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A GAMIFIED E-LEARNING MODEL BASED ON THE ONE SIZE FITS ALL MODEL AND THE STATIC AND DYNAMIC ADAPTATION MODEL

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ABSTRACT

In order to create a gamified e-learning system, several researchers have proposed models. some are based on the use of the same game elements for all users / learners "one size fits all", others have opted for the modification of these elements depending on the learner, we are talking about adaptive gamification or personalized gamification, this second type of model can be divided into two categories which are the static adaptation models in which the gamified e-learning system offers certain elements according to learners information or their learning style. The second category is the dynamic adaptation models which propose game elements depending on the behavior of the student during his learning process. In this paper we propose a new model in which our gamified learning system will display the game elements using the three categories explained above according to the type of game element, if they are easily noticed by the learner (intrinsic) or not (extrinsic).The objective is to help designers of gamified LMS and teachers to choose the right games element to display on the course in order to better maintain the learner motivation.

Keywords: *Adaptive Gamification, E-Learning, Instructional Design, Adaptation Model*

1. INTRODUCTION

E-learning researchers have a big challenge as students tend to lose focus and motivation easily [1]. Many researches aims to solve this problematic using gamification. This concept is considered one of the effective way to maintain motivation in learning activities [2]. It has been defined in scientific articles in different ways, but the most used definition is "the use of game design elements in non-gaming contexts" [3]. In the last decade, several researchers have proposed models for the use of game elements in e-learning systems. On the one hand, one size fits all solutions and on the other hand adaptable solutions have emerged, but currently no solution has been widely accepted.

In a previous research endeavor [4], our focus was directed towards a comprehensive analysis where we scrutinized the incorporation of gaming elements across five distinct gamified e-learning applications. Guided by an established gamification taxonomy [5], the primary objective was to discern the efficacy and practicality of these elements, with a larger aspiration to formulate an entirely new model for game elements. This innovative model was conceived as a response to the outcomes drawn from the experimentation process.

To systematically categorize the various elements, they are categorized into five distinct dimensions: measurement, social, ecological, personal, and fictional. These dimensions provided a structured framework for dissecting the various components and understanding their potential impact. The elements are also classified according to the relationship between each element and the motivation of the learner. They vary depending on whether the influence occurred in an intrinsic or extrinsic way. The analysis yielded a total of 19 distinct elements. These elements, which we now present, collectively shape the foundation upon which our subsequent explorations and models are built:

- Measurement: Acknowledgement (Extrinsic); Level (Extrinsic); Progression (Extrinsic); Point (Extrinsic); Stats (Extrinsic).
- Ecological: Chance (Intrinsic); Imposed choice (Extrinsic); Economy (Extrinsic);

Rarity (Extrinsic); Time pressure (Extrinsic).

- Social: Competition (Intrinsic); Cooperation (Intrinsic); Reputation (Intrinsic); Social pressure (Intrinsic).
- Personal: Novelty (Intrinsic); Renovation (Intrinsic); Sensation (Intrinsic).
- Fictional: Narrative (Intrinsic); Storytelling (Intrinsic).

Within this article, our focus centers on harnessing the potential of a comprehensive set of gamification elements - comprising 10 intrinsic and 9 extrinsic components - to formulate an innovative gamification model. The objective is to leverage these elements effectively, thereby enhancing and sustaining learner motivation within the educational context.

To achieve this, we employed two key frameworks: the Learning Style Model and Player Types. These frameworks play a crucial role in our approach, allowing us to dynamically tailor the gamified elements to each learner's preferences and tendencies. By incorporating the Learning Style Model, which classifies learners into categories, we ensure that the gamified content aligns with individual learning preferences. Simultaneously, the Player Types framework, aids in customizing the gamification experience. Each type has distinct preferences, from completing challenges to exploring content freely or engaging in collaborative activities.

By strategically integrating these diverse elements, we aspire to create a dynamic and engaging learning experience that addresses the multifaceted aspects of learner motivation and contributes to a more effective and rewarding educational journey. Through this work we aim to take an important step towards the evolution of gamification strategies, highlighting our commitment to optimizing learner engagement and success through a targeted approach.

Our model aims to recognize and respect the uniqueness of each learner. This dynamic framework promotes not only motivation but also deeper understanding and retention of educational content, making it a valuable tool for educators striving to create impactful learning experiences in diverse educational settings.

2. RELATED WORKS

Adaptation in gamification refers to the system's ability to modify game elements within the gamified e-learning environment. This capability allows for a customized and responsive learning experience tailored to individual learners' needs, progress, and preferences [6]. Incorporating gamification into a course can significantly alter student behavior, however, it's important to recognize that student engagement within a gamified course may be susceptible to the limitations of the "one size fits all" model [7] . In light of this, the adoption of a personalized modeling approach becomes not just beneficial but essential. Personalized modeling is crucial for maintaining student focus and motivation throughout the course [8]. Several studies have worked on the area of adaptive gamification models, each with a common goal: refining the gamified learning experience by observing and analyzing student behaviors. These efforts are driven by the aspiration to create a learning environment in which each learner encounters precisely the right set of game elements that will enhance their experience within the LMS.

Our research commenced with an exploration of existing scholarly literature following this steps:

- ✓ Emphasizing primarily the use of search engines, particularly Google Scholar.
- ✓ Our search query was thoughtfully composed, emphasizing the critical keywords "adaptive," "gamification," and "learning," with the aim of pinpointing articles that delve into the convergence of adaptability and gamification within the educational domain. This choice of keywords was specifically aimed at identifying articles that explore the intersection of adaptability and gamification in the field of education.
- ✓ The article selection was based on the publication date, from 2015 to the present day, and among the most relevant ones, we chose those that presented a model with adaptive or non-adaptive aspects of gamification in the field of education.

Our exploration yielded a diverse array of research papers, each offering the potential to illuminate the adaptive aspects of gamification

within the realm of education. By subjecting these selected articles to analysis, we embarked on a comprehensive comparative study. These insights served as the bedrock upon which our research findings and conclusions were constructed.

Shi Lei et al [2] relied on self-determination theory (SDT) to define a learner development strategy based on the three needs of SDT: Autonomy, Competence, and Relatedness. SDT is extensively recognized and stands out as one of the primary motivational theories that centers on the extent to which individual behaviors are inherently self-determined and self-motivated. It posits that individuals exhibit higher levels of self-determination and self-motivation when these three fundamental innate needs are satisfied. In their study, Shi Lei and colleagues implemented five autonomy-related strategies, five competence-related strategies, and five relatedness strategies, all rooted in the principles of SDT. Kamunya et al [9] used an adaptive gamification system to propose elements of gamification in accordance with the characteristics of the learner without specifying how the system will choose the elements. Hallifax[10] used the PDA-LPA design (Perception Decision Action - Learning Prediction Adaptation) to analyze the behavior of learners in the course and propose to the teacher modifications in terms of games elements so he can choose another elements to use in his the course. In summary from the system's perspective, it perceives the actions of the learner, makes decisions based on these observations, and implements adaptation actions (PDA). Following this, the system learns from the outcomes of these adaptations, predicts their impact on the user, and adjusts its adaptation system accordingly (LPA). Hassan et al. [11] collect the interaction of learners with the system to define their learning style in order to choose the right game element.

Baptiste Monterrat et al [12] in order to find the best element to propose, they used the product of two matrix the first one represents the traits of users and the second the weight of the traits for each game elements, the result is the preference of each learner for the games elements. Luiz Rodrigues et al [13] used Conditional Decision Trees; which is an alternative to traditional decision tree algorithms, chosen for its ability to reduce bias by using a statistical approach during variable selection, ensuring that measures' distributions are considered when splitting variables; with data collected from a survey in which users entered personal data (example sex and country...) and their preference concerning the elements of gamification the objective is to find the most useful game element for a specific characteristics of the user to be used later in both static and dynamic adaptive gamification system. A. C. T. Klock et al [14] who despite not having used a very advanced algorithm for the choice of game elements to display but they were able to create an adaptive system using a model based on four questions “Who?" which identifies the actor or the learner, "Why?" identifies behaviors that gamification can improve, "How?" is the choice of game elements and finally "What?" which is the data used in the process of gamification. Martin Böckle et al [15] proposed a design framework for adaptive gamification using four elements with different paths connecting them. The first element aims to define the purpose of adaptability by changing the attitude of the user, supporting the learning and participation and creating a meaning between the goals of the learner and the activity. The second element is the criteria of the adaptive gamification approaches, they used the player and personality types and a survey to know the learners preferences towards games elements. The third element is the use of adaptive game mechanics and dynamics which modifies the content by sending alert messages, changing the difficulty based on points collected by the learner or using customized challenges. Finally the last element shows recommendations, offers a personalized content, proposes an adaptive path depending on learner skills and adapts the user interface by displaying game elements basing on the learner interactions.

Based on the various articles explained above and the results of their analyzes displayed in table 1, we can divide the gamification models into 3 categories :

1. "One size fits all" model:

• In this model, the designer establishes a fixed set of game elements that are uniform for all users within the e-learning system.

• The game elements remain consistent regardless of the individual user's characteristics, preferences, or progress.

• This approach is straightforward to implement but may not provide a personalized learning experience. Users with different learning

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styles, abilities, or interests may not find the gamification elements equally engaging.

2. Static adaptation model:

• In the static adaptation model, the system adjusts the game elements based on the user's profile. Users with similar profiles receive the same set of game elements.

• Profiles can be defined by various factors such as prior knowledge, learning goals, age, or experience level.

• This model offers a degree of personalization by tailoring the gamification elements to a user's general characteristics, but it still treats all users within a given profile category the same way.

3. Dynamic adaptation model:

• The dynamic adaptation model takes personalization a step further. It not only considers the user's profile but also their real-time activity and behavior within the e-learning system.

• Game elements are adjusted not just based on who the user is, but also on how they are engaging with the content. For example, it may take into account their progress, the types of questions they find challenging, their pace of learning, and more.

• This approach makes each user's experience unique and aims to respond to their specific needs and preferences as they evolve during the learning journey.

In summary, these three models represent different levels of adaptability and personalization in integrating gamification into e-learning. While the "one size fits all" model is the simplest but least personalized, the dynamic adaptation model provides the highest level of personalization by considering both user profiles and real-time behavior, resulting in a more tailored e-learning experience. The choice of model depends on the specific goals and resources available for the e-learning program.

Table 1: Use of categories in gamification models..

Reference	"One size fits all" model	Static adaptation model	Dynamic adaptation model
[2]	X		
[9]		X	X
[10]		X	
[11]			X
[12]			X
[13]		X	X
[14]			X
[15]			X

3. PROPOSED MODEL

3.1. Defining The Problem

S. Hallifax et al [16] have raised critical questions regarding the actual influence of current adaptive models on learner motivation and engagement. Their research underscores the need for more rigorous and structured studies in this domain. Moreover, they advocate for the development of more comprehensive learner models that capture a wider range of learner characteristics and behaviors. Furthermore, they encourage exploration into novel adaptation methods. This implies a departure from conventional approaches to e-learning adaptation in favor of innovative strategies that may better align with the diverse needs and preferences of learners. Their call for these advancements suggests a growing recognition of the complexity of learner dynamics and the evolving landscape of educational technology.

Although in the literature, there are many research articles on the need for personalization of gamification approaches, but the lack of a model that addresses the design and principles of adaptive gamification in e-learning persists[17].

3.2. Addressing The Challenge

To try to solve this problem and to help teachers to create a gamified course which keep student motivated, our research propose a new model of adaptation model where we will use the three gamification models categories: one size fits all model, static adaptation model and dynamic adaptation model. To encourage the intrinsic motivation, the game elements that are not easily noticed by the learner when interacting with the

Learning Management System LMS must be absolutely used by the teacher and proposed by the system (one size fits all model), the extrinsic ones should be proposed by the system depending on the learner profile and personal information when he first join the LMS (Static adaptation model) and depending on his activity and behavior while using the LMS (Dynamic adaptation model).

To achieve our objectives, our (LMS) embodies a tripartite structure, comprising three pivotal actors: the teacher, the learner, and the system. The interconnected dynamics of these actors are vividly depicted in Figure 1, where their interplay forms the essence of our gamified educational system.

The interactions within this construct are symbolized by designated labels. The exchanges between the teacher and the system, and the teacher and the learner as encapsulated in I1 and I2, reflect the seamless dialogue that unfolds as the teacher shapes and administers the learning content, while concurrently engaging with the learner. Correspondingly, the system assumes an active role in its interactions with both the learner and the teacher, encompassed by I3 and I4. These interactions manifest as the system adapts its mechanisms to the learners' behaviors, offering tailored experiences and providing valuable insights to the teacher for effective course refinement.

Integral to this framework are the exchanges between the learner, the system and the teacher, epitomized by I5 and I6. These interactions spotlight the learner's pivotal engagement within the LMS. As the learner navigates the learning environment, they contribute essential inputs and receive tailored feedback, fostering an ecosystem of personalized growth and knowledge acquisition.

In the forthcoming sections, we will delve into a comprehensive exploration of these multifaceted interactions, delving into the rich tapestry of information exchange that occurs within each scenario.

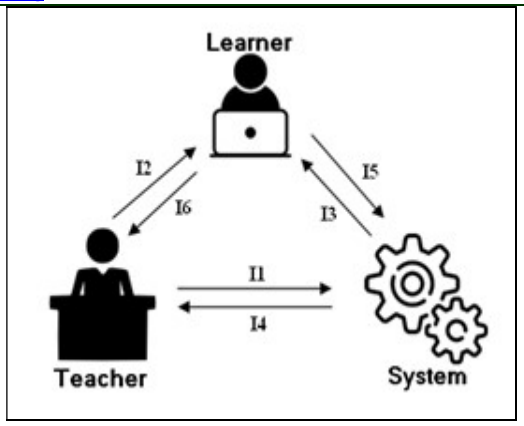

Figure 1: Interaction between actors

3.2.1 The teacher

In order to create the course the teacher must use an instructional design, in our model we choose the SAM (Successive Approximation Model) that is an instructional learning approach and a convincing alternative to many others used instructional design as ADDIE [18]. SAM is composed by 3 principal steps (Figure 2) that should be performed in a loop, the teacher does these steps while designing the course and also while designing each chapter of the course.

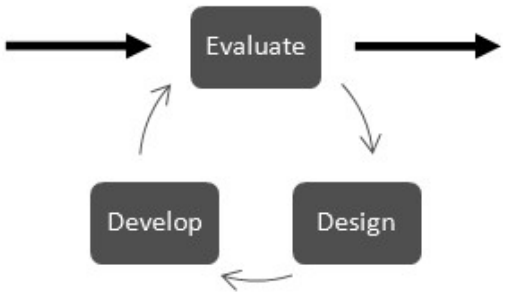

Figure 2: The Successive Approximation Model

SAM unfolds in a systematic three-step process, commencing with the "Design" phase. Here, the teacher embarks on a journey of crafting the foundational framework. This entails establishing clear objectives, meticulously structuring the course or delineating chapter units, and defining the scope of information to be imparted. Whether at the comprehensive course level or the chapter level, this phase lays the

blueprint that shapes the subsequent learning experience.

Subsequently, the progression leads to the "Develop" phase. At this juncture, the teacher transforms the conceptual design into tangible educational content. Through a harmonious amalgamation of textual narratives, audio supplements, illustrative graphs, and other instructional elements, the teacher crafts a rich and immersive learning encounter. This dynamic phase is marked by the transformation of pedagogical intent into an interactive and engaging learning reality.

Culminating the SAM process is the critical "Evaluate" phase. Here, the teacher undertakes a reflective appraisal of the course or chapter's efficacy. This involves an incisive analysis of its impact on learner engagement, comprehension, and achievement. The evaluation extends to discerning the alignment between the conceived design and the actualized learning outcomes. It is within this evaluative juncture that insights are garnered, allowing for informed refinements, optimizations, and enhancements that perpetuate the iterative cycle of educational excellence.

In our envisioned model, the teacher occupies a dynamic role that bridges interactions between both the system and the learner. Within this multifaceted framework, the teacher embarks on a creative journey while crafting the course content within the system (I1). Employing a gamified approach, the teacher strategically infuses the learning material with sensory stimuli (sensation), harnessing the power of audios, videos, and storytelling techniques. This transformation breathes life into the educational content, elevating engagement and comprehension.

Moreover, the teacher's involvement extends to fostering vibrant learner interaction (I2). This includes orchestrating stimulating competitions that spark healthy rivalries, promoting a spirit of healthy camaraderie through collaborative teamwork initiatives, and offering a second opportunity to learners who may not have initially succeeded in their chapter quizzes (renovation). Furthermore, the teacher diligently dispenses personalized feedback to both successful and aspiring students (Narration). This constructive feedback mechanism serves as a powerful motivational tool, nurturing a culture of growth and perseverance among learners.

3.2.2 The system

Our innovative approach entails the creation of an adaptive gamified Learning Management System (LMS), where the system (I3) leverages advanced machine learning algorithms to dynamically showcase extrinsic game elements in alignment with insights gleaned from the learner's behavior. This behavior-driven customization draws upon a spectrum of actions - ranging from the accumulation of badges and medals for accomplishments (acknowledgment) to the pursuit of limited items that evoke a sense of rarity. This intricate orchestration further unfolds through the strategic presentation of levels, progression bars, points, and performance statistics, all contributing to an immersive and motivating learning journey.

The system's adaptability extends beyond surface interactions, encompassing an array of engaging scenarios. Learners find themselves faced with intentional choices that prompt decision-making under time constraints, thereby nurturing both critical thinking and swift decision-making abilities. Additionally, the system delves into the realm of virtual economies, allowing learners to purchase items from a virtual store (economy).

Furthermore, this adaptive gamified LMS integrates intrinsic game elements. The system proposes elements such as chance and spinning roulette introducing an exciting element of unpredictability. This concept is further enriched by the infusion of novelty, achieved through dynamic content changes or even by the simple act of altering extrinsic elements.

In addition to its interaction with the learner, the system (I4) establishes a valuable connection with the teacher, providing crucial statistics and insights to evaluate the learner's engagement and progress within the gamified learning environment. The system offers a comprehensive set of data such as interaction with game elements, progress rate in the course, quiz Scores and Assessments and every valuable statistics that can help the teacher to evaluate the effectiveness of the course. This evaluation serves as a foundation for improvement in subsequent iterations of (SAM) loop, enabling the teacher to refine the course and enhance the overall learning experience.

3.2.3 The learner

In our gamification model, the learner takes on a central and pivotal role. They serve as an active participant who utilizes the system to navigate through a diverse array of courses and chapters thoughtfully crafted by teachers. This engagement goes beyond mere navigation much like the teacher and the system, the learner is an integral contributor to the interactive dynamics of the gamified learning environment.

When considering the data that the learner can transmit to the system (I5), it becomes evident that this process offers a valuable opportunity for learners to actively contribute to their own learning journey. Through this mechanism, learners are empowered to provide essential inputs that can significantly enrich and personalize their overall learning experience. This dynamic exchange of information enables learners to express their preferences, needs, and learning styles, thereby enabling the system to tailor content and interactions to align more closely with their individual aspirations and goals. In essence, this collaborative data-sharing process serves as a cornerstone for crafting a truly learner-centric and customized educational environment. Among these inputs are:

- Personal information: such as country, sex, age, and other demographic factors, plays a crucial role in our proposed gamification model. This information provides valuable insights into the learner's background and characteristics, allowing for a more tailored and personalized gamified experience.
- User profile: In order to enhance the functionality of the system, a decision has been made to integrate the learning style and player type. This decision is motivated by the system's inclusion of both e-learning and game elements. Through the use of forms presented to learners upon their initial connection, the Learning Management System (LMS) can identify and assess the user's learning style and player type simultaneously.

  Learning style refers to everything that characterizes a person when he learns, [19] many psychology researchers proposed different learning style models and theories but now Felder–Silverman's learning style[20] is widely accepted model and is adopted in many LMS[21]. We can use the Index of Learning Styles ILS questionnaire [22,23] to evaluate the learning style of the learner between 2 values within 4 dimension (Figure 3)

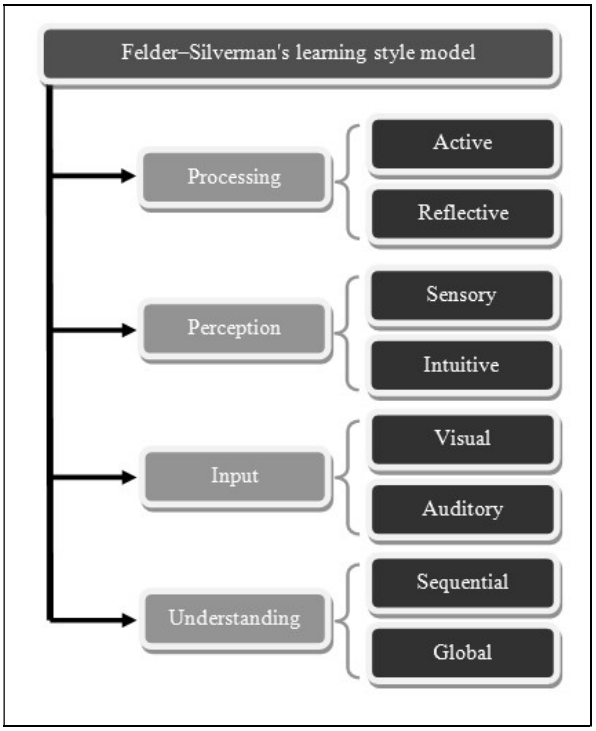

Figure 3: The felder-Sylverman's learning style model

Current research is actively exploring the possibilities of leveraging player types to optimize and personalize gamified applications. The Bartle Player Types, a renowned categorization system in the gaming community [24], have gained significant recognition. Bartle's classification [25] comprises four distinct player types (Figure 4). These player types offer valuable insights into different player motivations and preferences, providing a foundation for tailoring gamified experiences to individual users.

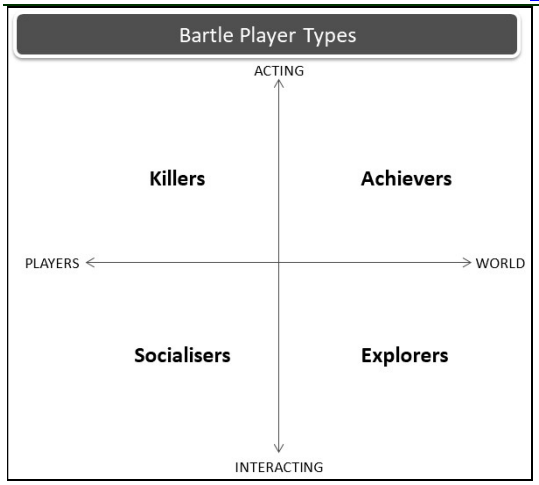

Figure 4: The Bartle Player Types

- Activity of the learner: within an educational platform encompasses a multifaceted spectrum of behaviors and interactions. These encompass quantitative metrics such as the time spent on the platform, the frequency of connections to the platform, the number of chapters or sections visualized, the duration of each visualization session, and the access period [26]. These informations are invaluable for educational platforms as they aid in assessing learner engagement, comprehension, and potential issues. Analyzing these data points can inform instructional design, allowing for the adaptation of content delivery to suit individual learning patterns and needs. Additionally, it can serve as an early warning system, flagging disengagement or difficulties that may require intervention or additional support to ensure optimal learning outcomes.
- Behavioral information: in the context of gamified e-learning systems encompasses a wide range of interactions between the learner and various extrinsic game elements. These interactions include activities such as collecting medals and limited items, tracking progress via progress bars and stats, participating in virtual transactions in the in-game store, and responding to temporal challenges, including tasks with imposed choices and countdown. Understanding and analyzing this behavioral information is essential for the system. It not only provides insight into learner engagement patterns and preferences, but also helps tailor gamification elements to optimize the learning experience. Additionally, it helps identify potential areas for improvement, thereby helping to refine the gamification strategy to improve both learner motivation and educational outcomes.

In their ongoing interaction with the teacher (I6), the learner actively shares important information related to their learning progress. By actively sharing their quiz and exam responses, competition results, and group project contributions, the learner establishes a productive feedback loop with the teacher. This exchange of information facilitates personalized guidance, constructive feedback, and recognition, ultimately supporting the learner's growth, motivation, and success within the gamified learning environment.

4. CONCLUSION AND PERSPECTIVES

In our paper, we aimed to present a novel gamification model that builds upon the existing categories of gamification models, namely the one size fits all model, static adaptation model, and dynamic adaptation model. Our proposed model takes into account two key factors: the actors involved (system, teacher, and learner) and the impact of game elements on the learner. By considering these factors, our model offers a more personalized and effective gamified experience.

While we have outlined the conceptual framework of our model, it is essential to validate its efficacy through experimentation, which will be the focus of our forthcoming work. The experiment will provide empirical evidence on the effectiveness of our proposed model in enhancing learner engagement and motivation.

Additionally, in the implementation of our model, the choice of the machine learning algorithm becomes crucial. Specifically, we need to select an appropriate algorithm for determining the extrinsic game elements to be incorporated into the static adaptation model and the dynamic adaptation model. This decision is pivotal as it influences the accuracy and efficiency of the adaptation process.

Overall, our paper sets the foundation for a new gamification model that considers the actors involved and the impact of game elements on the learner. Through future experiments and careful

selection of machine learning algorithms, we aim to validate and optimize our model, ultimately providing an enhanced gamification approach that positively impacts learner engagement and motivation in educational contexts.

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