



ADAPTIVE GAMIFICATION: ENHANCING PERSONALIZATION IN LEARNING THROUGH GAME-BASED MECHANISMS

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Abstract: Gamification in education leverages the motivational dynamics of game design to transform traditional learning environments into engaging and interactive experiences which enhances learning motivation, boosts classroom engagement, and improves students' learning outcomes. However, using these game mechanics for all type of learner can't cater to all the needs of the learners. Use of one-size-fit-all approach for gamification in education will create challenges like, less scope for personalization in learning, failure in utilizing diverse learning style, inappropriate feedback mechanism, scalability problem, and more focus on extrinsic motivation among learners. To bridge the gap between learner's, need and use of game mechanism, Adaptive Gamification can become the mean where it incorporates gaming elements according to the nature and learning style of the learners. Adaptive gamification with its features like real-time feedback system, scaffolding learning, dynamic adjustment mechanism and learning analytics can bring personalization that needs to be incorporated in order to fulfill the need of the learners' by keeping in view their learning pace and progress. Adaptive leaderboards, branching narratives and virtual mentors which promote inclusivity and equity in education by meeting the diversity among learners. Further, adaptive game mechanism also helps in developing the 21st century skills like, problem-solving, collaboration and digital literacy. It also helps in developing the mindset for a life-long learning. With all the benefits that came with adaptive gamification comes some challenges that can't be ignored. Some of the challenges are adaptive gamification have limitation in term of usability for different educational context. Other major challenges include technical limitation and data privacy problems. Adaptive gamification is a transformative innovation in education that bring the engaging and motivational part of gamification and customization of personalized learning, that help in making learning experience an interesting, effective and inclusive for each learner.

Key words: Gamification in Education, Adaptive Gamification, Personalizing Learning, Hexad's topology.

1. Introduction

In an ever so changing world, there is a need to accept and adapt to the change not only in personal or social aspect of life but also in the educational aspect of life too. The 21st century is the time of technology and innovation in all aspect of life. And in today's time it is being evident that students lack that motivation and engagement in classroom teaching learning process (Efremova & Huseynova, 2021). With the same teacher centric classroom where teacher is the active participant won't work anymore. The need of time is the student centric education where the student's interest, behavior, characteristic, motivation, capabilities and most important individuality is given the most importance (Bernard et al., 2019). In this attempt to achieve this student centric learning process gamification can play a notable

role. Gamification is the concept of applying the game elements like points, badges, and leaderboards, etc. in a non-game environment like health, administration and business as well as education (Tenório et al., 2018). Gamification is a revolutionary approach to pedagogy in which it's the student whose behavior, performance and preference plays an important role (Dichev & Dicheva 2017). Applying game principles in education process proved to develop learning engagement, motivation level, skill acquisition and ultimately help achieving the learning objectives (Dichev & Dicheva 2017). But despite of having such impact it lack in some aspect like using a one-size-fit-approach where same game element being used for all the students which reduce the chance of personalization and it doesn't consider the diversity of learners too (Rodrigues et al., 2022). And for these reasons gamification irrespective of being an impactful pedagogical approach doesn't provide the result that it intend to do. So, to bridge the gap between the students' preferences and use of game element a new concept had been developed known as "adaptive gamification" (Monterrat et al., 2015). This adaptive gamification is the transformative approach that bring personalization of education and game mechanics together to provide an active, interesting and motivational learning system. This conceptual paper further discussed adaptive gamification and

- what are the feature of adaptive gamification?
- What are the frameworks that support adaptive gamification?
- What opportunities does adaptive gamification bring in the education system?
- what possible challenge are there in implementing adaptive gamification in education process?

2. Gamification in education

"Gamification is the strategic integration of game-design elements and game principles into non-game educational contexts (Deterding et al., 2011). To trace the root of gamification it was supported by the motivation psychology theory the "self- determination theory" which describe how intrinsic motivation is driven by learning autonomy, competence of learner and relatedness among game elements and context for which the game elements are being used. Gamification bring a shift in educational paradigm in educational system by making learning an active and engaging one (Kapp, 2012). Gamification make leaning an intrinsically motivated activity (Zichermann & Cunningham, 2011). Gamification in education has notable impact on diverse aspect of learning like it increase motivation among students by making increasing student engagement, making learning an enjoyable and meaningful experience and providing immediate feedback on students' performance (Hamari et al., 2014). Also, it improve knowledge retention and promote active participation from students. (Dichev & Dicheva, 2017). It also develop skill like problem-solving, critical thinking (imões et al., 2013) and make learning experiential in nature. Apart from this gamification also help in improving student performance by providing clear learning objectives, personalizing learning system and offering progressive challenge structures.

3. Pitfalls of gamification in education

I. One-type-fit-all approach

There are diverse type of learner in a gamified classroom and by using same game-elements for every learner can be counterproductive (Winanti et al., 2021). "Some learners may be motivated by points and badges while others may prefer more exploratory and open-ended gameplay (Mbabu et al., 2019)." Therefore, it can be inferred that an adaptive approach need to be adopted to meet the need of each learner. Personality trait, motivation level and learning style such learner characteristic need to be consider while developing tailored gamified elements to further improve the effectiveness of gamification in education. (Mbabu et al., 2019). Leader boards and point system may be effective for extraverted and competitive learner while in other hand collaborative and explorative game elements are better for introverted learner. (Mbabu et al., 2019) (Rodrigues et al., 2022). Likewise, the learner with visual and kinesthetic style prefer game elements like virtual reality and augmented learning. (Winanti et al., 2021). Hence, using a one-size-fit-all approach in using gamification in education will decrease the effectiveness (Winanti et al., 2021).

II. Player type

Marczewski developed the Hexad player type framework which define six types of players (Tondello et al., 2019) namely, philanthropists' purpose and helping other motivates them. Disruptors bring change and innovation in the system, socializers' perfume well in a collaborative and social learning environment. Free spirits are autonomous learners and have creative learning style while achievers learn

through completing challenges and achieving mastery on learning. Players are motivated through external reinforcement and competitions. However, using the same game elements for every type of learner according to Hexad framework (Volkmar et al., 2019) create the following challenges,

a. Misaligned motivation

game elements like points and badges hinders motivation of socializer who need interaction, philanthropists value rewards and free spirit are autonomous learners. This misalignment decrease learning engagement and effectiveness (Peter et al., 2019).

b. engagement barriers

universal rewards may not cater to different learners, like disruptors can't innovates in a rigid system and achievers don't progress properly (Peter et al., 2019).

c. system ineffectiveness

using same elements of game can't meet changing needs and it fail to acknowledge different learning style which leads to decrease in completion rate, motivation level and learning outcomes (He, 2017).

4. Adaptive gamification

Gamification has become an approach that enhances the learning experience of students by including game elements into learning process. Deterding et al. (2011) define "gamification as the use of game design elements in non-game contexts, specifically highlighting its potential to increase student engagement and motivation." Despite being an innovative approach in the learning process gamification has some pitfalls that decrease its effectiveness. As gamification try to apply one-size-fit-all approach for the game-element use (Klock et al., 2020), inconsistent motivation level among students (Marczewski, 2015), lack in personalization (Böckle et al., 2018), superficial engagement in learning process (Harwood & Collis, 2017) and lastly the technical complexity (Monterrat et al., 2015) make gamification somewhat ineffective. Therefore, to fill-in these gaps the concept of adaptive gamification come to its origin. In adaptive gamification game elements are dynamically adjusted according to learner's characteristics, motivation and performance. With feature like personalized learning experience (Klock, 2020), dynamic difficulty adjustment (Monterrat et al., 2015), motivation specific game elements (Marczewski, 2015), Real time performance tracking (Böckle, 2018) and individual learning profile development (Halloluwa, 2018) adaptive gamification provide a more nuanced and affective approach to learning engagement.

5. Adaptive Gamification Framework: A Comprehensive View

I. Hexad framework

Marczewski (2015) has developed this framework on the psychological motivation of students and define six different type of learner type. Those types of learners are- socializer, free-spirit, achievers, philanthropists, players and disruptors. In this framework of adaptive gamification (Marczewski, 2015) explain how learner's motivational drive determine the type of game-elements.

II. Dynamic adaptation framework

Lopes & Bidarra (2011) in this dynamic adaptation framework discussed on how adaptive gamified system need to maintain the engagement level and effectiveness of learning by continuously modifying the system according to the preference of learner. This framework work on two levels of immediate adjustment, first being the immediate adjustment i.e., adjusting to the student's immediate struggle with the content and second the long-term adjustment where it has to modify the whole learning path.

III. Bockle framework

Bockle et.al., (2018) in his structured approach framework it consists of three interconnected components. First one if player modeling component it focuses on creating detailed learner profile by dealing with learner characteristics, preferences and behavior. Second adaptation rule which define specific condition and response like when to level-up challenges or to provide additional support to students. The last one being the adaptive elements which is the real game element that can be modified, for example reward system or presentation method of content.

IV. Caddish and ravid framework

Caddith and Ravid (2016) in their framework for linking micro and macro adaptation discussed the temporal aspect of adaptation through micro and macro adjustments. Micro adjustment are immediate adjustment like, giving hints, providing reward on success in task completion. Macro adjustment are

bringing change in the whole learning system or redefining the combination of game elements. This framework use the feedback loop mechanism to meet both the micro as well as macro learning goals.

With all the adaptive gamification framework it creates an opportunity to develop a comprehensive adaptive system which can identify the type of learner and appropriate game elements and with continuous assessment it maintains the effectiveness and meet the dynamic need of learner.

6. Feature of adaptive gamification

I. Personalization

In an adaptive gamified system, it continuously monitor and adjusts its gaming elements according to the learner's characteristics and need (Rodrigues et al., 2022).

II. real-time feedback system

in adaptive gamified system real time feedback feature is like student's having their personal tutor which guide them with their learning. It can provide helpful information on learner's performance and provide instant feedback to learners when they need in the course of their learning process. It shows what mistake the learner made and which way they can correct it and make their learning effective (An, 2020).

III. scaffolding learning

scaffolding learning provide the dynamic support to the learners' progress (Klock et al., 2020). It provide learner with the content which is according to the need and understanding level of the students (Böckle et al., 2018). If a student face challenge in learning a concept it can break the content in understandable bits and if a student is performing well then it can also provide students with advance content which will encourage students to learn more (Halloluwa et al., 2018).

IV. dynamic adjustment mechanism

adaptive gamification come with the adaptability to provide opportunity for bringing the necessary changes that are according to the student's preferences (Tenório, 2020).

V. learning analytics

in an adaptive gamified system, it continuously optimize it's features to provide better learning experiences by regularly assessing the learner's learning difficulties and with the data-driven insight feature it improve the system according to the learner's real need (Rodrigues et al., 2022).

7. Adaptive gamification with Hexad typology

Marczewski (2015), developed an adaptive gamification framework known as "Hexad Framework" in which he explain how learner's type decide the type of game elements to be used. In "Hexad Framework" he define learner type in six different types and adaptive game elements fit for the learner type.

Socializers are the learners who motivated themselves by building relationship and prefer team work and social networks. For this type of learner, the social discovery and social comparison tool and social pressure mechanism work well (Marczewski, 2015, p.87). for free-spirit learner are self-exploratory and like customization in learning process. Game elements like easter eggs, unlockable content and creative tools is effective for this type of learners (Marczewski, 2015). In term of achiever type learners, they are motivated by mastering content and reward like competing in challenges. For them tailored game elements like quests, levels and progression boards more (Marczewski, 2015, p.96). In the other hand, for philanthropist's learner are interested in sharing knowledge so points, prizes and leaderboard like elements make learning for them engaging (Marczewski, 2015, p.99). and for disruptors voting mechanism, innovation platforms and developmental tools provide them opportunity to influence system and bring change in learning process. (Marczewski, 2015, p.104-106)

8. Adaptive gamification in Education

Adaptive gamification positively impact students learning and engagement ((Rodrigues et al., 2022; Imran, 2019; Tenório et al., 2018; Daghestani et.al, 2020).

I. Increase motivation and engagement

Personalized game elements like tailoring rewards, challenges and feedback significantly increase intrinsic motivation among students which make students engage in the learning content. (Imran, 2019; Alsawaier, 2018; Daghestani, 2020; Rodrigues et al., 2022)

II. Improved academic performance and conceptual understanding

Adaptive gamification enhanced academic achievement also in developing skills for applying learned knowledge. Adaptive gamification foster surface level as well as deep learning too (Hallifax et al., 2019).

III. 21st century skills

Adaptive gamification develop the 21st century skills among learners in the following ways-

a. problem-solving

in an adaptive gamified system tailored challenges are provided according to learning style of students. With flexibility in adjusting to dynamic difficulty level it able to maintain the optimal challenge level. It foster creative thinking by accepting multiple solution path and with real-time feedback it help in developing analytical thinking. adaptive hint mechanism support self-learning among students (Li et al., 2023).

b. Collaboration

Adaptive gamification system support collaborative learning with its elements like dynamic team formation, customized communication tools. It provide opportunity to create group according to the learner's type which further encourage team interaction and personalized role of each learner (Mbabu, 2019)

c. digital literacy

adaptive gamification has significant impact on student's digital literacy by providing customized digital tool, intelligent tutoring system and multi-format content delivery mechanism. Adaptive gamification adapt to the digital literacy of each student and develop learning content by the level of digital competency of student and increase difficulty level as needed (Daghestani, 2020).

IV. inclusivity and equity in education

adaptive gamification develop an inclusive and equitable learning space by meeting the need and style of learners which look into providing opportunity to all learners to succeed irrespective of the individual differences of learners (Alsawaier, 2018).

9. Challenges of adaptive gamification

Adaptive gamification lack in accuracy in measuring and interpretation of learners' engagement pattern (Böckle et al., 2018). Adaptive gamification with its tracking metrics only able to check the login frequencies and time spent by learner but it lack in determining whether the engagement is genuine or superficial (Dicheva et al., 2020)

Data and privacy of learner can be compromised in an adaptive gamified system. Adaptive gamification work on the learner's personal data like, their learning behavior, performance and preferences, etc. and storing such huge data should be according to the data protection regulation (Hassan et al., 2019).

Scalability is another challenge in using adaptive gamification. Adaptive gamification work on learner's type and preferences of learners. But the cultural and contextual differences of learner make the adaptive gamification system complex. At time tailored game elements aren't appropriate for the cultural and contextual need of the learners.

Apart from this adaptive gamification has another challenge like resource allocation and maintenance, learners' long-term engagement (Dicheva et al., 2020) and personalizing algorithms to effectively adjust to the need and preference of learner (Klock et al., 2020). Toda et al. (2019) suggest that learner prefer some control and understanding of adaptive gamification process, which is difficult in an automated personalized system.

10. Conclusion

Despite of all the above challenges adaptive gamification has the scope for making learning process an engaging, motivation-oriented by leveraging the personalization feature of game-elements according to learner's behavior, preference and performance. And if these challenges could be overcome then adaptive gamification can bring a revolutionary transformation in the scope of education as it meet the engaging and motivational part of gamification and customization of personalized learning, that help in making learning experience an interesting, effective and inclusive for each learner.

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