The Gamification in Education

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Abstract—Given the interactive media characteristics, computer games have potential and are very effective teachers that affect players in multiple domains. Studies on the learning effects of games have shown better results than traditional media. This work presents a comparative study that thoroughly investigates the effects of video games, their interactivity and media richness on the players, and how to use it for its own benefit.

Index Terms—Computer games, entertainment, education, interactivity

I. INTRODUCTION

Video games which are arguably one of the most sophisticated forms of information technology to this date are influencing the world higher and higher every year, including education. According to research from 2013, 97% people till adolescent lives were playing at least one hour per day in USA [1]. "The vast majority of research by psychologists on the effects of "gaming" has been on its negative impact: the potential harm related to violence, addiction, and depression. There is recognition of the value of that research; however, one can argue that a more balanced perspective is needed, one that considers not only the possible negative effects but also the benefits of playing these games." [1]. And yet despite the focus on the negative features of games on society for more than 20 years researchers have been using video games for researching individuals and as societal experiments that are increasingly used. How an individual can use it for their own advantage? By understanding how certain aspects of a game can develop specific skills and implementing them in life.

In the first part, there is a delve into the current state and attempts at gamification in the world, followed by a look at what characterizes a good game and what designers look for when creating games. Then how one of the most successful gamification frameworks currently works and is used. Further how to combine the good game design directive with the gamification framework in making a difference in the education system. And finally, with the condition that when the game is more fun the higher advantage player can have from, a summary of the impact, the opportunities it brings, and the potential for future use of video games and gamification in education are discussed in the conclusion in the article.

II. CURRENT STATE OF GAMIFICATION

Nowadays, almost every student in a developed or developing country has access to a computer and the internet and, as video games are becoming more influential and mature as a form of entertainment thanks to advances in technology and ubiquitous availability via the internet and platforms such as steam, the greater the potential for their use in the education for the next generation as exercises or teaching materials, as well as for the gradual gamification of certain parts of the current education system.

The question is how to use video games and make gamification of the education system work so that it brings the most significant benefits to the recipient - the learner or player as both are correct. A partial answer to this question that imposes itself on every gamer is the high-quality gameplay, the storyline, the art design, graphics, and the last is the challenge. And yet simulations that are most commonly used in education today, in comparison with games which are widely regarded as fun, are crude and devoid of entertainment leading to reduced involvement and interest in the subject.

However, teaching institutions, to keep up with technological change, increasing demands for knowledge of the material after starting a career in higher education, competition, and changing approach in society, must gradually develop. The pioneers that of currently under development of game-like experience are, among others: The University of Pennsylvania, Wharton School of Business Wharton's Alfred West Jr. Learning Lab has fostered the development of more than 30 games for supplementing business education courses.

Bristol University where Paul Howard-Jones preaches and several of his graduate-level courses in educational neuroscience are taught using his TWIG (teaching with immersive gaming) method.

The Kanda University of International Studies where the English language is taught through video gaming. [3]

Massachusetts Institute of Technology, National Science Foundation, Siegel Family Endowment, LEGO Foundation which created Scratch (https://scratch.mit.edu) and Microsoft Kodu Game Lab that is used to teach the younger generation basics of programming and animations, yet is very similar to the game.

And the icing on the cake Minecraft Education Edition with support of the python scripts.

Despite the plethora of tools, opportunities, research confirming the positive effects of gamification, technological change, and time, there has been little action to increase the level of learning through game-like experiences on a larger scale. It is also worth noticing that the experiential education

that introduces game-like experience is more relevant than ever thanks to the presence of COVID-19.

So it's worth trying to ask the question what drives, what are the characteristics, the ingredients of the successful games. What gamification models, research, and results exist. And finally how to combine and use this in education.

III. THE PLAYER

"But when I come to think more on it, the biggest reason it has become that popular is Mr. Tajiri, the main developer and creator of Pokemon, didn't start this project with a business sense. In other words, he was not intending to make something that would become very popular. He just wanted to make something he wanted to play. There was no business sense included, only his love involved in the creation. Somehow, what he wanted to create for himself was appreciated by others in this country and is shared by people in other countries. ...And that's the point: not to make something sell, something very popular, but to love something, and make something that we creators can love. It's the very core feeling we should have in making games."

— Shigeru Miyamoto, talking about the creation of Pokemon [5]

When creating games (this problem is especially true for educational games) or the gamification of certain activities, there can be a problem due to the focus on the knowledge itself to be imparted during the activity. Forgetting or not paying attention that sharing the knowledge itself is not making the game experience enjoyable and even though the result can be better than the standard type of teaching, with such an approach it will not give as good results as could by exploiting the potential of what makes games addictive. For the best outcome, this approach should be avoided as this is the recipe for failure, which in the case of game companies there is a problem of "reuse" of what players liked last year. "Often game designers are so bereft of an idea of what will be fun and what gamers want that they instead only include gameplay ideas that have been tried before, rehashing what was popular with game players last year" [5]

While the first thing before the creation of a successful game should be the question: Is it fun?

Then connection of the second part as the thing to deliver.

What would be the game that you would play —fun part— and at the same time would provide the information you want to provide —purpose—?

While these basics are mostly a subjective part, it is worth paying attention to aspects of what players want and expect.

A. Want Part

It is worth noting that even though some of the "Want Parts" seem to be contradictory, they can be applied in one game. For example "Socialize" and "Solitary Experience" as "Want Parts" are in the game that has both multiplayer and single-player modes.

1) Challenge: As one of the basic expectations of the game is a challenge where the most common and basic implementation is the difficulty level that player can choose to be individually adapted. There is joy and the knowledge that remains after overcoming a challenge in a game, and properly implemented challenge is the fundamental of the game design. The example of games is Tetris with Physical coordination (speed and reaction time), Pac-Man - Conflict (survival), Civilization - Economic (accumulating resources), Doom - Conflict (survival) & Exploration (finding hidden passages) and other games. [6] For proper implementation of challenge (that is - making the game balanced) in-game "The Concept of Flow" created by Mihaly Csikszentmihalyi is used which determines the appropriate level for the player depending on their skills [9]
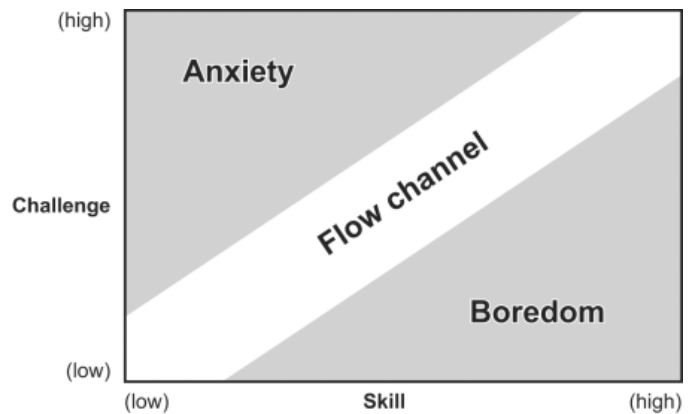

Fig. 1. Flow Channel (Csikszentmihalyi 1990, Flow: The psychology of optimal experience. [11])

The basic application of it would be difficulty modes as previously mentioned, on the other hand, more advanced use is in system Dynamic game difficulty balancing (DGDB) which automatically adjust difficulty based on feedback from player's ability. The system used in Left 4 Dead is called The AI Director, or simply as AID [10].

2) Interaction: Games are superior in terms of interactivity compared to other entertainment options and in this respect, they are also distinctive which makes it a reason for choosing a game over anything else. Interactivity within games has tremendous value, it is most heavily used, helps in the explanation of complex subjects, and is worth paying attention to [7] [8], especially when it should be used in research and education. Focusing on interactivity is one of the keys to success, yet the interactivity itself is not enough.

3) Solitary Experience: Depending on the person solo games attract introverts, the person who has had enough interaction with other people, or somebody who wants to experience the story in the game. The motives and reason can be different yet the control over the level of play, the ability to play, stop and go whenever you want, the lack of team pressure from other players make solo games the basis of player expectations.

4) Socialize: From playing with friends on Scrabble or Chess, Lan Party playing Warcraft to League of Legends with strangers or team. Enjoyment of spending time with friends or competing with strangers with the benefits of "being the best within statistics" or rewards in coins in case of current online multi-player games with modern connection and commonplace of internet connection makes people stay longer online within the game. But for many individuals, multiplayer games are time pleasantly spent with friends.

5) Dynamism: The dynamism of the game with a nice graphic design makes the player focus and increases imersiveness if implemented properly and the most important: makes the game less boring and more attractive.

6) Explore: Curiosity is the critical cognitive function influencing human behavior and the main factor for motivation to explore. [12]

"I have no special talents. I am only passionately curious."

— Albert Einstein

Different levels in *Super Mario* or *Ori and the Blind Forest*, new enemies in *Doom: Eternal* or strategic choices in *Stellaris* fulfilling curiousness.

7) Fantasize: The elements of fantasy are major components creating an interesting climate and adding color to the "gray" everyday life. Strange dangerous and intelligent creatures that player can interact often mixed with realistic physics *Divinity 2: Ego Draconis*, realistic space development and interaction with other aliens *Stellaris* or maybe another world filled with colors like in *Ori and the Will of the Wisps* or dark futurism *SOMA*. People enjoy being transported into a different, more colorful, or simply more interesting world than their own that creating a cultural strand called "escapism" which under current situation intensifying [13] [14]

B. Expect Part

1) Consistency: The game world must be consistent and comprehensible. If there is some sort of skill that is used by the player to attack it cannot fail for no apparent reason. Such mechanics make a person frustrated and such a game with it is often called "crap".

2) Reasonable Solutions to Work: Through the progress of the game by solving many challenges if the player will find a reasonable solution that will not work because the designer has not foreseen it makes the player frustrated. The less the designer predicts possible solutions to a scenario that the player can come up with, the more frustrating the game will be, or to put it more laconically, it will be more rubbish.

3) Direction: A game with a strict objective, the goal of where the player should aim yet with a certain degree of freedom that gives the ability create their own story of victory. In *Super Mario* rescue of the princess and get & survive to the end of the level, in *SimCity* make dream city or in *Warzone 2100* to destroy the enemy. The *SimCity* goal is not explicit yet the foundation of what is the goal is based within the reality that is widely understood, making the player come up with

their own goals. The concept is known as "software toy" - the player can do whatever they want without explicitly defined failure.

4) Immersion: By the proper pace of the game, look game flow [9], and depending from the individual, by realistic game world, good graphics, gameplay or other aspects of the game which create "presence", the player can be immersed. Presence can be defined as "the extent to which a person's cognitive and perceptual systems are tricked into believing they are somewhere other than their physical location" [15] and it can be easily shattered by bugs in the game.

5) Fair Chance: It should be possible in theory to get through the obstacle without fail. If the player cannot avoid failure with knowledge and skill this leads to frustration due to the short-sighted design of the gameplay.

6) Lack of Repetitiveness: Except for games with game mechanics based on repetition like *Tetris*, *DOOM* and *FIFA* the repetitiveness in games is and should be avoided. As if the same or similar task is given many times, or maybe the player finished a mundane task but there is no checkpoint or auto-save, the game will become simply mundane and boring.

7) Doing Instead of Watch: This is a typical problem for educational games and in some cases also with gamification. The long introduction to certain topics, in some cases with low quality which makes the experience even worse, makes it a typical stiff school experience effectively discouraging any major learning without being forced to. Just as interactivity characterizes games it should be used. The cut-scenes, introduction to topics should be short and give the player time for action and reward for its completion.

IV. GAMIFICATION DESIGN FRAMEWORK

"According to the Entertainment Software Association, 70% of major employers are already using gamification to enhance performance and training at their companies. In a similar report, the market research firm Gartner predicted that 70% of Fortune 500 firms would use Gamification by the end of 2014... Unfortunately, in the same report, Gartner also predicted that 80% of those gamified efforts will fail due to bad design"

— Yu-Kai Chou "Actionable Gamification" [16]

The Octalysis Framework is a gamification design framework used to analyze and build strategies around various systems to make games engaging. It is presented in a figure 2.

A. 8 Core Drives

Almost every successful game appeals at a greater degree to certain Core Drives within us and motivates us towards a variety of decisions and activities.

1) Epic Meaning & Calling: The belief that the action is for a higher purpose or the person is the chosen one to be able to accomplish the task greater than themselves. In *Mass Effect* player take actions that can not only save or exterminate planets with their natives but also life in the entire

-Status Points
-Badges (Achievement Symbols)
-Fixed Action Rewards (Earned Lunch)
-Leaderboard
-Progress Bar
-Quest Lists
-Dessert Oasis
-High Five
-Crowning
-Anticipation Parade
-Aura Effect
-Step-by-Step Overlay Tutorial
-Boss Fights

-Narrative
-Elitism
-Humanity Hero
-Revealed Heart

-Beginners Luck
-Free Lunch
-Cap Switcher
-Co-creationist

-Milestone Unlocks
-Real-Time Control
-Chain Combos
-Dynamic Feedback
-Boosters
-Blank Fills
-Plant Pickers
-Poison Pickers
-Attribute Web Chart
-Double Edged Sword

-Exchangeable Points
-Virtual Goods
-Build from Scratch
-Alfred Effect
-Collection Sets
-Avatar
-Protector Quest
-Pet Companion
-Observer Attachment

-Friending
-Social Treasure/Gifting
-SeeSaw Bump
-Group Quests
-Trophy Shelf
-Brag Button
-Water Cooler
-Conformity Anchors
-Mentorship
-Social Prod

-Appointment Dynamics
-Magnetic Caps
-Dangling
-Prize Pacing
-Bootleg Quest
-Last Mile Drive
-Count Down Timer
-Torture Breaks
-Moats
-The Big Burn

-Sunk Cost Prison
-Progress Loss
-Rightful Heritage
-Evanescence Opportunity

-Status Quo Sloth
-Streaking
-Evil Egg
-FOMO Punch

-Glowing Choice
-MiniQuests
-Visual Storytelling
-Easter Eggs
-Random Rewards
-Obvious Wonder
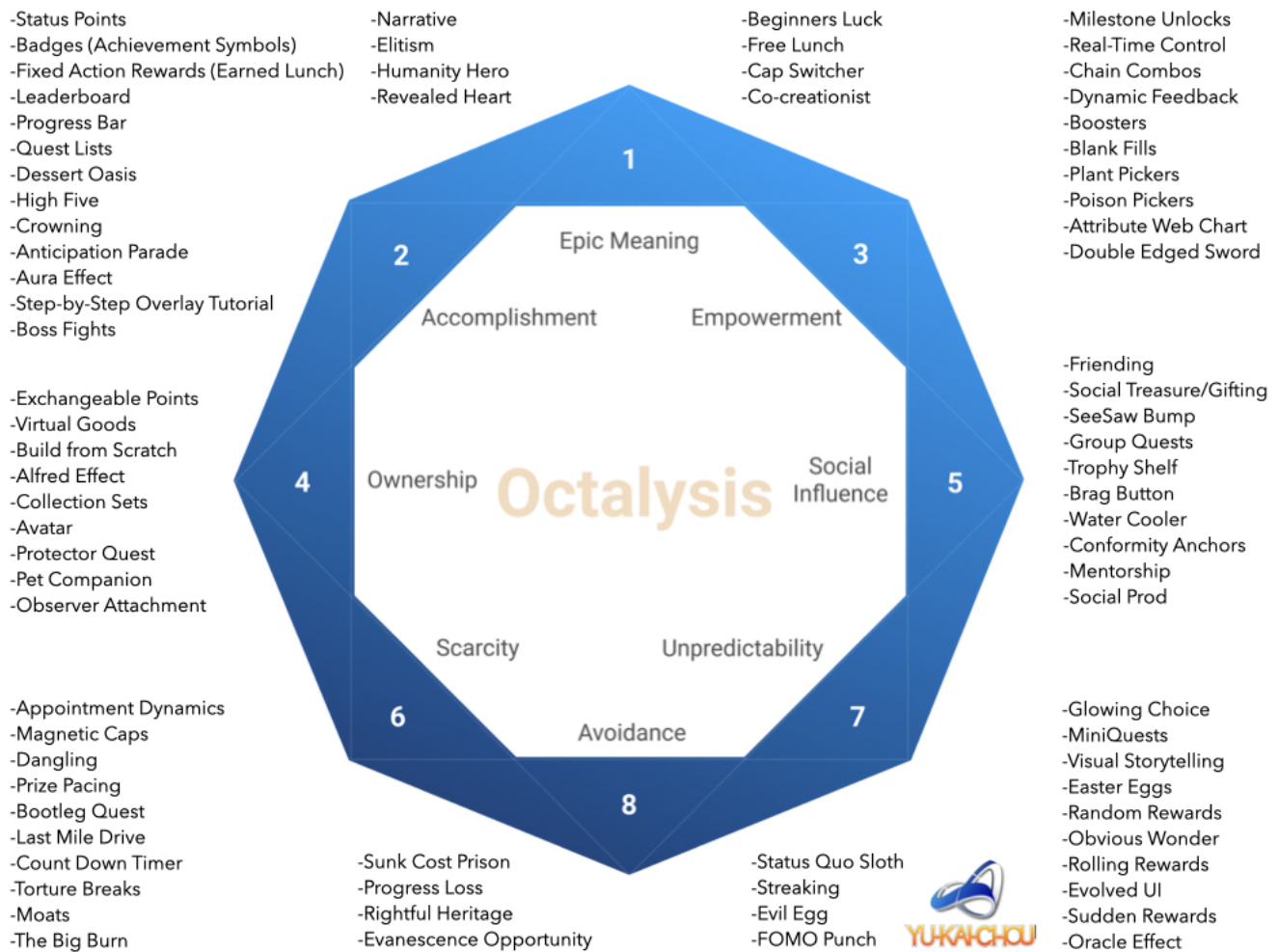-Rolling Rewards
-Evolved UI
-Sudden Rewards
-Oracle Effect

Fig. 2. Octalysis gamification design framework with 8 Core Drives present [4]

universe. As an example also *Wikipedia* is a good example as people contribute their time and knowledge to protect and share humanity's knowledge, that is, for the greater good.

2) Development & Accomplishment: This core is empowered by the desire for developing skills, overcoming challenges, and getting trophies for them. However, it should be noted that achievements are only meaningful thanks to the challenges.

3) Empowerment of Creativity & Feedback: When a person is committed in process of creative thinking figuring out how to solve the problems or challenges in different combinations. To empower this drive core more the player should not only have a way to express their creativity but also the result, feedback, and possibility to adjust the result. The *Opus Magnum*, *Minecraft* or *Legos* are good examples.

"where a game designer no longer needs to continuously add additional content to keep the activity fresh and engaging. The brain simply entertains itself"

— Yu-Kai Chou "Actionable Gamification" [16]

4) Ownership & Possession: This core is empowered thanks to the sensation ownership or control of something. Through ownership of something, there is an internal drive to improve, accumulate more of it (gold for example) or destroy. The virtual currency, loot boxes of which the infamous EA is, or the *Sims* in which player controls the entire life of the sim.

5) Social Influence & Relatedness: All elements of social influence that motivate people like acceptance, companionship, envy, and competitiveness. The relatedness when you feel nostalgia because the product reminds you of your childhood - the people have a natural tendency to draw closer to things which can be relating to.

6) Scarcity & Impatience: Rarity, exclusivity with the inability to get it immediately are a thing that can drive prices to heaven for some products and also these sensations are the empowerment of this drive core. In many online, especially mobile ones, games like *Arcaea*, *Dragon Mania* there are Appointment Dynamics or so-called "Torture Breaks" [16] where to get a reward or renew the energy you need to wait

hours. Lack of immediate acquisition motivating player to wait for it which result in getting back to the product more often. This is also used in games as "daily rewards" almost universally used in newer multiplayer games, for example, *Quake Champions.*

7) Unpredictability & Curiosity: In gambling, the result is not fully predictable and the curiosity with a chance of getting a reward that makes the player try again. When something deviates from the previous pattern the attention increases as it is perceived as interesting and it makes the player curious about the outcome.

8) Loss & Avoidance: It is natural for the player to do what they can to avoid defeat and beat the final boss in the game. The possibility of a negative, harmful outcome motivates the player to perform certain actions. Often used in ads is limited time offers and in games in the possibility of losing progress if you will not log in.

9) —Hidden— Ninth Core Drive: Sensation: Sensation Core is described as "physical pleasure one obtains from taking an action" [16]. Which is based on physical feelings like touch, sight, smell, taste, nociception, and others that drive trigger the taking of action as an example: petting the cat, getting and writing messages, scratching oneself and even getting drugs, drinking alcohol, or having sex.

10) White and Black Hat Gamification: Top core drives on a figure 2 are considered as mostly positive motivators and products/techniques utilizing it are White Hat Gamificators that engage, make express creativity, and leave filling of successfulness and meaning. On the opposite side, the bottom Core Drives are considered as mostly negative motivators with the creation of Black Hat Gamificators through utilizing it that will leave a bad taste in the player's mouth and in the longer term are harmful and addictive. If the action to play, gamble or buy is made due to not knowing what will happen next, by fear of losing something it is probably Black Hat Gamified. On the other hand, the high White Hat Gamification does not mean that the game or product is necessarily good. For example, it can be used to make induce the player to buy unnecessary things. On the other side, The Black Hat Gamification does not have to be used only for malicious actions or to exploit the player, as many people voluntarily use it to improve their lifestyle, health, or increase productiveness. However, it cannot be denied the use of psychological tricks to exploit a player, making him addicted, get the most of the information, and obtain the maximum amount of money. It is very common practice by companies like *EA, Zynga, Gameloft* and many others.

Yet for the introduction of gamification to be successful, all 8 Core Drives should be examined and evaluated to obtain the best result and in this case, the most productive, fun, and overall positive impact.

11) Obtaining score: To get the score, an analysis of the selected subject that is performed using all the data, knowledge about the product, and personal judgment, is required with assessment from 0 to 10, that squared is assigned to the specific Core Drive. The site: [19] speeds up and facilitates the determination of the final result with graphical representation.

Arguably, subjectivity may also have a large influence in this case, yet defining the parameters of the game mechanics is not difficult and the result will likely be similar or the same for different people.

"Of course, the Score itself is not very useful or actionable, so I always tell my clients to focus on what Core Drive is lacking, instead of being obsessed with their "score." "

— Yu-Kai Chou 'yukaichou.com' [4]

12) Application of Gamification: The most crucial is the identification of the game mechanics and assigning them to the Drive Cores, then analyzed to determine the score. The result will be so-called "Level 1 Octalysis".

In most cases, any product/game that can be considered good has at least a higher score or potential in one of the Octalysis Core Drives.

13) Other Frameworks: Of course there are other gamification frameworks, for example: *MDA framework*, *Werbach and Hunter's gamification framework*, *Schell's gamification framework*, *Dynamical model for gamification of learning (DMGL)*, *Integrative gamification framework*, *the Playful Experience framework (PLEX framework) for gamification dynamics*, which are described in greater detail in book "Gamification in Learning and Education" [18]. Yet the Octalysis framework is currently most successful, commonly used and, if one looks deeper into it, the basics of operation are similar.

V. GAMING EDUCATION SYSTEM

A. Environment

"To reach a point where educational games can provide good educational value, high utility, and an interesting and motivating experience for students your school needs to be ready for them. Some games place higher requirements on your environment than others - highly advanced games need advanced technology and game-savviness on the part of the teacher. If an environment does not have the right setup to support a game, it won't be very useful and it won't be able to provide good educational value nor a good experience."

— Björn Berg Marklund "Working with Educational Games" [17]

The environment and the approach are the key features that can make successful the use of game-like education. Starting a new project with new technology introduced into classrooms is time-consuming and also depends on the infrastructure. And the state of these aspects is subjective to the individual and institution.

By simplification of the design application, reducing requirements, and enabling offline operation of the application (if a student loses connection/is unstable the quizzes, tasks, and progress are still available) it is possible to reduce the negative impact of immediate change.

If a high-tech game or application is to be used for which your environment is inadequate, the result may be worse than with standard methods as shown in the chart in figure 3.
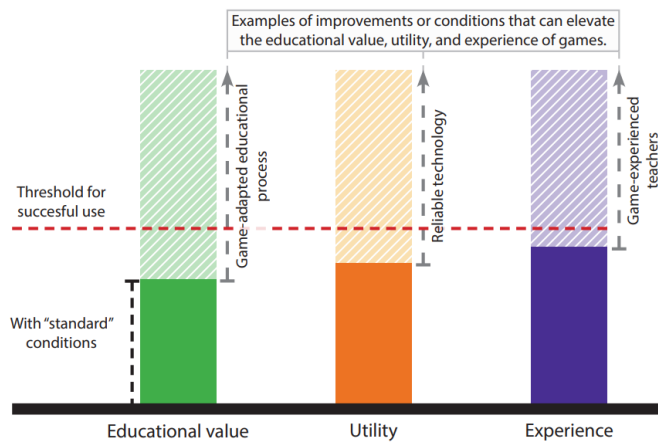

Fig. 3. Conditions and use of games ("Working with Educational Games" [17])

B. Use of Current Solutions

By using currently available programs, games, and tools that are mostly free and have been tested reduces costs and allows faster or immediate implementation. For example *Habitica*, *Todoist Karma* or *Bounty Tasker* which are used as game-like life productivity tools. It is also worth referring to successful tools and creating a learning tool based on an existing solution. For instance *SoloLearn* and *Duolingo* are used as learning apps similar to the games.

C. Creation of new Solutions

On the other hand, by creating its tools or modification of existing tools and programs the institution is in full control of implemented mechanics and safety, which allows the gradual introduction of mechanics to the institution. Yet by deciding to create a game, application as a basis for teaching, for it to be successful there is a need to be the focus on the player as referred on the third part and proper implementation of the White Hat Gamification referred in part four.

D. Ideas for Implementation in Institution

1) ItsLearning as a Game: The basic of implementing gamification should be of the breakdown of a complex topic to simple tasks as quests, quiz assessment with the allocation of points as a prize.

Simple application available on every platform with options from the teacher side: - Schedule meeting - Create Quiz - Create Assessment - Upload Material (Drag & Drop function is very intuitive and useful) - Play.

By playing/quiz/assessment it can also use external apps or environments to teach. For example automatic install of MatLab, Visual Studio of Unity with prepared tasks and examples by teacher and institution. For every task there could be points used as a currency for evaluation, unlocking new level (new chapter in subject) and negative life points for lack of execution in time.

And from the student's perspective simple, standardized design as shown in figure 4.

2) Gamification of a Meeting: Setting a clear objective - summary of what students/players should learn on the uploaded document. Short - max 10 or 15 minutes of explanation of uploaded material (containing explanation and references) with prepared quizzes with points on ItsLearning, Quizlet, or own site in which progress send to the teacher. Tasks to do on Codewars (the site used by employers for the recruitment of programmers) or on own website that unlocks other people's answers by honoring the best ones.

Quizzes and tasks that unlock progress for solutions/other materials increase the activity of the student and make the lecture enjoyable if properly implemented.

To make even higher attention it's good to make the gamified lecture more: visually pleasing, rewarding (gamelike), creating competition between two competing individuals or groups - competitiveness.

VI. CONCLUSION

Gamification in any aspect of education can have directly proportional effects if properly implemented using tried and tested methods. Based on the fun aspect, the fact that work, the school can be entertainment in itself is still inconceivable to some people, however, thanks to modern technological and social progress it is slowly becoming a reality. It is likely to be progressively more strongly implemented thanks to current successes in corporations, changes in public attitudes, and further development of technology.

On the other hand, it is difficult at the moment to determine the negative impact gamification may have, yet given the increasing amount of time spent in front of the monitor by the majority of the population it will have an additional, indirect effect. But gamification does not have to take place in the realm of computers and new technologies either, instead, it can be implemented through the board and fun gamification methods that have a similar level of effectiveness.

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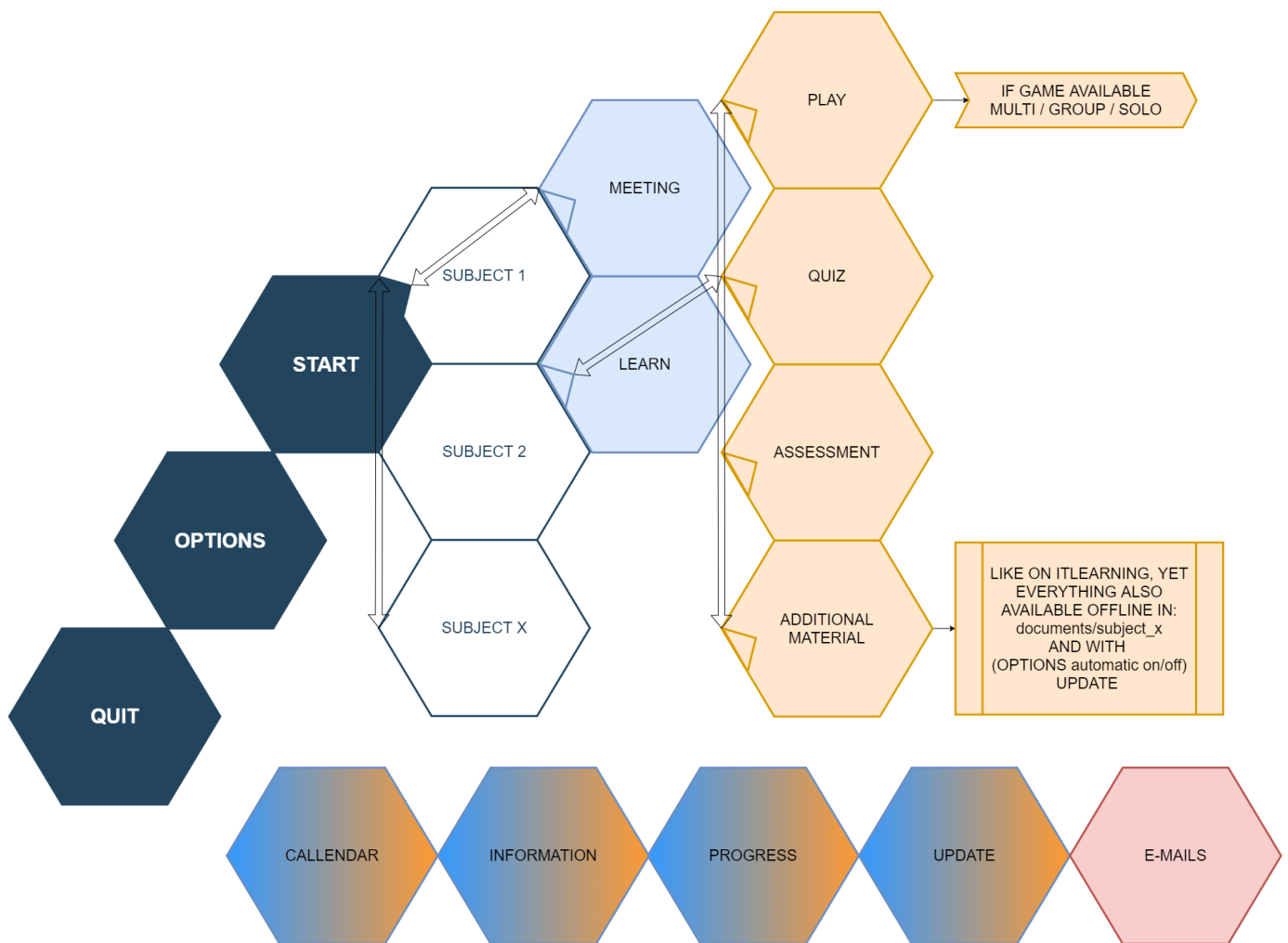
[19] Tool for graphical representation of Octalysis: https://yukaichou.com/octalysis-tool/.

Fig. 4. Examplanary design of an application