-for-profit organisation that is dedicated to transforming teaching and learning, making it more relevant and engaging to 21st century learners through the use of innovative practice and technology.

We have a long track record of researching and demonstrating innovative uses of technology and aim to support systemic change in education – and we are uniquely placed to bring together those with an interest in improving education from the policy, industry, research and practice communities to do this. Futurelab cannot do this work on its own.

We rely on funding and partners from across the education community – policy, practice, local government, research and industry – to realise the full potential of our ideas, and so continue to create systemic change in education to benefit all learners.

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Key to Themes

Futurelab understands that you may have specific areas of interest and so, in order to help you to determine the relevance of each project or publication to you, we have developed a series of themes (illustrated by icons). These themes are not intended to cover every aspect of innovation and education and, as such, you should not base your decision on whether or not to read this publication on the themes alone. The themes that relate to this publication appear on the front cover, but a key to all of the current themes that we are using can be found below:



Digital Inclusion – How the design and use of digital technologies can promote educational equality



Teachers and Innovations – Innovative practices and resources that enhance learning and teaching



Learning Spaces – Creating transformed physical and virtual environments



Mobile Learning – Learning on the move, with or without handheld technology



Learner Voice – Listening and acting upon the voices of learners



Games and Learning – Using games for learning, with or without gaming technology



Informal Learning – Learning that occurs when, how and where the learner chooses, supported by digital technologies



Learning in Families – Children, parents and the extended family learning with and from one another