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Essential Features of Serious Games Design in Higher Education

Authors: Petros Lameras

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Author(s)	Petros Lameras[1]		
Role(s)	Senior Researcher, The Serious Games Institute, Coventry University[1]; Professor, Institute of Educational Technology, The Open University[2]		
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Executive summary

The 'Essential Features of Serious Games Design' scoping study analyses, presents and discusses findings on how learning design features and game properties can be planned, designed and implemented by university teachers interested in using games for teaching and learning in higher education. The report offers one possible point of departure for providing guidance and support to university teachers, instructional and game designers to design, plan and use serious games for a topic or entire module. The report contributes to introducing the concept of learning design as a fundamental modality in game's design architecture; it adopts a bottom-up approach for categorizing learning activities, learning outcomes feedback progress indicators and teacher's roles, it offers a game design pedagogic planner for principled guidance and support during the design phase; it discerns game attributes grouped to categories such as rules, goals and choices, challenges, collaboration and competition, feedback and assessment and it attempts to match learning and gaming attributes, outcomes, types of feedback and assessment and teacher roles as means to discern possible learning instantiations though game attributes in optimal ways and thereby enhancing the in-game learning experience.

The main outputs of the study, in line with the overarching aims and research questions, are:

- **Systematic analysis** on how games are conceptualised, modelled and researched.
- Delineating learning activities, progress feedback indicators, learning outcomes and teacher roles as **learning attributes**.
- Providing **a game design planner** for principled guidance and support on planning, designing and using serious games.
- Discerning **game attributes** and associated **game categories** such as **rules, goals, challenges, motivation, collaboration, competition** for characterising games based on primary purpose of design and use.
- **Mapping learning, game attributes, outcomes, feedback, assessment and teacher roles** as means to scaffold teachers' understanding in classifying learning aspects with game features.
- Articulating on gaps of the **evidence-based and identify avenues of further research**.

1 Introduction

Based on a scoping study as part of an SRHE award, this report draws together evidence and material from a range of specialist and disciplinary fields to offer a critical review and synthesis of the design and use of serious games in higher education. It attempts to map game and learning attributes in a coherent way encompassing aspects such as activities, outcomes, feedback, assessment, rules, goals, challenges, motivation, collaboration, competition and feedback. It also provides a game design planner for helping academics and practitioners alike to plan, understand and implement the underlying design methodology, principles and elements drawn together to create a serious game. Current literature on the field of serious games seems to be inconclusive in terms of providing a comprehensive analytical structure on serious games design drawing on both game and learning attributes essential for creating an engaging, immersive and transferable learning experience to the student.

The study connects with wider strands of research on serious games in higher education, including work on learning design (Beetham, 2008) game mechanics (Lameras et al., 2014; Charsky, 2010; Juul 2005; Fabricatore, 2007) and linking game attributes to learning (Bedwell et al., 2012; Arnab et al 2014; Amory 2007), educational design for games (Gunter 2006; Gonzalez et al., 2014; Hainley et al., 2011, Hirumi et al., 2010) engagement and motivation (Boyle et al., 2011; Boyle et al., 2012; Hainey et al., 2006). It was carried out with four main aims:

1. To **inform development in the design and use of serious games** to support teaching and learning in higher education.
2. To contribute to the cross-fertilisation and further integration of evidence on serious games design with particular focus **on mapping learning elements to game attributes.**
3. To provide a **serious games design planner** for planning, describing, orchestrating and sharing game designs of any scale.
4. To identify gaps in the **evidence base and avenues for future research**.

The scoping study set out to address the following research questions:

1. How is the use of games for teaching and learning **conceptualised, theorised, modelled and researched?**

2. What are the **essential features** for designing serious games in HE?

3. How **do learning attributes match game elements** as a means to optimise serious games design and the student learning experience?

4. How may academics be supported to **plan and design game-based learning activities** inspired by best practice principles and examples?

5. What **issues and implications** arise from serious games design, use and facilitation in the development of academic practice?

2 Learning attributes

Studies on how serious games may improve the teaching and learning process have focused on certain approaches to learning and teaching as well as on instructional strategies that facilitate learning in games. In games, it is not uncommon for students to use games in a playful way with little attention on the learning aspect (Connolly et al., 2012), bringing to the fore serendipitous or incidental learning where students learn without insinuating a learning goal (Erhel and Jamet 2013). Evaluating the effects of learning using serious games by applying a *value-added* approach may provide empirical evidence on mapping game elements to learning (Harteveld et al., 2010; Hess et al., 2010; Hirumi et al., 2010). Researchers have already attempted to create taxonomies and classifications of game and learning attributes (e.g. Hainley et al., 2011; Arnab et al., 2014; Bedwell et al., 2012) as means to personalise in-game learning experiences.

2.1 Learning activities

Learning activities in games drive the learning outcomes set out by the teacher. The output of some activities is used as inputs to others resulting in game flows that can be adapted while the student is executing the learning activity. A game-based learning activity, introduced in this scoping study, as distinct from game content, is the central concern of work within the game-based learning design, which has historical roots in the wider field of instructional design (McLean and Scott, 2011). Following Goodyear (2002), it is helpful to establish a distinction of in-game *learning task* and *learning activity*, but in line with common practice in the literature the terms 'tasks' and 'activities' are used as synonyms. For this study, it is perceived that in-game learning activities to be a situated action – that is influenced by the beliefs and values held by teachers as game designers in specific contexts of practice – as an emergent iterative process that occurs during as well prior to the orchestration of the learning activity in the game.

The scoping study suggests therefore, from teacher's perspective, there may be two main advantages associated with the concept of designing in-game learning activities: Firstly it may provide a framework for linking learning with play for more creative educational practice; and secondly it offers a framework for participation in sharing and reuse/repurposing of practice with professional communities (see Table 1).

Type of learning activity	Source
Information Transmission • Lecture / lecture notes / slides • Memorising concepts • Labelling diagrams and concepts • Exampling • Incomplete statements • Lecture summary • Listening	Beetham 2008; Laurillard 2002; Gutner 2008
Individual (constructivist) activities	Crawford, 2007; Bybee 2008, Kleemans, 2011;

• Web-quest (information search and retrieval) • Exercise solving • Carrying out scientific experiments • Reflection • Simulations • Modelling • Role playing • Inquiry (pose questions) • Determining evidence • Analysing evidence • Formulating evidence • Connect explanations to knowledge	Lacasa, 2008; Gee, 2002
Collaborative (constructivist) activities • Brainstorming • Group projects • Group web-quests • Rank and report • Group of students posing questions to each other • Group simulations • Pair-problem solving • Group data gathering • Group data analysis • Group reflection	Dillenbourg 1999; Anjewierden 2011; Bell et al., 2010 Gijlers et al., 2009
Discussion and argumentation activities • Guided discussions (discussion topic provided by teacher) • Open discussions (discussion topic provided by students) • Choices: data on events and several choices for students to make comments • Debates (justifying explanations)	Dillenbourg 1999; Dominguez, 2013, Laurillard, 2002; Beetham, 2008; Jarvinen, 2008

Table 1: Types and sub-types of learning activities used in games

The focus of design for learning using games is learning activity: what accounts as most important, in relation to in-game learning outcomes, is what the student does (Biggs 1996). Beetham defines learning activity as a *"specific interaction of students with others using specific tools and resources, orientated towards specific outcomes"* (2008 p.28). Contextualising and applying this definition to serious games design should discern a meaning such as: *a specific interaction of students with others or [individually] using specific game mechanics and dynamics, orientated towards specific outcomes.*

2.2 Learning outcomes

In addition to categorising learning activities that may be enacted in games, it is important to think about learning outcomes mapped to such activities. The most important categorization used for this scoping study is Bloom's taxonomy of learning outcomes. It is perceived that by mapping Bloom's taxonomy to game attributes will provide a broad framework that attempts to achieve an abstract generalisation of learning outcomes that games might incorporate. Hainley and Henderson (2006) contests that games have variable outcomes permeated, for example, in the form of a game journal (Dunwell et al., 2015), at the start, during or at the end of each level. Combining these principles on game outcomes effects to the player, Bloom's taxonomy sought to closely align with game features and models allowing games to be fun thus, at the same time, enclosing a learning purpose as means to understand better how knowledge is gained.

Category	Outcome
Remembering	Learner can memorise and recall information
Understanding	Learner can comprehend, explain and predict.
Applying	Learner can use information and solve problems
Analysis	Learner can analyse data patterns or concepts and findings can be discerned to prior evidence
Evaluating	Learner can compare and make justifiable judgements about the value of ideas, methodologies or products
Creating	Learner can design, build, invent, plan or produce original knowledge and transferring it to new contexts for making a contribution to the society

Table 2: Bloom's classification of learning outcomes

Bloom classified learning into three domains: cognitive, affective and psychomotor. For this study, the focus is on the cognitive domain (Table 2) as it refers to the knowledge structures relevant to perceiving games as artefacts for linking knowledge-oriented activities with cognitive outcomes. Bloom defined the 'cognitive domain' as a student's intellectual level that is what a student knows and how they organise ideas, opinions and thoughts. The cognitive domain connects with in-game activities that advances learning and knowledge and are integrated throughout in-game learning experiences.

2.3 Assessment and feedback

A major challenge in serious games is helping learners to identify learning problems and misconceptions and providing meaningful feedback for addressing such problems when playing games (Barzilai et al., 2014; Swanson et al., 2011). Gee (2002) argues that all assessment in games should be authentic. Using the immersive and fun features of games, assessment should be both summative and formative as means to provide the necessary

scaffolding for understanding misconceptions but also for learning to be initiated as naturally as possible through game play. Assessment tied in authentic game activities is central as not to only test the knowledge that has been acquired but also the processes and skills the students should use for completing a game level. Teachers therefore need to design formative and summative assessments that are tailored to activities and outcomes (e.g. Whitelock and Cross 2012) as well as to game mechanics and dynamics (Starks 2014).

In-game meaningful feedback is key for helping students to achieve the embedded learning goals and also for encouraging students to reflect on misconceptions and transfer learning to new contexts (Swanson et al., 2011). Feedback therefore plays an instrumental role to encourage knowledge construction and reflection on existing and completed learning activities. Whitelock (2011) argues that feedback forms an essential component of any assessment task, which is described as 'advice for learning'. Gaved et al (2013) define feedback as responses to a learner's performance against criteria of quality; and Feedback Progress Indicators (FPIs) as responses indicating the current position of a student within a larger activity related to time. Jones et al (2014) developed the SCAMP framework (Social, Cognitive, Affective, Motivational for reviewing Progress).

Type of FPI	*Example in games*	*Game mechanics*
Social	'liking' gaming progress through an in-game discussion mechanic	Visual feedback (emoticons), discussion thread
Cognitive	Selecting the correct choice out of an in-game dialogue script	Prompts; in-game hint; assessment tool; game levels, gaining/loosing lives
Affect	Avatar visual indicators in terms of solving correctly or not a puzzle	Scoring, achievement
Motivational	Winning currency for finishing the treasure hunt mini-game Winning XP points for passing a games level	Experience points, game levels; lives/virtual currencies to be used for buying game items from an online inventory;
Progress	Game journal; goal progress in the form of visual feedback; level badges to highlight learning mastery.	Progress bar, achievements, dashboards; assessment tool

Table 3: The SCRUM model contextualised for inducing FPIs in serious games (adapted from Jones et al., 2014)

Contextualising the application of FPIs in games (Table 3), the most common representation of feedback is through (1) progress bars (2) in-game hints, (3) scoring (4) achievements, (5) experience points, (6) virtual currencies (7) prompts; (8) assessment tools and (9) dashboards. The use of 'achievements' to recognise players' activities within the game helps

to scaffold learning activities, monitor progress, and provide direct feedback. Supports are also embedded into the game primarily within easier levels which are typically played first, advancing on to more ill-defined and complex levels as mastery is achieved by the player. Vygotsky's notion of the Zone of Proximal Development (ZPD) is applied here when the player is becoming more experienced in playing the game and thereby feedback is fading. Other FPIs can be achieved through the use of graphics, such as navigation maps, which can scaffold player's cognitive load while playing the game.

2.4 Teacher roles

From a game design perspective, features that necessitate careful planning of teacher's different role types need to be approached from balancing learning and fun is presented in Table 4.

Type of role	Example
Designer	• Genre of game and difficulty should be aligned with the specific role permeated to the teacher spanning from an active to a more passive role. • Designing experiences, materials and sources of information in conjunction to game-play and methods of conveying content via the game. • Designing in-game tutorials on how the learning content, virtual instruments and overall game play including rules, dynamics and mechanics are instantiated within the game context. • Design for collaborative opportunities and dialogic game-play
Player	• Engage in actual playing individually or collaboratively with the students the game for scaffolding students' efforts to play and learn. • To act as a best practice example in terms of what is the optimal way to play and learn via the game.
Facilitator	• Asking questions that encourage students to transfer learning originated from the game to learning applied in real-world situations. • Engaging students via in-game discussion mechanics or in-game hints on how to evidence their ideas or answer their questions through game play evidence or curated content in the game (i.e. content mushed-in from external resources)

	• Provide guidance and support for solving learning problems and progress to next game levels.
Motivator	• Use KPIs as means to motivate and reward students to learn existing knowledge and transfer knowledge to new game or non-game settings.
Evaluator	• Asking pre- and post- gaming questions to elicit understandings on what students do during the game (role of the evaluator with focus on formative assessment) • Including measurable and quantifiable metrics for assessing students performance in the game (role of the evaluator with focus on summative assessment).

Table 4: Types of teacher role in designing and playing games

In games, the teacher provides support and guidance in case of student's inability to proceed to the next level and thereby suggests actions in relation to student's game practices. Teachers may also observe student's actions during game play as to not interrupt student's immersive experience in the game undertaking a more *passive* role (Bellotti et al., 2012).

2.5 Game pedagogic planner

The term 'game design planner' is used in the scoping study to refer to: a resource for teachers that provide principled guidance in designing serious games and game-based learning activities and the preparation of associated learning resources (see Table 5).

Features of SG design	Questions to consider
Learning Attributes	• What are the **learning outcomes** of the game? (e.g. memorising, understanding, applying?). • What type of **learning activities** should be designed? (e.g. individual, collaborative, discussion, argumentation, information transmission?) • What **approach to teaching** should be applied to align with learning outcomes, activities and assessment? • **What** will be **assessed**? (Game activity, process, content, progression) • **How** it will be assessed? (Formative, summative?) • **Who** will do the **assessment** (game, teacher, student) • **What feedback** is going to be provided (motivational, progress, affect, motivational, social?) • Who will provide **feedback**? (game, teacher, student, peers?). • What **learning content** will be in the game?

	• How this **learning content** will be visualised? • Who will **create** the learning content? Teacher, student, both, peers? • **What is the teacher's role** before, during and after playing the game? (Designer, player, facilitator, motivator, evaluator)? • How **teacher's role** is **visualised** in the game? (NPC, chat tool, character, stealth role?)
Game attributes	• What is the **genre** of the game? (Strategy, simulation, RPG?) • What is the **type** of game? (Individual, collaborative, competitive?) • What **rules** are going to be designed in the game? • How **rules** match learning in the game? • How **rules** are visualised in the game? (Scoring, moving, timers, progress bars etc.) • What is game's **goal**? • How goals are **visualised** in the game (game mission, objective cards, storytelling etc.) • What type of **choices** the player needs to make? (Expressive, strategic, tactical?) • How choices are visualised in the game? (NPCs, avatars, puzzles etc.) • What **tasks / challenges** are designed for the game (e.g. collect X number of coins, complete the level in Y time) • How tasks / challenges are **visualised** in the game? (e.g. branch tasks, puzzles, research points) • How students will be **motivated** to complete the tasks? • How **flow channel** (balancing skills with task difficulty) is achieved? • How **collaboration** and **competition** will be visualised in the game (e.g. Role-playing, community collaboration, epic meaning, bonuses) • How feedback and assessment is **visualised?** (e.g. game hints, NPCs, game levels, gaining/loosing lives, progress bars, dashboards; lives/virtual currencies).
Matching learning with game attributes	• How learning activities, outcomes, feedback and assessment are **instantiated via game attributes**? • How rules, goals, challenges, competition, feedback **support learning attributes** • **Are there particular learning attributes that match with specific learning activities** (e.g. memorizing concepts with solving a puzzle by finding and matching similar text words or icons) • **Are there particular game attributes that match with specific learning activities** (e.g. community learning affords a particular learning activity?)

Problems / challenges	• What problems or challenges do you envisage could arise in designing the learning attributes? • What problems or challenges do you envisage could arise in designing the game attributes? • What problems or challenges do you envisage could arise in matching learning and game attributes? • How will you tackle these?

Table 5: The serious game design planner

The planner provides guidance and support in the form of presenting features of design (learning, game) with associated questions for helping teachers to trigger design decisions on (a) how learning activities, outcomes assessment, feedback and teacher's role will be planned and represented in the game, (b) how game genre, types and attributes will be planned, designed and visualised and (c) matching and balancing learning with game attributes particularly identifying affordances between learning variations and game mechanisms. The planner is perceived as a complementary resource initiated before or during the design process and shared or repurposed by teachers, game and instructional designers. The planner is based on, and inspired by, the pedagogic planner developed by Jisc.

3 Game attributes

Game attributes have been broadly understood as a way to summarise game rules (Lundgren and Bjork 2003) - but it is still unclear as to whether only rules define game mechanics or encompass sub-features used in game design to form an actual game. Rouse (2005) approaches game attributes from an overall user-game design perspective in terms of *"investigating what the player is doing in the game, how it is done, and how this leads to a memorable and compelling [learning] and game experience"* (2005, p. 310). Fabricatore (2007) gives a computational-based abstraction in terms of inputs and outputs and gameplay: *"[...] proper tools for game-play, atomic-rule based interactive subsystems capable of receiving an input and reacting by receiving an output"* (2007, p. 6). Decomposing this definition, it is perceived that a game may consist of several attributes, and an attribute may be part of many games (Lundgren and Bjork, 2003). Cook (2005) interpreted game attributes from an educational perspective giving emphasis to feedback properties while acknowledging the relations between player's rules and attributes.

3.1 Games as rules

The rules of a game provide the context in terms of the challenges, goals and actions and how these are formalised in relation to game design. In that sense, rules may be characterised as constraints that limit the actions of the player (Charsky 2010). Playing a serious game is an activity of improving content knowledge, skills and competencies in order to achieve learning outcomes. Games are structured in two ways comprising rules and challenges for learners: through *emergence* and *progression*. Juul (2005) argues that *emergence* is a game structure, where a game is specified as a small number of rules that combine large numbers of game variations for which the players must design strategies to handle. Such type of games includes strategy, action and board games. *Progression* – is where the player has to perform a predefined set of actions in order to complete the game. The game designer has control over the sequence of the events, and therefore games with strong *storytelling* features are dominant as progression games. Although, there are game rules that can be influenced or changed by player's actions (Chersky 2010).

3.2 Goals and choices

There is common understanding in the research evidence-base that games should be goal directed, competitive and designed within a framework of rules, choices and feedback to enable teachers and students to monitor progress towards the goal. Goals should be communicated by game attributes such as a score mechanism or a puzzle to resolve, which in turn adds a competitive factor and a player's decision informed by a specific choice. For example, van der Spek et al., (2011) described the *code red: triage* serious game as permeating specific goals, teaching the player to perform triages. These goals are achieved through specific choices that need to be taken by the player. Choices in games refer to the number of decisions a player has before and during game play (Hannafin and Peck 1988), and a game is a series of interesting choices (Juul 2005). An interesting choice is mentally challenging, strategic rather than skill-oriented.

3.3 Tasks, activities and challenges

It is prevalent from the findings of this study that learning enhancement and performance improvement stems from learning that originates out of task completion (Bedwell, 2012; Gunter et al., 2006; Huang, 2011; Kebritchi et al., 2008; Lacasa et al., 2008). During a serious game, the player needs to separate task-relevant from task-redundant information (Juul 2005) and determine the inherent complexity of game tasks. An overarching task of the player is to familiarise with the rules, controls and logic of each level for adjusting game-play. For example van der Spek et al (2011) argue that in the domain of a crisis management game where information is redundant, players have to make decisions to discern information that is relevant to them; and allow them to make connections from information that is irrelevant to the task and overall mission.

3.3.1 Role of motivation in accomplishing tasks

A compelling aspect of the focus on tasks/challenges is enjoyment that it can be explained and contextualised through the flow framework (Csikszentmihalyi, 1990). Flow is a state of "*deep concentration is which thoughts, intentions and feelings are focused on the same goal"* (Csikszentmihalyi, 1990, p.41).

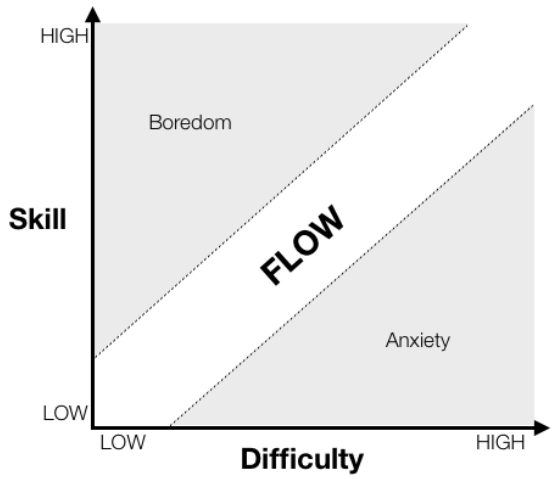

Figure 1: The flow channel (Csikszentmihalyi, 1990).

To achieve a state of flow, learners need to be engaged in challenging activities that require deep learning and reflection. Game design needs to ensure a delicate balancing of in-game challenges and skills needed to achieve the challenges. According to the flow framework, the learner enjoys learning and playing if the challenges are based on learner's skills and abilities and thereby drives the learner into a state of flow. If the game-based learning tasks are too difficult, the player will experience a stressful situation and de-motivation will occur. If the in-game learning tasks are too easy then repetition of choice will result in boredom. The flow channel (see Figure 4) may alleviate this problem as any task/challenge has a given flow challenge in which the player will be in an enjoyable state of flow. Outside this channel, the students will be either bored or anxious.

Category	Game Attribute
Rules	scoring, moving, timers levels, progress bars, 'game instructions including victory conditions
Goals and Choices	Game journal, missions, objective cards, storytelling, nested dialogues, puzzles, NPCs / avatars
Tasks / challenges	NPC-based task description, progress bars; multiple choices to select, major tasks, branch tasks, puzzles, research points, study, requirements
Collaboration and competition	Role-playing, community collaboration, epic meaning, bonuses, contest, scoring, timers, coins, inventories, leader boards, communal discovery
Feedback / assessment	Game hints, NPCs, game levels, gaining/loosing lives, progress bars, dashboards; lives/virtual currencies to be used for buying game items from an online inventory; progress dtrees

Table 6: Game categories and associated game attributes

Table 6 classifies the games categories with relevant attributes. An attempt is made to map overarching gaming categories discerned to game attributes that may be used to afford the instantiation of game attributes with focus on educational practice. For example, rules may be realised through scoring, timers or game instructions as to direct students on what needs to be achieved during the game thus to sufficiently explain the purposes and ways of playing and learning. From a research perspective, there is no comprehensive taxonomy that classifies game attributes with initial categories as to specifically depict how these elements can be translated into actual processes in games that support both fun and learning. Thus, it would be beneficial for the research community if there was a study that matched categories and proprietary game attributes with genres. This would pave the way on helping game and instructional designers to select particular types of games that afford distinct mechanisms for supporting certain game categories and thereby aligning specific types of game-play with congruent practices.

3.4 Mapping learning attributes to game attributes

Amory (2007) designed a theoretical framework based on units that includes relationships and dependencies with one another. More recently Arnab et al., (2014) identified key components of Serious Games Mechanics (SGMs) reflecting a reciprocal relationship between play and learning. A non-exhaustive list of Learning Mechanics (LMs) has been proposed for twinning with suggested Game Mechanics (GMs).

Learning Attribute	Game Attribute	Outcomes	Feedback/ Assessment	Teacher Roles
Information transmission	task description; multiple choices to select, content description, challenge repetition, scoring	Remembering	Progress; affect Summative	Designer/ evaluator
Individual	Game journal, missions, objective cards, storytelling, dialogues, puzzles, branch tasks, research points, study requirements, game levels	Understanding, applying, analysis	Motivational; Progress, affect Formative and/or summative	Player, Facilitator, Designer, motivator, evaluator
Collaborative	Role-playing, community collaboration, epic meaning, bonuses, contest, scoring, timers, coins, inventories, leader boards, communal discovery; game levels	Applying, analysis, evaluating, creating	Motivational, social Formative and/or summative	Player, facilitator, motivator
Discussion and argumentation	Nested dialogues, NPC interaction, in-game chats; game levels, research track, maps; progress tress	Evaluating, understanding, analysis	Motivational, affect, social Formative	Motivator, evaluator, facilitator

Table 7: Linking learning and game attributes, outcomes, feedback and roles

Table 7 links primary leaning attributes (i.e. learning activities in Table 1) with game attributes (Table 6) learning outcomes (Table 2), feedback /assessment (Table 3) and teacher roles (Table 4) based on the findings of the scoping study. An attempt is made to provide a more holistic interpretation of learning attributes and how these may be translated to game attributes by encompassing key aspects of the learning process such as outcomes, feedback and assessment and teacher roles. It is perceived that there is no hierarchical orientation or progressive development for applying this classification to a serious game of any scale. Rather it is developed as a research instrument that provides guidance and support of related activities, game mechanisms, outcomes, feedback and roles teachers may enact when designing serious games for learning and teaching. The classification contributes to the advancement of research in the field of game and learning affordances by analysing and relating them to feedback and progress indicators and teacher roles. University teachers, game and instructional designers will be able to design and implement particular learning activities in the context of appropriating what the teacher does' in conjunction to designing outcomes, feedback and assessment.

4 Summary of study and future research

The 'Essential Features of Serious Games Design' scoping study has analysed, presented and discussed findings on how learning design features and game properties can be planned, designed and implemented by university teachers interested in using games for teaching and learning in HE. The report offers one possible point of departure for providing guidance and support to university teachers, instructional and game designers to design, plan and use serious games for a topic or entire module. The report contributes to introducing the concept of learning design as an overarching modality in game's design architecture; it adopts a bottom-up approach for categorizing learning activities, learning outcomes feedback progress indicators and teacher's roles, it offers a game design pedagogic planner for principled guidance and support during the design phase; it discerns game attributes grouped to categories such as rules, goals and choices, challenges, collaboration and competition, feedback and assessment and it attempts to match learning and gaming attributes, outcomes, types of feedback and assessment and teacher roles as means to discern possible learning instantiations though game attributes in optimal ways and thereby enhancing the in-game learning experience.

Drawing on the literature review and on the scoping study's outcomes, it is clear that more qualitative research is needed, instead of continuing to carry out experimental studies using RCTs and quasi experimental studies, towards understanding the essential features of serious games design and consistently aligning them in a way that teachers and practitioners will be able to understand, discern and balance learning with fun. **It is also essential to understand variation in ways of theorising and using specific learning modalities with game attributes in different game genres** as to create a taxonomy of learning and game attributes for particular types of games. In particular:

- Future research is needed for **understanding university teachers' conceptions of teaching and learning using serious games**.
- Future research is needed for understanding **university students' conceptions** of teaching and learning using serious games
- Future research should broaden the scope by studying **variations in understanding serious games between teachers and students**.
- Future research should focus on specifically addressing **empirical associations** between particular **learning features and game mechanics** for optimising key learning aspects (e.g. feedback and progress indicators in games; or learning outcomes) based on game genres.
- Future research should focus on establishing a **comprehensive and common vocabulary** for describing game-based learning concepts and design features.
- Future research should focus on how new or existing serious games could be **integrated into lesson plans orchestrated as part of a learning sequence** at any scale.

5 Conclusions

This scoping study, supported by SRHE, provided an analysis of features of serious games design. The main outputs of the study, in line with the overarching aims and research questions, are:

- **Systematic analysis** on how games are conceptualised, modelled and researched.
- Delineating learning activities, progress feedback indicators, learning outcomes and teacher roles as **learning attributes**.
- Providing **a game design planner** for principled guidance and support on planning, designing and using serious games
- Discerning **game attributes** and associated **game categories** such as **rules, goals, challenges, motivation, collaboration, competition** for characterising games based on primary purpose of design and use.
- **Mapping learning, game attributes, outcomes, feedback, assessment and teacher roles** as means to scaffold teachers' understanding in classifying learning aspects with game features.
- Articulating on gaps of the **evidence-based and identify avenues of further research**.

It is envisaged that this scoping study is the **point of departure in terms of creating a research agenda in conjunction to understanding 'disjunctions between espoused and enacted' personal theories of using games** as means to identify **variations** in ways games are designed and used in academic teaching and learning. This will shed light in the underdeveloped research area on **qualitatively different ways of understanding experiences of using games in HE** – other than Randomised Controlled Trials. Hence it will pave the way for identifying an inclusive hierarchy for **describing ways, frames and discourses of experiencing the phenomenon and contextualising it in particular academic tribes and territories**.

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