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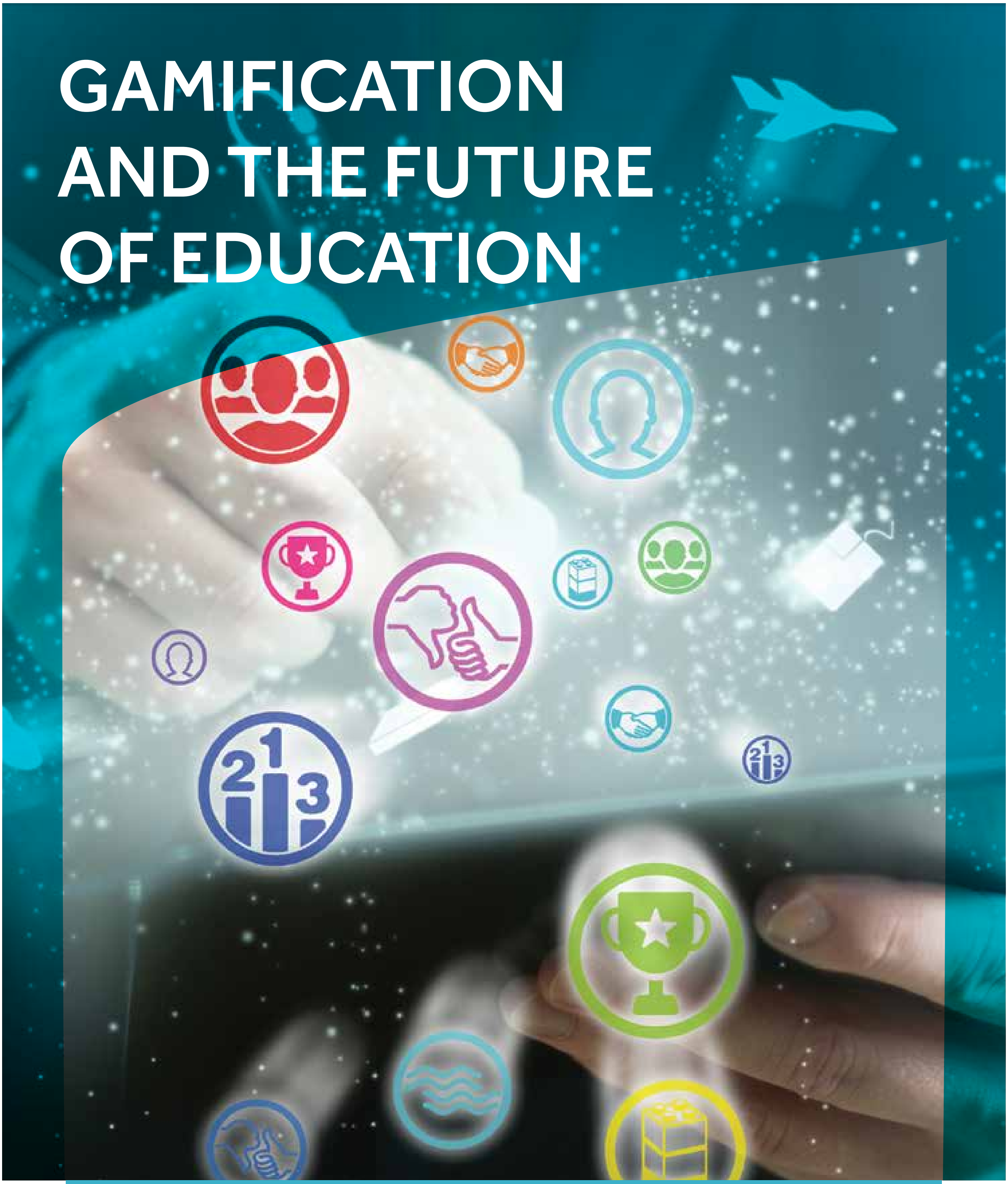
GAMIFICATION AND THE FUTURE OF EDUCATION



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ABOUT THIS REPORT

Gamification and the Future of Education is a forward-looking report that explores how the mechanics and dynamics commonly found in games can be applied in the educational context to improve educational outcomes.

At the core of this report is an important policy puzzle: what role does gamification, as a pedagogical innovation, play in the future of education?

In the attempt to solve this puzzle, this report addresses four fundamental questions: How has gamification evolved? How has gamification been applied? What are its advantages and drawbacks? And what strategies and policies are necessary for gamification to be incorporated successfully in education?

The report is global in scope and focuses throughout on the crucial distinction between learning phases pertinent to education systems across the globe: basic education, for pre-adolescent students; and skill-building, for adolescent students.

There is no agreed definition of gamification, no definitive verdict on its usefulness in education, and no agreed set of best practices for gamifying the delivery of education. However, there are numerous examples of its use, and experts and practitioners of gamification have some initial evidence of its utility. These have been incorporated into the report through a series of case studies and expert interviews.

EXECUTIVE SUMMARY

Gamification – defined in this report as the introduction or application of elements of games into non-game contexts – is a relatively new concept but an old practice. Games, and the elements that make up games, have been incorporated into other areas of life throughout history. This is particularly true of education, where the need to ensure student interest and participation has meant that game mechanics – such as rewards and group tasks – have become core teaching tools.

All games share three fundamental characteristics: they have a clearly defined set of rules; a rapid feedback system; and a well-established goal. With few exceptions, participation in games is voluntary and is primarily for enjoyment.

Among the many elements that games consist of, three of particular relevance to education are:

- mechanical elements, such as incremental progression, onboarding, and instant feedback;
- personal elements, such as status and visibility, collective responsibility, and leaderboards or rankings; and
- emotional elements, in particular the psychological state of flow.

Thus far, gamification in schools has been led by a small group of pioneering teachers and academics who have gamified particular activities or courses in an effort to find new ways of delivering old material. This ad hoc experimentation has been largely confined to Western Europe and North America, with the United States at the forefront of both the academic study and practical application of gamificaiton.

As a new mode of teaching and learning, the principal appeal of gamification is the liberty that it provides pupils and teachers, as encapsulated by the four freedoms: the freedom to fail, freedom to experiment, freedom of effort and freedom to self-express. These freedoms represent a welcome pedagogical shift for those students whose educational potential is being hampered by conventional teaching methods. However, these freedoms do not guarantee educational success and do not mitigate against the potential drawbacks of gamification.

Realising these freedoms can be difficult due to the numerous barriers that stand in the way of gamification. In education systems in which gamification is possible, attempts to gamify activities may fail due to resistance from parents, a loss of pupil interest, or poor implementation due to a lack of expertise or experience. Additionally, for students who lack access to technology, for schools facing financial difficulties, and for students performing well under conventional teaching programmes, a transition towards gamified education could prove limiting, if not damaging.

The ad hoc gamification of courses and activities means that there is no established track record of success or failures. But the future of gamification, and its role in the future of education, is ripe with possibility. Gamification presents opportunities to improve the stock of technological skills of future generations of students as well as encourage public-private collaboration in the investment or design of gamified curriculums.

GAMIFICATION: HISTORY AND EVOLUTION

WHAT IS A GAME, AND WHAT IS GAMIFICATION?

Games

Games are a universal part of the human experience and have existed across all cultures. Many different types of games exist, which makes an exact definition difficult. However, games can largely be defined by the following characteristics:

- Rules. Games are activities that have rules that are different from everyday life. These rules generally exist to define the scope of the player's choice of actions throughout the game.
- Feedback systems. Much of a game's interactivity relies on its feedback system, which is often instant. The consequences of a player's actions are usually presented immediately on taking the action.
- Goals. A game's goal, or victory condition, is clearly defined and unambiguous. Often games have several mini-goals which yield points towards the ultimate goal, that of victory, but in nearly all cases the path to victory is clear and known to all players.

With few exceptions, participation in games is voluntary, and is primarily for enjoyment.

Gamification

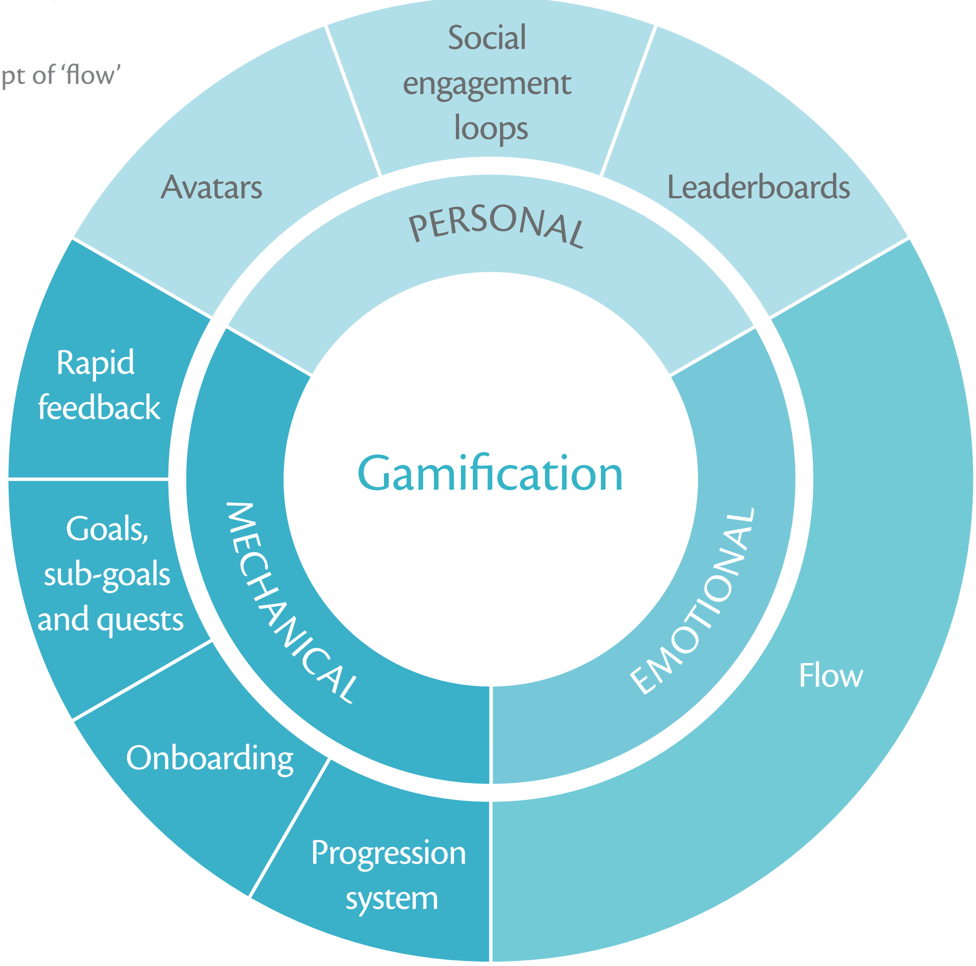
As a relative neologism, the term 'gamification' has been used in many forms in different contexts. In this report, gamification is defined as the introduction or application of elements of games – what make games so enjoyable – into other areas of life. This report focuses specifically on the application of such elements into education.

Unlike using a game to teach – for example, asking children to play word-based games like Scrabble to encourage better reading skills – gamification focuses on extracting the underlying principles of games and asking whether an education experience can be reconfigured to build on those principles. A successful gamification programme will look to use what Scot Osterweil, creative director of the Massachusetts Institute of Technology's Education Arcade, calls the "four freedoms of play":

- The freedom to fail: games allow mistakes to be made with little consequence;
- The freedom to experiment: games allow players to explore and discover new strategies and pieces of information;
- The freedom to assume different identities: games encourage players to see problems from a different perspective;
- The freedom of effort: games allow players to go through periods of intense activity and relative inactivity, so that players can pause and reflect on tasks they have accomplished.

To this end, gamification can be broken down into individual elements, each of which bring specific advantages and disadvantages to educational processes. These categories include how game elements can trigger greater engagement through their internal design, how they foster student engagement, and – ultimately – creating an environment of intense focus that stimulates learning and retention of information. We have classified these elements into three categories: mechanical, personal and emotional. The elements are categorised as follows:

- Mechanical: Incremental progression; Onboarding; Instant feedback; Goals, sub-goals and quests
- Personal: Avatars; Collective Responsibility; Leaderboards
- Emotional: Using the concept of 'flow'


Gamification
PERSONAL
MECHANICAL
EMOTIONAL
Social engagement loops
Avatars
Leaderboards
Rapid feedback
Goals, sub-goals and quests
Onboarding
Progression system
Flow

MECHANICAL ELEMENTS OF GAMIFICATION

Gamification spans all principles of game design. However, there are some mechanisms which have gained prominence as the most fundamental, with wide applicability particularly in education:

Incremental progression system: goals, challenges, and quests

In most games, particularly video games, part of the reward for solving a problem is to be presented with a slightly more difficult problem. A game's sub-goals, often called missions, levels, or quests, are layered in such a way as to present incremental challenges to the player. They are clearly defined and segmented, and in many cases offer isolated rewards.

This model applies particularly well to education, both in a short-term and a long-term sense. If a task is too easy, the learner gets bored; too difficult, and they are overwhelmed. In the short term, the replacement of a completed task with a slightly more difficult one helps to ensure the learner is optimally stimulated as their skillset expands. This method also allows the cumulative addition of layers of complexity, thereby isolating each and aiding comprehension. In the long term, incremental sub-goals with clear definitions keep the learner focused and motivated. They also promise immediate and substantive rewards.

Badges

Building on the encouragement of incremental progression, games often incorporate visible symbols of achievement, often termed badges or 'levelling up'. This provides more intermediate goals for the game, to ensure that the player is not only focused on the immediate task, which might lead to lack of interest once completed, or on the ultimate goal of the course, which might be too far off to trigger motivation.

> “The role of a teacher and the role of game rules are roughly equivalent. A teacher wants to exert influence on students to encourage certain behaviours; to reward the positive and discourage the negative. In games, rules are designed to guide players through a level or stage in an intuitive manner.”
>
> – Steven Lumpkin, Senior Designer, RollerCoaster Tycoon World

Onboarding and increasing accessibility

Onboarding concerns the first interaction a player has with a game. Most games, particularly video games, have tutorials, which aim to guide players through the initial first few minutes of play. If there are not explicit tutorials, early levels will often play the role of a tutorial; such levels are generally easy to complete and serve to introduce the concepts which make up the game one by one.

Games use onboarding to acquaint players with the mechanisms of the game and the objectives. In a gamified educational environment this serves two purposes. First, it helps decrease uncertainty among the students about how to complete the task, allowing them to more fully engage with the work. Second, it saves time for the teacher, who would otherwise be required to explain the process of the experience to the class – a time-consuming and non-individualised mechanism for conveying information.

Instant feedback

Games are designed to be responsive. The consequences of a player’s choice or action during a game are either apparent to them as they make the decision or relayed to them almost immediately.

Where consequences are delayed, progress towards the expected impact of the decision is often clearly displayed or is otherwise readily available to the player. Players can use such prompts and delays to assess opportunities and threats as they progress. Many modern games make use of ‘achievements’: one-time awards to players for completing certain tasks, or for completing tasks in certain ways, that are secondary to the game’s main goal. Achievements are publicly displayed and can be shown off to other players.

In contrast, many educational programmes involve long feedback cycles and delayed consequences and rewards. A submitted assignment may not be marked for several weeks; even then, when it has been marked and returned, it may not count for anything until the final grade is calculated at the end of the year. During a course, students may not be aware of whether or not they have met expectations, or learned the required material, until much later in the course cycle.

PERSONAL ELEMENTS OF GAMIFICATION

Games also increase engagement by attaching to a player's sense of identity, a technique which can help educators further student engagement in the learning process.

Visible status: avatars

Games often provide players with an 'avatar' – a representation of self within the game – that is visible to other players. Avatars vary from 3D representations of characters to abstract symbols. They are almost always designed in such a way as to permit an element of personal expression and creativity.

Usernames, handles, or tags – a player's 'name' within the game – are a further element of social customisation. Most multiplayer or social games allow (and in some cases, obligate) a player to create a username of a certain length or structure by which they will be known in-game.

The benefits of this form of gamification are primarily social. Part of the appeal of games is that they allow players to adopt new identities or roles, and make meaningful decisions in-game from an unfamiliar vantage point. Avatars are an extension of this.

In the context of education, gamification of this type may allow students to project a profile of themselves, complete with relevant scholarly achievements, to other students and the outside world. It can allow students to experiment with different forms of identity and approach their studies from different perspectives.

Collective responsibility

This form of gamification is designed to use group-based activities to provide an incentive for learners to keep learning. Many popular online video games, such as League of Legends, played by upwards of 67 million people each month, are also focused on the concept of teamwork and cooperation. In these, and in nearly every team sport, players describe the sense of not wanting to let down their teammates as a key motivational factor.

Applying this element of gamification to education is relatively simple, and largely pre-dates the gamification movement. By giving students a level of social responsibility, their emotional investment may increase. The gamified 'house system', which has been present in the English-speaking world since at least the 19th century, is a traditional application of this. Many secondary-age schools, particularly boarding schools, have 'houses' to which students belong, and completing tasks allow individual students to contribute points to their house, with the winning house rewarded in some way at the end of the school year. The house system is designed to foster cameraderie that encourages increased effort, and is a prominent feature of school-based stories in the English-speaking world, dating back at least to Thomas Hughes' Tom Brown's School Days (1857) and most famously in JK Rowling's Harry Potter series (1997-2007).

Leaderboards or rankings

All competitive games rank their players in order of ability or achievement, and the most widely used of these is the leaderboard, where players or teams are displayed often using a points-based system demonstrating accumulated results.

The introduction of leaderboards is among the most common elements of gamification. For ethical reasons, using public leaderboards for student achievement at the basic educational level is uncommon. Those at the bottom may suffer loss of confidence and motivation, which can lead to social exclusion and psychological damage. Instead, leaderboards tend to be limited to university courses focused on skill-building.

Additionally, all students may not be displayed on a leaderboard; for example, a course at the Technical University of Lisbon displayed only the top 15 participants[1]. However, this approach can have downsides; by broadcasting how well the top students are performing, those below them, seeing how far they may have to go to enter the leaderboard, may lose motivation towards the end of a course.

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[1] Barata, G., Gama, S., Jorge, J., & Gonçalves, D. (2013, October). Improving participation and learning with gamification. In Proceedings of the First International Conference on Gameful Design, Research, and Applications (pp. 10-17). ACM.

CASE STUDY 1:

MATH LAND

Social: Yes

Ages: 11-18

Created by a special education teacher in Michigan, in the United States, Math Land breaks up the standard mathematics course into 20 levels, each of which contains a final mastery test, to determine whether the student has completed the level. The test is taken when the student wishes and can be re-taken until the student passes.

Each student moves their avatar higher up a board on the classroom wall as they progress through the course, and they are rewarded as well with more elaborate representations for their avatar. This provides an aesthetic goal for their students, a practice copied from games, which often use visual elements to maintain entertainment and novelty.

Math Land has experienced significant educational success. In its first two years, attendance increased 13% (a major accomplishment, as the programme was used on students who had emotional and behavioural issues) and, in the first three years, performance on standardised testing increased by 22%.

Progression system	
Avatars	✓
Badges	✓
Collective responsibilities	
Onboarding	
Leaderboards	
Instant feedback	
Flow	
Freedom to fail	✓
Freedom to explore	
Freedom of effort	✓
Freedom to assume different identities	

CASE STUDY 2:

SMART GAME SYSTEMS: MALARIA VECTOR CONTROL

Social: Yes

Ages: 21+ (professionals)

Smart Game Systems (SGS) is a company that specialises in making games that help organisations build internal capacity to meet systemic challenges. For a UK university, SGS were tasked with improving the decision-making of healthcare professionals looking to use pesticides to combat the spread of malaria in sub-Saharan Africa.

SGS built a program simulating various environments experienced by the client, building in variables associated with the university's dataset on the use of pesticides in controlling mosquito populations and vector-borne diseases. Through the use of appropriate data resources, players are tasked with developing and implementing an effective Insecticide Resistance Management Plan based on the environment generated by the program; players succeed if they prevent the spread of malaria. The game incorporates mini-games, which explain or expand on key topics in the control of vector-borne diseases.

The game was used by healthcare professionals in Malawi and Zambia to better understand the nature and consequences of the decisions they made on a day-to-day basis. Feedback from players was positive; engagement and focus was high, and the majority said that by being placed in a decision-making position, they had learned something new about both the subject matter and the limitations faced by their colleagues. Building on its success, SGS is in the process of expanding the game to incorporate more variables and allow players to assume additional roles.

Progression system	✓
Avatars	✓
Badges	✓
Collective responsibilities	✓
Onboarding	✓
Leaderboards	✓
Instant feedback	✓
Flow	✓
Freedom to fail	✓
Freedom to explore	✓
Freedom of effort	✓
Freedom to assume different identities	✓

EMOTIONAL ELEMENTS OF GAMIFICATION

One of the key principles of games is that they bring players into a mental state called "flow", a state of total focus on the task at hand. This idea was pioneered by psychologist Mihaly Csikszentmihalyi, who suggests that there are three necessary conditions for flow to be achieved:

- A clear goal, or set of goals. This adds structure and direction to the task.
- Clear and immediate feedback. This helps people adjust their performance to meet any changing demands.
- Balance between challenge and skill. For flow to be achieved, a person must consider the challenge level to be appropriate – they can neither be bored nor anxious. [1]

Building from this base, games designers have used the concept of flow to keep players engaged. A core theory of game design involves incremental progression, which is designed specifically to maintain the 'flow' state. An example of a technological aid to this is dynamic difficulty adjustment (DDA), which is the process of automatically allowing some parameters and behaviours within a video game to change in real-time based on the player's input or ability.

This concept was introduced into the mainstream with the video game Flow, which was written by Jenova Chen and was based on his study of DDA. Since then, many games across a diverse range of genres have incorporated it into their designs, from role-playing games (RPGs) to strategy games to sports games.

In education, flow can be achieved at both the basic educational and skill-based levels. However, achieving flow is difficult in noisy and crowded classrooms, where students' attention is easily disturbed. Gamification helps to establish flow by taking students out of their normal routine and presenting them with a series of tasks that are engaging enough to prevent students' minds from wandering. Sometimes the very presence of a game activity – a break from what is considered normal for most students – can help achieve flow by presenting a novel experience.

Flow is both a technique of gamification and, due to the increased focus of students on the educational material, one of its objectives.

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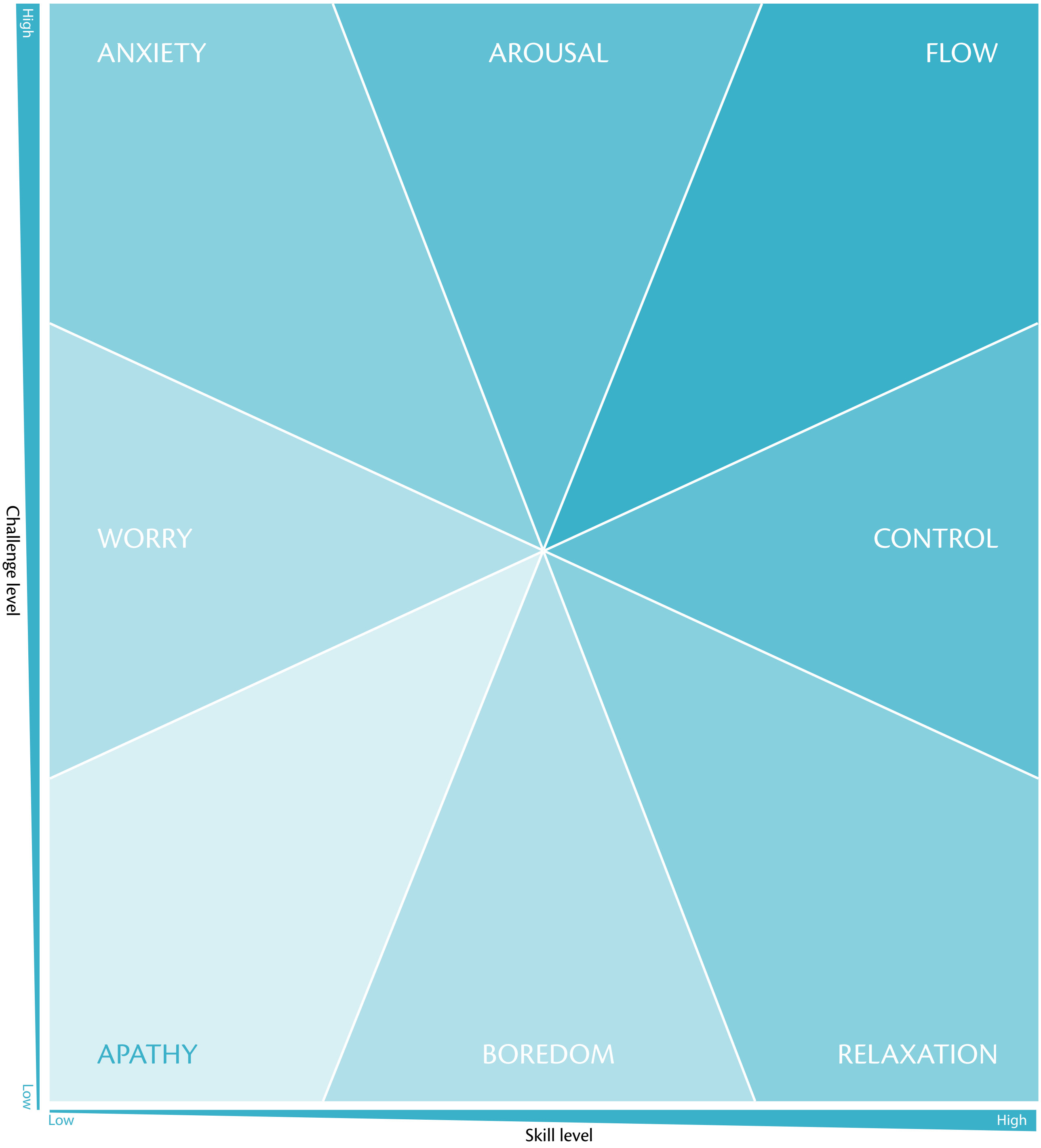
[1] Csikszentmihályi, M.; Abuhamdeh, S. & Nakamura, J. (2005), "Flow", in Elliot, A., Handbook of Competence and Motivation, New York: The Guilford Press, pp. 598–698

Flow


ANXIETY
AROUSAL
FLOW
WORRY
CONTROL
APATHY
BOREDOM
RELAXATION
High
Challenge level
Low
Low
Skill level
High

The first documented use of the term dates to 2008, but it was only in the second half of 2010 that several industry players and conferences popularised it.[1]

"[S]chools already have several game-like elements. Students get points for completing assignments correctly. These points translate to 'badges', more commonly known as grades."[2]

WHERE AND HOW DID GAMIFICATION IN EDUCATION ORIGINATE, AND HOW HAS IT DEVELOPED SINCE?

While elements of gamification have undoubtedly always existed in education, the term 'gamification' itself is a relatively recent neologism.

Education has always contained elements or mechanics used in games. The provision of rewards of various types – in the United States often known as 'gold stars' – has been common throughout educational history, at both the basic education and skill building levels. The 'house' system is a further example of a gamification concept which has already been adopted and implemented within the culture of education.

Part of the innovation of modern discussions of 'gamification' is therefore using technology to better isolate the effects of each of the elements of gamification and apply them to other parts of life more consistently.

Many of the best-known initiatives of the past few years have been the brainchildren of individual lecturers and teachers rather than the outcome of any systematised approach. For example, Lee Sheldon, professor at Rensselaer Polytechnic Institute, allowed students to earn 'experience points' instead of grading them conventionally, and converted homework assignments into 'quests'.

The study of gamification is still relatively nascent, and lacks large-scale studies assessing its effect on individual learning programmes. The studies that do exist are small in scale and, given their lack of control groups, the conclusions they produce have significant methodological problems.

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[1] Deterding, S., Khaled, R., Nacke, L. E., & Dixon, D. (2011, May). Gamification: Toward a definition. In CHI 2011 Gamification Workshop Proceedings (pp. 12-15).

[2] Dicheva, D., Dichev C., Agre G., & Angelova G. (2015). Gamification in Education: A Systematic Mapping Study. Educational Technology & Society, 18 (3), 75–88.

CASE STUDY 3:

THE INSTITUTE OF PLAY

Social: Yes

Ages: 11-18

Founded in 2007, the New York City-based Institute of Play aims to create learning experiences rooted in the principles of game design. It supports teachers in implementing gamified learning techniques, with a focus on fostering an environment where students are free to experiment (and fail) as they learn to solve specific problem sets.

The IoP's first major initiative was Quest to Learn, a fully gamified school (see Case Study 6). The Institute of Play has also consulted for leading commercial and cultural institutions on game design, audience engagement and innovation.

The IoP's focus is primarily, although not exclusively, on secondary school-level students, beginning at age 11, where student motivation tends to begin to decline. It aims to provide children with what it considers the 'higher-order' skills it has identified as crucial to success in the modern world, such as the ability to think, solve complex problems or interact critically through language and media. It also runs summer and after-school programmes for students.

Progression system	✓
Avatars	✓
Badges	✓
Collective responsibilities	✓
Onboarding	✓
Leaderboards	✓
Instant feedback	✓
Flow	✓
Freedom to fail	✓
Freedom to explore	✓
Freedom of effort	✓
Freedom to assume different identities	✓

> **"There are three key moments in game play with important implications for learning. The first is when a would-be player approaches a game and expresses a wish to participate. The second moment comes when a player asks, 'Can I save it?' In other words, 'I'm deeply invested in this experience, which has value and meaning, and I'd like to pick up where I left off.' The third moment comes when a player attains a level of mastery and offers advice to a novice."**

– Institute of Play website

The IoP focuses on the two schools (Quest to Learn and CICS ChicagoQuest) that are fully gamified, but its extracurricular activities may provide a more fruitful avenue towards expansion. Because summer programmes, when children in the United States and Europe are not in session, are seen as additional to the traditional school schedule, there is a greater willingness to try alternate methods. Further, because it is during a time when children are otherwise on holiday, an approach that is considered fun is in fact deemed more appropriate. These activities, with lower initial investment costs and ability to spread more quickly, could begin to generate the data on the effects of gamification very rapidly.

1958

1958
Tennis for Two, the first game to use a graphical display created by Dr. William Higinbotham, an American physicist. Tennis for Two simulated a game of table tennis using an oscilloscope.

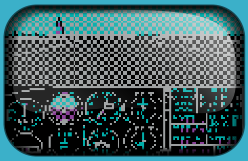
1978
MUD1 (Multi-User Dungeon), the oldest virtual world in existence was created by Roy Trubshaw at Essex University on a DEC PDP-10 in the UK.

1978
Elementary school teacher John Hunter designs the World Peace Game, an educational simulation using a fictional geopolitical setting. The World Peace Game was not widely publicised until 2010, when a documentary on the game won awards at the Bergen Film Festival.

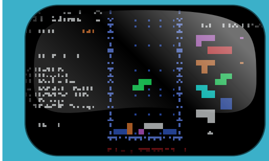
1980

1980
Thomas Malone publishes his paper “What makes things fun to learn? Heuristics for designing instructional computer games”.

Flight Simulator released



1982
The first version of Microsoft Flight Simulator is released



Tetris released

1984
Tetris is launched. Designed by Russian computer engineer Alexey Pajitnov, it saw tremendous popularity on release. The 2006 mobile re-release of Tetris is the best-selling pay-to-download game of all time, with over 425 million copies sold across all platforms.

1989
The benefits of applying computer games, and techniques used by computer games, to other areas of life is discussed in Howard Adelman et al’s Toward a Procedure for Minimizing and Detecting False Positive Diagnoses of Learning Disability, one of the first commentaries on the subject.

1990

Doom released

1993
Doom, a first-person shooter, is released, helping to establish video games as a mainstream pursuit. In 1995, it was estimated that the game was installed on more computers than Microsoft’s Windows 95 operating system.

MAJOR MILESTONES IN THE EVOLUTION OF GAMIFICATION AS AN EDUCATIONAL METHODOLOGY

Everquest released

1999
Everquest, the first successful massively multiplayer online role-playing game (MMORPG), is released, bringing social online gaming into the public consciousness. Everquest would pave the way for World of Warcraft, a 2004 release, for which more than 100 million accounts were created in the game's first decade.

2000

'Gamification' coined

2002
British computer programmer and entrepreneur Nick Pelling coins the term gamification, defining it as "applying game-like accelerated user interface design to make electronic transactions both enjoyable and fast".

2005
Scratch, a visual programming language designed to teach the concepts behind computer programming, is released.

2007
The Institute of Play is founded in New York City.

2007
James Paul Gee publishes his book "What video games have to teach us about learning and literacy".

2009
Quest to Learn (Q2L), a project initiated by the Institute of Play, opens. Q2L has gamified nearly all of its courses and classes.

2010

2010
Gamification gains traction within academic literature and becomes a popular term in internet searches.

2011
The first gamification conference is held in San Francisco.

2011
The Oxford English Dictionary adds gamification to its word of the year shortlist. It defines it as 'the application of concepts and techniques from games to other areas of activity'.

2012
The Deloitte Leadership Academy is revamped with gamified content, implemented by a specialised gamification consultancy.

2015
Fantasy Geopolitics, a gamified website designed to encourage students to learn about the world's news, is released through Kickstarter.

2016
Oculus Rift, the first commercial PC-based virtual reality head-mounted display, is set to be released.

2020

GAMIFICATION IN PRACTICE

WHERE HAS GAMIFICATION BEEN DEPLOYED?

There have been no government or sector-wide efforts to use gamification in educational systems. In the United States, the three most recent educational initiatives revolved around setting educational objectives – such as a standardised list of subjects students should master by certain age levels – or tying funding to test assessments. However, in none of the policies do they advocate for any particular pedagogical techniques, such as gamification.

The introduction of gamification has therefore been ad hoc, largely at the wish of individual teachers. Gamification has tended to be used in two distinct manners: gamified courses, and gamified activities.

Gamified courses

Course-long gamification efforts have tended to proliferate at the skill-building level, especially at universities.

Gamified courses have obvious application at the university level. There are a number of reasons for this, some due to the utility of gamification and some reflecting the availability of data:

- Universities have more discrete sets of courses than at the primary or high school level, and adopting a novel approach is easier in a course of four months than one that extends over an academic year.
- University instructors tend to have greater freedom in developing pedagogical approaches than at primary and secondary schools.
- University instructors are often researchers, and are accustomed to publishing the results of their experiments.
- In many countries with tightening educational budgets, professors must highlight their instructional acumen to gain employment in a competitive job market that is highly susceptible to social inequities. This may encourage the innovation that leads to greater use of gamification.

Gamified activities

At the basic educational level, there appears to be a greater number of discrete gamified activities, which supplement the core teaching structure rather than supplanting it. In this way, teachers are able to engage students without abandoning the traditional teaching structure and obligations that are often required for state-level testing. Teachers are therefore able to utilise gamification for individual lessons or particular subjects while maintaining traditional approaches for others.

Examples in schools are varied in their emphasis on gamification. Some are unintrusive, such as the Ticket to Read program. This online and mobile-enabled platform rewards students from age six to twelve with 'tickets' for completing reading passages. It awards schools 'gold stars' when more than 90% of their participants read a passage in a week. It therefore utilises social and reward mechanisms to encourage greater motivation with the product. However, it does not do much more than connect previously existing incentive structures with modern technology; awarding gold stars for completing assignments has been a long-standing tradition in US classrooms and the term "gold star system" has been used to refer to an incentive structure by the US Department of Education.

Gamified schools

The principles of gamification have been fully embraced by a school in two cases, at Quest to Learn (Q2L) in New York City and CICS ChicagoQuest. Q2L is a public school that teaches 662 students from ages 10 to 18 and is designed and supported by the Institute of Play. CICS ChicagoQuest is a public charter school (funded by the government but run semi-independently by a private firm) which will be a similarly sized school by 2017.

This private-public partnership appears to be key to the success of Q2L. Because of the unique nature of the curriculum, Q2L required considerable upfront investment into its approach – an investment that may not be possible in school districts with limited budgets.

ChicagoQuest is funded in part by the John D. and Catherine T. MacArthur Foundation and the Carnegie Corporation of New York, and Q2L has funding also from the Bill and Melinda Gates Foundation and the Margulf Foundation. While this is a positive indication for the appetite of private donors to engage in gamification, it also shows that governments are wary of committing fully in a financial sense to a gamified approach at this point.

CASE STUDY 4:

DELFT UNIVERSITY OF TECHNOLOGY

Social: Partially

Ages: 18-25 years old

At the Delft University of Technology in the Netherlands, instructors gamified two courses, a first-year undergraduate course on computer organisation and a master's level course on cloud computing.

In these courses, the instructors employed a spectrum of game-design inspired mechanics to increase engagement throughout the term. These included:

- a points system;
- badges;
- status, including a 'Hall of Fame';
- an onboarding game to acquaint students with the course structure;
- social game patterns, including group projects; and
- the ability to 'unlock' additional assignments.

The instructors were able to use nearly every game-inspired mechanism available, as the length of the course and the variety of learning experiences in computer science – lectures, theoretical material, practical work and group assignments – permitted such.

Feedback was positive from the students, and instructors were pleased with the progress made. The content of work on cloud computing, a relatively new and booming field, likely also contributed to higher student engagement. Further, by applying gamification to a computer science course, the university likely had a higher proportion of video game players than the population at large, as studies have shown historical correlation between playing computer games and later studying computer science.

Progression system	
Avatars	
Badges	✓
Collective responsibilities	✓
Onboarding	✓
Leaderboards	✓
Instant feedback	
Flow	
Freedom to fail	✓
Freedom to explore	
Freedom of effort	✓
Freedom to assume different identities	

CASE STUDY 5:

BEEUP

Social: Yes

Ages: 15+

BeeUp is an online platform where students can register to 'solve' business case studies. The case studies are based on real-world problems faced by BeeUp's company partners; for example, developing a novel business model for an innovative product, or a marketing strategy for a specific small or medium enterprise. The platform is open to the public, and after solving 10 case studies, students receive a certificate in 'business model innovation' worth 10 European Credit Transfer and Accumulation System points (one-sixth of an academic year).

BeeUp is increasingly being used by teachers in high schools. Their learning objectives include increasing cooperative and collaborative skills (cases are solved in groups) and enabling students to apply theoretical concepts to solve real-world problems.

Starting from a concept developed by two universities in St Gallen, Switzerland, learning objectives were derived and translated into appropriate game-like elements.

It uses two points-based systems: one for solving cases (by working on a solution for the case study within the platform) and one for cooperation and collaboration (by answering other users' questions on the online message board). Both types of points accumulate towards a single 'experience score' which reflects the overall level of qualification received by the student. This score is visualised in a graph which shows the student's progress over time. Learners can also obtain different user levels based on their experience score which allow them to attempt more advanced case studies.

In terms of technology, the platform employs a variety of different functionalities to spur both collaboration and competition. The point system and individual case studies create a series of sub-goals to ensure students' attention is engaged, but its most crucial element may be the credit system, in which participating in the game is considered as schoolwork. This increases institutional support for the system.

Progression system	✓
Avatars	
Badges	
Collective responsibilities	✓
Onboarding	
Leaderboards	✓
Instant feedback	
Flow	
Freedom to fail	
Freedom to explore	
Freedom of effort	
Freedom to assume different identities	

CASE STUDY 6:

QUEST TO LEARN

Social: Yes

Ages: 11-18 years old

Funded by the Institute of Play (IoP, Case Study 3), Quest to Learn is a fully gamified high school in Manhattan, which first opened in 2009 to a class of sixth graders (11-12 year olds). As that class aged, Q2L added grades, so that this year sees its first class of twelfth graders (17-18 years old), the final year in US high schools.

Q2L has gamified nearly all courses and classes and is considered by its parent organisation, the Institute of Play, to be a "lab" and precursor to other locations. The IoP is a private institution that aims to introduce gamification to schools around the country, having done so with Q2L and CICS ChicagoQuest, which opened two years after Q2L.

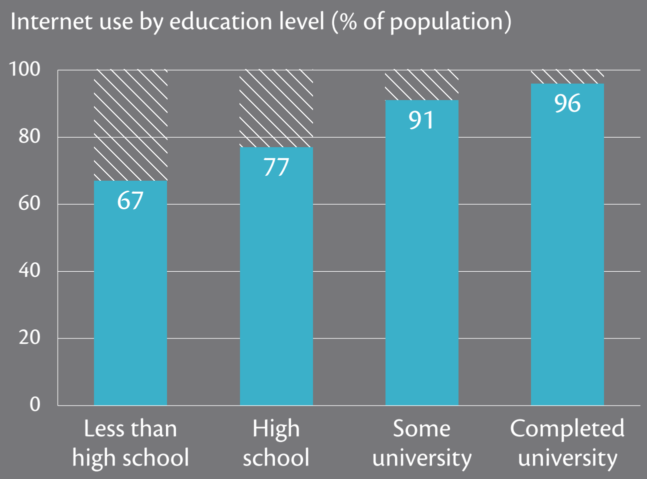
Q2L uses a full-spectrum of gamified methodologies for its classes. For many classes, the gamification activities are not internet-enabled, but involve role playing and classroom exercises. One of the underlying principles is to identify what profession requires the use of such knowledge, and to design activities that encourage children to act as that profession, (ie, teach civics through acting as politicians).

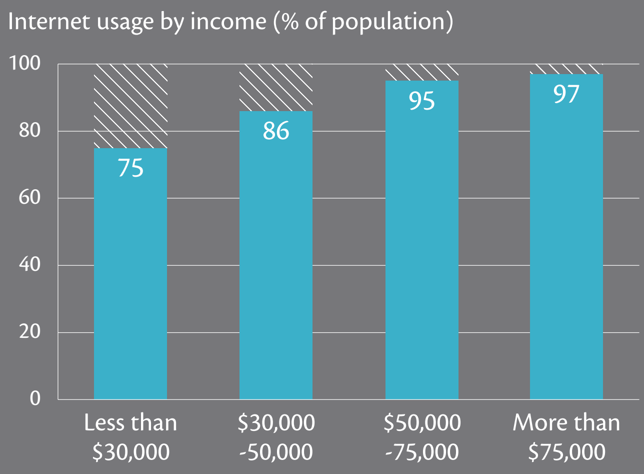
Another principle is to embed the information that must be learned in a broader purpose. For example, in a literature course on William Shakespeare's play Romeo and Juliet, the class was asked to stage a trial determining the guilt of the concept of fate for both protagonists' deaths. In order to participate in the trial, the students would need to read and understand the text, but were incentivised to do so by the idea of 'winning' the trial.

The IoP is compiling data on the results of the gamified approach at Q2L, but with its first group of final year students yet to graduate, this data is not yet complete. However, reviews of Q2L have been largely positive in tone, with reservations on quality.

The New York City Department of Education rates the school as "fair" in Rigorous Instruction, Effective School Leadership, and Trust; and "good" in Collaborative Teaching, Supportive Environment, and Strong Family-Community Ties.

Internet disparities in the United States





However, it is rated as “excellent”, the highest rating, in how well it helps students improve proficiency in English and Mathematics (“good” for science and “fair” for social studies).

One important variable is that 36% of the student body at Q2L has special educational needs. This is significantly higher than competitor schools. Therefore, Q2L has a lower predictive quality on the utility of gamification, as its sample is not representative of the general student body.

Q2L believes that there are several reasons that such a high proportion of its pupils have special needs. First, as an alternate teaching structure, it attracts the parents of children who feel poorly served in standard schools. Therefore, as gamification increases at other schools, the uniqueness of Q2L may decrease and these numbers decline. However, there may be the fact that gamification, by offering greater freedom to learn at one’s own pace, mimics the individualised education programmes that are created for students with special needs. Therefore, gamification may be particularly well-suited to these students.

Progression system	✓
Avatars	✓
Badges	✓
Collective responsibilities	✓
Onboarding	✓
Leaderboards	✓
Instant feedback	✓
Flow	✓
Freedom to fail	✓
Freedom to explore	✓
Freedom of effort	✓
Freedom to assume different identities	✓

Table 1: Student body type at elite New York City public schools

School	Students with special needs
Quest to Learn	36%
Bronx High School of Science	1%
La Guardia High School of Music and Arts and Performing Arts	2%
Millennium High School	9%
Beacon High School	6%

WHAT LED TO GAMIFICATION'S INTRODUCTION?

Gamification at the university level appears to be the product of instructors who wish to deliver courses in innovative ways. For instance, the Delft University of Technology gamified courses were not part of a department-wide programme. At the primary school level, adoption of gamified courses has been similarly ad hoc, although they were likely approved by the department.

In the corporate setting, gamified educational tools tend to begin as experiments when traditional educational systems present difficulties. The Deloitte Leadership Academy, a gamified executive training programme, was implemented by the Manager of Innovation to confront competing demands on the time of their target audience.

The ability to implement a gamified course therefore hinges on an institution having an internal innovator with enough authority within the organisation to devote the time and resources to a new and relatively untested enterprise. However, it can be aided by the presence of existing gamification firms or programmes. Some examples of this include:

- Quest to Learn, which relied on the Institute of Play's curriculum design and support to convince New York City to accredit it as a public school.
- The World Peace Game, the creator of which runs workshops training teachers to implement it.

QUEST
TO LEARN
ABOUT US
FAMILIES
STUDENTS
ADMISSIONS

What if we could build a school where students are excited about learning, solving problems and facing complex challenges?

At Quest to Learn, students are engaged in their own quests to be inventors, designers, innovators and problem solvers.

LESSONS LEARNED: WHAT IS NEEDED FOR GAMIFICATION TO WORK?

Gamification is not a universally successful technique, and must be designed to suit the objectives of the classroom. Some of the most important aspects are institutional support, level of engagement, and correct mechanism selection.

Institutional support

Gamification enterprises are novel and so often require long time commitments (for role-playing simulations); monetary commitments to build technological platforms (for course-long gamification); and administrators willing to sanction the investment required. Additionally, as gamification is still new, the techniques will likely need to be refined, and administrative support beyond the first attempt is required to take gamification from a trial concept to a refined pedagogical approach. Quest to Learn stresses the importance of being flexible with gamification attempts and to continually adjust based on student reactions.

In light of this resource intensity, the novelty of gamification is likely to attract resistance from educators and administrators worried about introducing an untested approach into classrooms and the potential social and financial implications of this.

Q2L is an example of extreme institutional support, insofar as the entire school is dedicated to the gamification approach. Nonetheless, it has also benefited from support from the New York City Department of Education and was approved at a time when the department had a chancellor with a business background who was actively seeking innovative approaches to education.

Appropriate level

Gamification is designed to better engage students, but this engagement can be lost if the tasks demand too much from students, or require too much prior knowledge. Therefore, efforts to introduce gamification are most likely to succeed when gamifying the existing curriculum, rather than introducing an entirely new activity, which may be beyond the means of the students.

Mechanism selection

The variety of tools available to course designers provide a wide variety of routes to the course objectives. However, not all are suited for all environments. An initial overview is provided in the 'Strategy and Policy' section of this report.

As the field is still enjoying rapid expansion and experimentation, there is not yet a definite set of gamification best practices.

CASE STUDY 7:

DELOITTE LEADERSHIP ACADEMY

Social: Yes

Ages: 21+ (professionals)

Although the implementation of gamification programmes in schools is often hindered by a lack of institutional buy-in and a lack of resources, training programmes in the corporate world have largely been successful in increasing levels of participation and engagement. First launched in 2008, the Deloitte Leadership Academy (DLA) is an online training programme for Deloitte employees and clients.

In 2012, Deloitte enlisted the help of a specialist gamification consultancy to gamify the programme, introducing badges as rewards for participation and achievement, and leaderboards for the top achievers. One of its innovations was to reset the leaderboards after seven days, to stop users becoming discouraged after missing a few weeks. Some of the rewards are group-based – if all members of a specific group watch a video, they are all given an extra reward at the end of that week.

The programme also makes extensive use of onboarding. The first ‘mission’ learners must complete is a three-minute tutorial video explaining how to get the most out of the website. The content on the DLA website is sourced from leading business schools, including Harvard and Stanford, and users are rewarded for engaging and interacting with the videos and activities presented to them.

Since the integration of gamification into the Deloitte Leadership Academy’s programme, there has been a 37% increase in the weekly usage statistics, according to the Harvard Business Review, and a 46% increase in the number of users that return to DLA daily. The amount of time users spend on the site per visit has also increased markedly since the content was gamified.

Progression system	
Avatars	✓
Badges	
Collective responsibilities	
Onboarding	✓
Leaderboards	✓
Instant feedback	
Flow	
Freedom to fail	
Freedom to explore	
Freedom of effort	
Freedom to assume different identities	

CASE STUDY 8:

WORLD PEACE GAME

Social: Yes

Ages: 10-11 years old

One of the more extensive examples of gamification in the classroom is the World Peace Game, designed by a public school educator in Virginia for a 'gifted and talented' programme.

This game is a simulation using a fictional geopolitical setting designed to encourage interpersonal communication, an awareness of modern political, economic and environmental issues, and analytical thinking. It engages a class of 25-30 students and can last for months. It is played on a large multi-tiered board that must occupy a part of the classroom for the entirety of the exercise and comes with a 20-30 page manual.

As a result, the World Peace Game is recommended only for specific environments. The creator of the game urges that it only be used if the class and teacher meet several criteria, including:

- a relatively high level of intelligence;
- "intellectual stamina";
- positive teacher-student relationships (where the teacher can mediate in case of dispute) and;
- a socially cohesive group of students (as the game is expected to spark conflict).

The World Peace Game is an example of the potential advantages and disadvantages of gamification. When properly applied, according to its creator, students grapple with issues beyond their usual age range, and develop social skills useful in a variety of settings. However, as the guidelines suggest, by hosting the game with a class not capable of the intellectual demands, the instructor risks a considerable amount of wasted time, the school system may have spent money for the teachers' training course, and the students may have triggered damaging social tension that lasts throughout the school year.

Progression system	
Avatars	
Badges	
Collective responsibilities	✓
Onboarding	
Leaderboards	
Instant feedback	
Flow	
Freedom to fail	
Freedom to explore	✓
Freedom of effort	
Freedom to assume different identities	✓

LESSONS LEARNED: WHAT HINDERS GAMIFICATION?

Gamified courses may fail for several reasons, primarily relating to feasibility, student interest, and misaligned objectives.

Feasibility

Gamification mostly relies on technology as the platform by which teachers and students communicate and learn. Therefore, schools that lack the necessary hardware and resources – such as computers or portable devices and broadband internet – will struggle to introduce gamification. Additionally, gamification activities that are accomplished as homework may require every student to have access to the internet – something which is far less likely in low-income areas. In the United States, 85% of adults use the internet, but this is highly dependent on income level and educational attainment.

Making the internet a prerequisite for learning in this way risks exacerbating disparities in the education system and, due to education's link to economic success, could penalise children for their family's lack of technological access.

Student interest

Gaming is often considered to be a popular and widespread activity, but there are large groups of people who do not play videos games and gamification is unlikely to be a useful pedagogical innovation in these contexts. A Pew Research Center survey conducted in mid-2015 found that 49% of US citizens play video games – but that only 10% of that population consider themselves "gamers".

This "anti-gamer" mentality and the existence of negative popular stereotypes about video games could result in a backlash against efforts to gamify courses. Gamification may also undermine the educational success of some students that have performed well under more conventional pedagogical approaches. Such students may be turned off by the conscious analogies to video games. To avoid these outcomes, teachers may need to revert to more traditional teaching methods.

Misaligned objectives

Gamification is an educational technique and therefore does not include any set objectives.

Gamification has tended to be introduced in areas with a quantifiable skill or set of knowledge: the sciences and mathematics (especially at the university level) and reading (at the primary level). It is difficult to gamify writing an essay – a critical part of most university entrance examinations and one of the primary testing mechanisms in university. Essay-writing can be part of a gamified experience, for example, writing an essay as part of a role-playing activity, but teachers may not wish to spend the time on such an exercise.

Inappropriately applied gamification

Gamification will be hindered, and likely acquire a negative reputation throughout the educational system, if it becomes associated with failed endeavours in which the appearance of gamification was introduced, while the underlying elements were not included. What is important is not the appearance of gamification through visible elements, but applying the underlying principles of gamification to the existing curriculum.

> “The most important thing is for teachers to avoid introducing chocolate-covered broccoli! It may look good at first, but learners will know what they’re being fed by the time they take the first bite. If gamification is applied to educational content in an inconsiderate way, learners are likely to only focus on the rewards and not the learning process itself. This will end in frustration for both educators and learners, and will kill the effort more or less immediately.”

– Kai Erenli, University of Applied Sciences, Vienna

ADVANTAGES AND DRAWBACKS

ADVANTAGES

The primary advantages of gamification are that it encourages what Scot Osterweil, creative director of the Massachusetts Institute of Technology's Education Arcade, calls the "four freedoms of play".

Freedom to fail

Many of the fundamental concepts of video games – puzzles that must be solved, high score leaderboards in arcades, and multiple 'lives' for the characters – are predicated on the assumption that players will repeatedly fail as they learn how to play the game.

However, in life, people are extremely averse to failure. The psychologist Peter Cathcart Wason in 1960 conducted a simple experiment to find whether people will seek confirming and disconfirming evidence when asked to identify a number pattern. The study found that even when there are no consequences to doing so, people will avoid risking failure and seek only to confirm their initial assumptions.

The natural human tendency to avoid failure in schools is combined with real consequences for failure on even minor assignments. This can inhibit learning, because students are held back from potentially inspiring experimentation by the need to prevent mistakes.

Because games assume that mistakes will be made, and present little to no consequences for mistakes, failure becomes a smaller concern and students are not constrained by worry.

Freedom to experiment

When students are free to fail, their freedom to experiment is heightened. Experimentation permits greater avenues for self-directed learning, and therefore increases the volume and quality of learning. Students will continue to learn, focus, and observe when not explicitly instructed to do so.

Gamification in this area draws to a large extent on sports. In sports, although there is a defined objective, the path to that objective is left open for the player to decide. From a young age children are therefore encouraged to try different strategies, learning about the game while expressing their own identity.

Experimenting also serves the purpose of increasing the amount of knowledge the student may learn. Rather than operating within a finite list of facts, experimenting will lead students down new avenues for which, to succeed, new pieces of information must be learned. This is especially useful in fields of study that contain vast quantities of information, of which only a selected portion is taught, such as history. While a student in a traditional setting may be taught only key dates and names, a gamified learning experience (such as an immersive historical activity) could see them to delve deeper on their own.

CASE STUDY 9:

SCRATCH

Social: Yes

Ages: 5+

Progression system	✓
Avatars	
Badges	
Collective responsibilities	
Onboarding	✓
Leaderboards	
Instant feedback	
Flow	
Freedom to fail	
Freedom to explore	✓
Freedom of effort	
Freedom to assume different identities	

Scratch is a visual programming language developed by the Lifelong Kindergarten Group at the Massachusetts Institute of Technology (MIT). Released in 2005, it is a free desktop and multimedia authoring program designed as a learning tool to enable students, teachers and parents to create games and multimedia videos, and also as a stepping stone to computer programming. Using Scratch allows people to understand the logic of computer programming, without needing to learn a specific programming language.

Within the program, users drag blocks (which represent programming functions) from the block palette, and attach them to other blocks to represent strings of code. Each type of function is given a certain shape, and can only be placed inside or below blocks that will accommodate it. In this way, users are introduced to the core concepts behind programming and code construction, and gain an intuitive grasp of the mechanisms of event-driven programming languages.

Scratch has been widely used since its release. Many schools have used it as part of introductory courses on computer science, and its application for basic educational needs is widely acknowledged. Scratch's success spawned another version, ScratchJr, designed specifically to introduce coding skills to younger children (ages 5-7). The use of a visual nature of the coding helps to reduce one of the significant barriers of computer coding in children whose basic reading skills are still developing.

At the skill building level, a Harvard University introduction to computer science course uses Scratch for its first weekly task before switching to the more popular C programming language for the remainder of the course.

when clicked
show
forever
move 20 steps
if on edge, bounce
set size to 50 %

Freedom to assume different identities

One of the primary roles of entertainment is escapism, to inhabit or experience a different life temporarily. It is a central part of most children's play and can be a powerful pedagogical tool. By assuming a new identity, or role-playing, students are encouraged to see the world through a different perspective, to dive into an area of knowledge needed to understand the new identity's viewpoint, and are often asked to communicate how the new identity would act in a situation, building a child's language skills while also encouraging empathy.

This freedom is most important at the basic educational level, when children are most likely to enjoy that style of play. It can be replicated at the skill building level by the creation of teams, which allow for group identities. This is most commonly seen with houses at boarding schools and residential colleges at the university level.

Freedom of effort

Most games have an internal rhythm. This can be as simple as a turn-based system in group games; players must concentrate when it is their turn, but can relax when others have their turns. In single-player games, this is instead accomplished through designing games to have moments of relative inactivity. This could take the form of breaks in between levels, informational or entertaining cut scenes in which characters talk, or times when the task at hand is simple.

By alternating periods of intense concentration and relaxation, games do not overtax or exhaust the players. Average attention spans in children range from about 10 minutes for a 5-year-old to 20 minutes for a teenager. After this period of time, students will naturally lose their focus. In a gamified environment in which high focus is alternated with breaks, students will have their attention spans naturally refreshed, and can pursue a single task for a considerably longer period of time than if they were asked to do so in a continuous period of moderate concentration.

Freedom of effort also helps to enhance the learning process. Research on meta-cognition has found that pausing to consider an exercise increases the amount of information understood and retained.

Automated teaching

One of the main advantages in gamification for the future of education is that it automates many of the tasks that would otherwise be performed by the teacher. For example, rather than a series of quizzes and tests taken in class that requires the teacher to manually grade each, a gamified course can automatically evaluate questions that have definite answers.

These time savings have been utilised in two major areas: language and music. Much of the learning in these areas depends on repetition. Apps for mobile devices, such as Duolingo and TabRider can provide the instant feedback needed for a student to know whether he or she has chosen the correct word or note. This allows the student to practice with a virtual teacher, so that when in the class with a real teacher, time can be devoted to more difficult issues that cannot be addressed by software.

CASE STUDY 10:

FANTASY GEOPOLITICS

Social: Yes

Ages: 14-18

Fantasy Geopolitics is a game that is designed to encourage students to learn about the world and to follow current events.

It is based on the principles of fantasy sports, in which a group of students ‘draft’ countries into their own team. Countries gain points based on their mentions in major media outlets and students’ teams are the aggregates of their component country totals. Students may trade countries with each other.

The game was developed by a high school teacher in Minnesota, in the United States, and is a relatively inexpensive tool for school systems. The current pricing is only 200 dollars per year for 250 players, enough to cover all students in many US high schools. It is one of the more obvious links to games among gamification efforts, in that it is directly modelled on a ubiquitous type of game that is played by 18% of US teenagers and 30% of Canadian teenagers. This reduces the need for an onboarding process, as the game mechanics will be known by many students already.

However, there is a potential downside with this approach. The largest fantasy sports providers in the United States have become dominated by a small group of players that have developed algorithms to predict performance. Rather than being a platform to engage with sports, they have become fodder for the mathematically minded to hunt for patterns as in any other market. In Fantasy Geopolitics, it is conceivable that a similar pattern develops, in which students find ways to win the game without grappling with the subject matter. If this should happen, instead of education becoming gamified, it will have been replaced by a game.

Progression system	✓
Avatars	
Badges	✓
Collective responsibilities	
Onboarding	
Leaderboards	✓
Instant feedback	
Flow	
Freedom to fail	
Freedom to explore	
Freedom of effort	
Freedom to assume different identities	✓

Drafting Countries

Individualised learning

One of the most crucial ways in which gamification can serve the educational process is by permitting a cost-effective way for school systems to personalise the learning process. It is generally accepted among educational specialists that smaller class sizes lead to higher student achievement.

In a gamified environment, the student, by choosing the pace of learning (through an incremental progression system and a freedom of effort) or the area of learning (with a freedom to experiment), tailors the educational agenda to his or her own preferences. This has the effect of simulating a class size of one student, allowing school to offer the benefits of small class sizes without hiring additional teachers.

DRAWBACKS

Gamification, however, is not an educational panacea and, when misused, can lead to a less conducive learning environment.

Distracting attention

Gamification can work by providing alternate pathways to learning, designing a system in which the pursuit of a game-based goal, such as points or badges, is accomplished through learning. This technique works by aligning the objective of the student (points) with the objective of the teacher (the educational material). However if the course is poorly designed students may discover a path to their game objective that does not require learning.

Gamifying education can therefore redirect attention from a student that would otherwise have gone to the subject matter, and transfer it into discovering enough loopholes in the game to succeed more easily.

Social tension

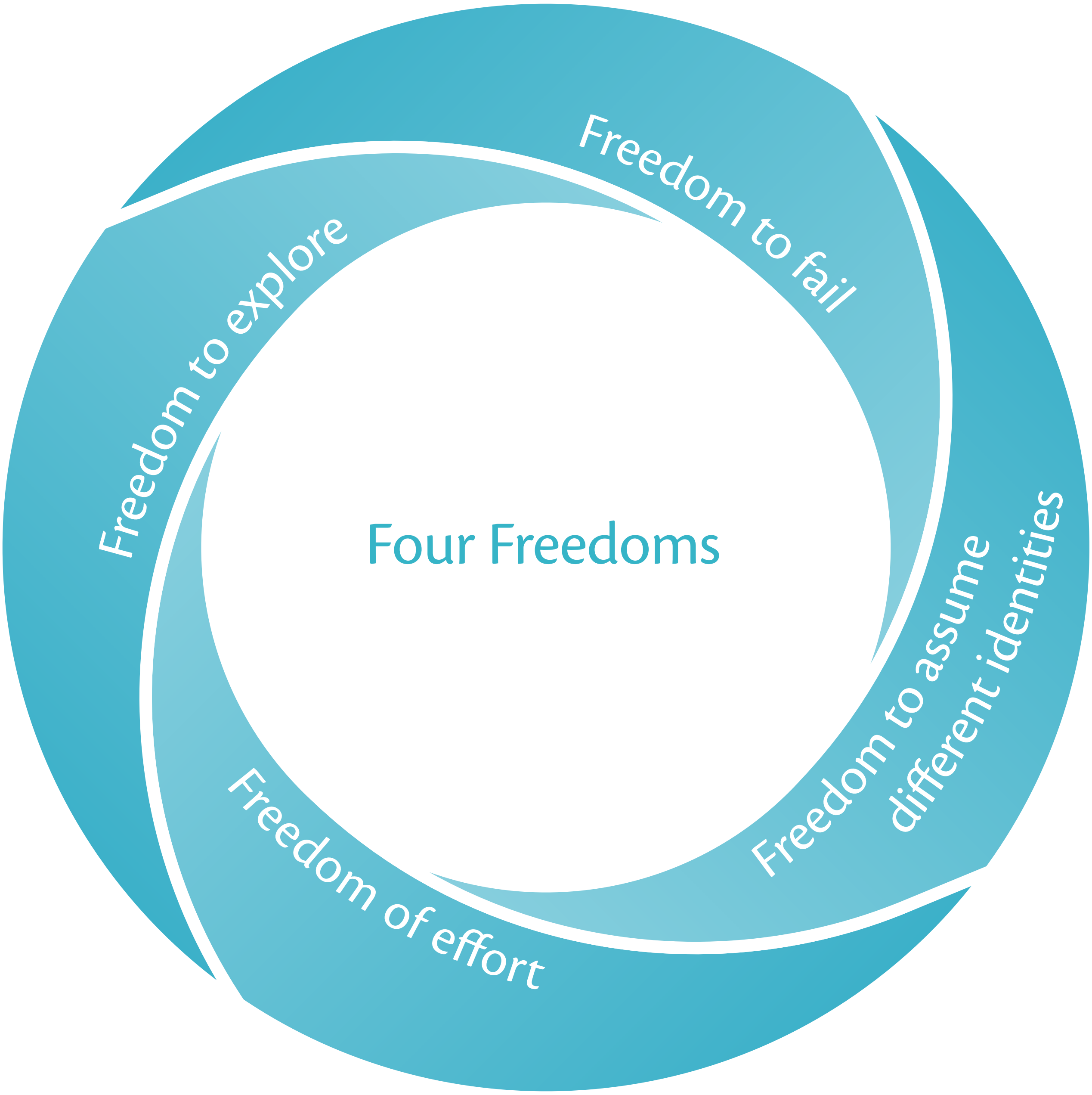
Team-based video games tend to have a solo ‘onboarding’ system that allows a player to learn the game before playing with anyone else, where the new player’s mistakes might hurt the veteran player’s ranking. This permits the player the freedom to fail before triggering any social responsibility.

While games have foreseen the social dynamics in cooperative games, classroom exercises often neglect to do so. Group exercises can be a powerful tool at encouraging learning and team work. But group activities also generate challenges, such as when an entire team receives the same grade despite some members of the group contributing more than others. When poorly executed, gamification can therefore create strains in the classroom and inhibit learning.

Extrinsic rewards

Perhaps the largest risk with gamification is that it prioritises extrinsic rewards over intrinsic rewards. By making learning into a search for points, badges, or levels, gamification may de-emphasise the innate rewards of learning a new skill. This can be a serious risk to learning, especially as one of the fundamental goals of education is to create a lifelong love of learning that will lead to continued self-directed learning. In the attempt to increase the time students devote to study in the short-term, gamification may reduce the long-term drive for education.

However, by enhancing freedom to experiment, freedom of identity and social rewards, gamified courses can build the intrinsic rewards of the experience by increasing the three core psychological needs of motivation: competence (the student feels like he or she is learning a new subject); autonomy (the student feels in control of the learning process); and relatedness (the student feels connected with other students throughout the process).



STRATEGY AND POLICY

WHAT BEST PRACTICES HAVE BEEN ESTABLISHED FOR INCORPORATING GAMIFICATION INTO EDUCATION SYSTEMS?

The concept of gamification covers many discrete elements, and the success of these elements is difficult to quantify. There is little reliable empirical data about the effects of the introduction of gamification and a scientific study on a pilot scale is needed before any firm conclusions can be drawn.

However, the achievements of Quest to Learn are impressive – the school has earned 'excellent' ratings in how well it helps students improve proficiency in English and Mathematics. While the academic research catches up, there are a number of policy-related inferences that can perhaps be drawn from its success, and that of others like it:

- **Gamified education may suit students who sit outside the boundaries of traditional education.** Students with special needs, or with specific physical or psychiatric disorders, may benefit to a greater extent from such an approach. Over a third of Q2L's student body has special educational needs, twice as many as the New York City average.
- **Gamified education is particularly well-suited for subjects in which the subject matter is relatively discrete, and in which the use of technology is already mandated.** The Delft University of Technology case study shows perhaps the most amenable environment of this type for a gamified educational programme.
- **Interactive media, including games and gamified applications, are likely to operate in tandem with gamified courses.** Research on massive online open courses (MOOCs) and other free online delivery platforms suggest that they are most useful for self-motivated learners, provide immediate feedback through interactive exercises and tutorials, and are especially helpful when paired with a tutor.
- **Immersive experiences are useful when information is primarily visual or experiential.** Role-playing games and simulations (sometimes grouped as 'serious games') are used most often when lectures or textbooks would be cumbersome ways to deliver information. For example, dissection components of science courses have long been utilised to help students learn about anatomy and use many of the same principles of gamification, including instant feedback and freedom to experiment (examine the material on one's own).
- **Intermittent reward patterns.** Psychologist B. F. Skinner demonstrated that people and animals are conditioned to maintain effort in a task if there is a variable reward pattern, ie, if the person does not know whether effort will translate into success. This has been embraced by the game industry and is at the core of many successful games. Incorporating the idea of variable rewards – such as achievements that are distributed semi-randomly – into gamification can tap into this natural reaction to encourage longer focus from students. However, this is also the psychological trigger for gambling addiction, and there are considerable ethical concerns for introducing it to young children and it is considered useful only for short-term educational results.

- Reduce distractions to establish flow. Game makers often work to create an immersive environment to encourage flow. For example, games for mobile devices tend to hide the device's clock function. Therefore, some gamified activities work best without set time limits or when teachers can set aside large blocks of time for the activities.
- Groups are most effective with mixed skill levels. One of the most effective ways to solidify learning is to teach the content to someone else. In group settings, students will often take on the role of teacher to explain issues to those less advanced. This has benefits for those explaining, those being instructed (as they receive a more personalised lesson), and for teachers, who have received a 'multiplier effect' by enlisting students in the teaching process.

BASIC EDUCATION VS. SKILL BUILDING

While gamification and its principles can be applied to students of all levels, its utility is vastly different among those acquiring basic educational skills, typically pre-adolescent students, and those developing disciplinary, technical or professional skills, typically adolescents.

Early education is highly concerned with building social-emotional awareness, which will allow children to play in groups without disagreement, to share toys, and to apologise for hurting others. These tasks are needed due to a general lack of social cohesion among children and a lack of importance placed on how others' feel towards oneself. As children mature, they gradually place more and more importance on how their peers view them, transforming from the stereotypical role of the carefree child to the angst-ridden and rebellious teenager.

In education, students are therefore more susceptible to social pressures and more able to engage with their peers in groups as they age. Social elements of gamification can therefore take a progressively larger role throughout the educational system as children grow up.

However, because teenage students are so highly aware of group dynamics, education must be designed so that the social tensions do not corrupt the learning process. Steps to ensure that this does not happen include:

- assessing students individually, so that more capable students are not bullied into doing all of a group's work;
- minimal leaderboards, to prevent the lowest scoring students from being publicly shamed;
- ensuring that group projects are lengthy, so that students have time to get to know one another;
- and strong teacher supervision, to intervene when intra-group tension is incipient.

These guidelines can be relaxed in elective university courses, where students are presumably invested in the projects (to prevent free-riding), and where the students are legally adults (and can be expected to handle social unpleasantness).

SHOULD EDUCATION AUTHORITIES CONSIDER A PHASED OR A ‘BIG BANG’ GAMIFICATION ROLL-OUT?

For a gamification policy to succeed, each of the elements that make up gamification need to be understood, both in isolation and as a cohesive unit. Gamification poorly implemented can lead to negative impacts. Indeed, a group project at the skills-building level without proper supervision or a leaderboard showing the worst students at the basic educational level could lead to psychological damage to the student that reverberates across their entire educational experience.

Gamification should therefore proceed cautiously, ensuring that at each stage of its expansion it remains founded on adequately applying the correct mechanics to the learning experience. Ideally, implementation should be modular, with each aspect of gamification introduced in discrete form, and feedback sought at every opportunity.

Gamification will likely be most successful to start at the basic educational level and at the skill-building level in universities. With young children with short attention spans, the introduction of incremental progression mechanics will help engage them in the subject matter. At universities, the relative emotional maturity of the students and the discrete nature of the courses will contain the damage from an improperly gamified course. Nonetheless, pilot programmes are still recommended before a country-wide implementation, and adolescent students, when educational interest for many students begins to drop, may be most in need of alternative education styles.

WHAT TECHNICAL AND EDUCATIONAL CAPABILITIES DOES A STATE NEED FOR GAMIFICATION TO SUCCEED?

Technological prerequisites

Technology dominates much of the discourse surrounding gamification, but gamification does not need technology to be implemented, and many reward programmes have been introduced in the classroom without any technological input at all.

Gamification can be aided by technology, however. Many of the case studies discussed in this report use technology either to provide the mechanism behind some of the gamification elements, or to track the gamification elements more easily. Online learning platforms reduce the costs of individualised learning and permit teacher supervision of independent work in a way that would not be possible without the technology.

Therefore, one of the most important aspects of a gamified learning experience is a fully internet-enabled school system. According to the latest data, this suggests that gamification is most likely to be successful in those countries that have high internet penetration or are comfortable spending considerable funds on education.

However, tracking student activity online must be joined with a strong commitment to privacy. Should a student's personal information and performance be leaked to classmates, that student might face negative consequences and the school system may face legal liability.

Educational prerequisites

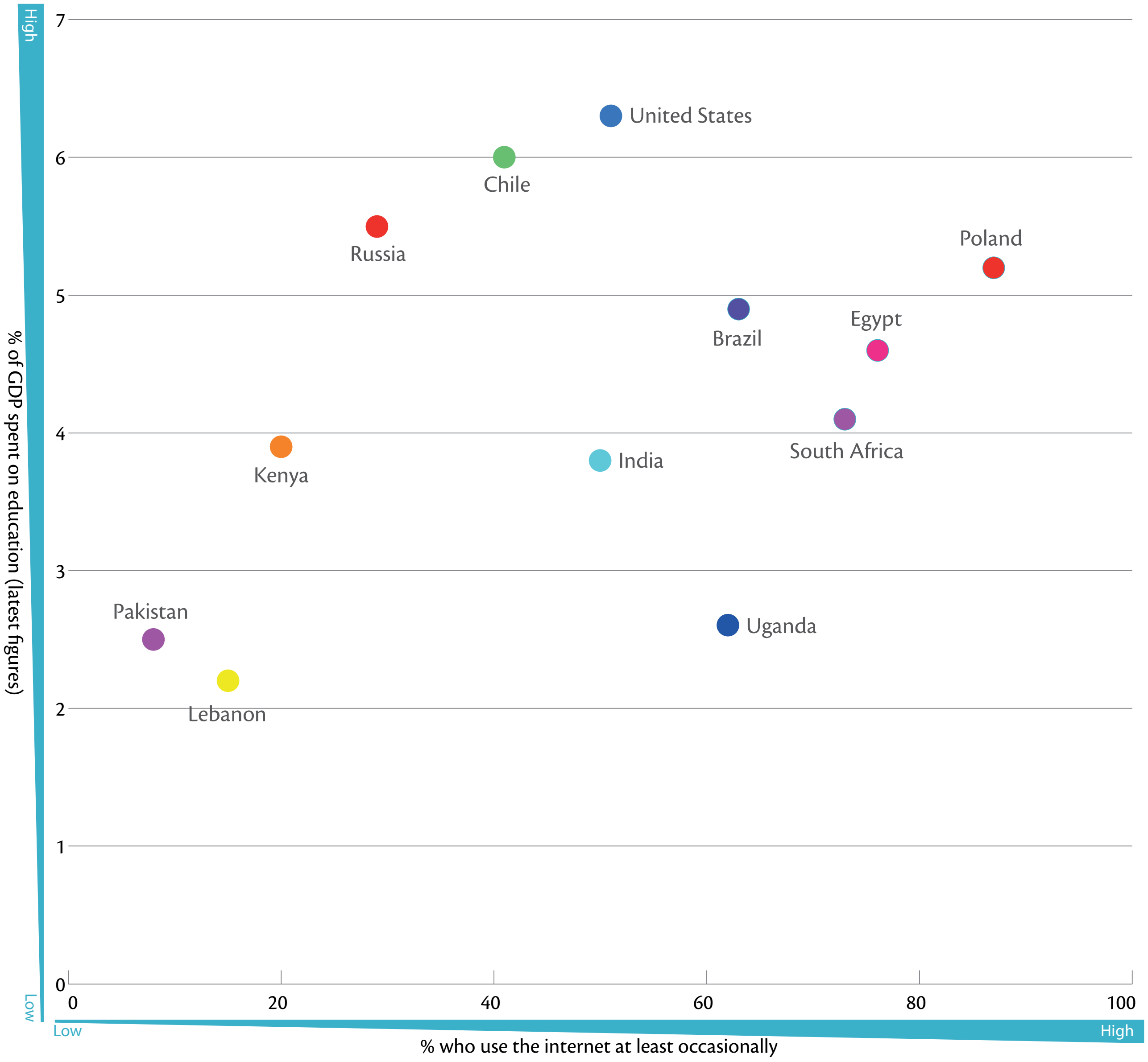
A number of elements of gamification have been outlined in this report, each with their own specific advantages and drawbacks, and each with a potentially varied application. To that end, a number of educational prerequisites become apparent.

Knowledge. Teachers must be able to pick and choose the most relevant elements of gamification for their students and course, and the ability to apply those elements consistently. An application of all elements of gamification at once is unlikely to be successful, and even a careful application will not be universally popular. Being able to react to individual students' needs as they arise, and to assess the impact of gamification in real time and on an ongoing basis, is crucial.

Flexibility. The topic of gamification is still a controversial one, largely because it is perceived as being closely associated with video games. The reputation of video games is reinforced by media narratives and stereotypes, which typically characterise them as addictive, subversive, and a waste of time. Any introduction of gamification elements is therefore likely to be met with resistance, particularly if the specific element in question is not carefully and thoroughly explained. Introducing any technological aspect in the classroom is also a challenge. Teachers using innovative technologies in this way might lack experience with the technology, and its introduction might create an extra burden of knowledge for them, while students will be at different levels of engagement with the technology: some may find it boring, and some daunting.

Commitment. The professional and thorough preparation of gamified educational content is crucial. Since gamification is a controversial topic – some consider it hype, some consider it a negative influence to learning – the aims and priorities of its introduction must be closely aligned and communicated.

Internet penetration and education spending by selected countries



CONCLUSION: THE FUTURE OF EDUCATION

The combination of an increased focus on student engagement and the possibilities provided by digital learning make gamification a powerful tool for educators.

Throughout history, education has been determined by the most cost-effective way to deliver information. Societies worldwide must balance spending on education with other fiscal imperatives. When books were expensive and rare, as before the invention of the printing press, teaching was conducted in small groups and only to the children of the wealthy. University lectures were created as a way to maximise the amount of information one expert could convey in a finite period of time to as many students as possible.

Gamification is on the cutting edge of innovation in the ever-changing education system. Since information can be distributed far more cheaply on digital readers and tablets than in books, and since computer programmes can offer instant feedback, educational systems depend much less on the number, cost, and time availability of teachers. Additionally, with game-based motivations, students have less need of teachers' constant discipline and supervision to conduct their work.

However, these changes will not eliminate the need for teachers. Rather, similar to the changes in manufacturing through automation, teachers will now be responsible for supervising students' activity remotely, creating flexible educational experiences, and managing the social needs of students in new and challenging social game environments.

In order to train teachers of these new roles, education systems will need to incorporate gamification in all phases of their processes. Greater cooperation with the private sector and non-profits, which may develop gamified curriculums (as with Quest to Learn's relationship to the Institute of Play in New York), will be needed, as will gamified teacher preparation and parental awareness of the needs of the child in working with games.

Above all, gamification must avoid the chocolate-covered-broccoli problem and proceed in a deliberate and evidence-based method. While it is a powerful tool for new ways of teaching, it is a costly and ineffective tool when used improperly.

Alone, gamification cannot address the many difficulties that education systems across the globe continue to face. In the United Kingdom, for instance, a rise in the number of students has coincided with a long-term decline in the number of qualified teachers. The shortfall is particularly acute in several compulsory subjects, such as maths and the natural sciences, such that there are many schools in which non-specialists teach these subjects. The UK is forecasting a sustained shortfall in teaching supply and the gamification of some topics or activities represents a partial solution.

In many other countries the primary educational challenge is insufficient demand for school and university leavers. Traditional rote-learning educational systems have contributed to the problem of the ‘educated unemployed’, with large numbers of school and university graduates under-equipped for the modern workplace. For the ‘educated unemployed’ it is skills, not information, that is the barrier to post-education outcomes. Though there is mounting evidence that gamification is well suited to the delivery of information, its value in training people to be creative, entrepreneurial and analytical – skills sought after by employers – is less well established.

However, educational environments such as this provide ample opportunity for public-private partnerships in which large firms sponsor or co-design causes designed to quickly re-skill or up-skill potential employees.

Greater amounts of data from real-world teaching scenarios in each country where it is being considered are needed before major overhauls of educational systems. Therefore, gamification will be a part of the future of education, but only after extensive pilot programmes show where it is most useful.

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