

Gamification empowered with AI tools to enhance student learning engagement and involvement for personalized effective learning experiences.

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Abstract. A prevalent mindset in modern society that can transcend the educational process should be "Game Thinking"; because there is a strong connection between game-like environments and workplace settings. The application of game-inspired thinking in non-gaming contexts, particularly through technological tools, is referred to as "Gamification."

Technology-savvy Millennials, the current dominant workforce, represent the future of business leadership. Therefore, gamification is highly effective in engaging this generation in meaningful ways. The intersection of the Gamification of education and AI presents numerous opportunities for enhancing learning experiences. Continuous research in these areas can lead to innovative solutions that empower students enabling them to achieve their educational goals more effectively as a benefit. Secondly, gamified outcome-based educational approaches can produce industry-ready skilled manpower.

AI tools based on Large Language Models (LLM) enhance their capabilities in multimodal means to handle not only text but audio-video-graphics too; hence these tools can bring new excitement to education pedagogy. The first part of the paper provides a psychological framework for gamification, while the second segment explores how to develop and construct a technological framework to implement AI-based gamification.

Keywords: Large Language Models (LLM), AI Agent, Gamification, OpenAI.

1 Introduction:

Cloud technology with AI empowerment on digital platforms can be the game changer in modern means of education which can be extended to underprivileged rural Indians as the most cost-effective education. An important aspect of AI-powered education is assessment tools, which can be designed with a 360-degree approach in terms of aptitude and attitude evaluation.

Even though gamification is an old concept that evolved in the early part of the 21st century; it could not get that momentum as some argue that we cannot have a one-size-fits-all approach as it is not personalized or adaptive. But these two aspects are very well handled by AI-enabled gamification which will be explored in the later part of the paper. The following theories define a psychological framework for gamification.

1.1 Flow Theory by Mihaly Csikszentmihalyi:

The major issue of the new millennial students is that the attention span is so short that it leads to boredom; to keep them engaged we must retain students within the flow channel as defined by Mihaly flow Theory.

This flow theory establishes an association between a user's skills and the challenges or levels of difficulty they encounter in their work, impacting their

experience of either anxiety or boredom. An individual performs at their best when operating within the flow zone, as illustrated in the accompanying Figure 1. The flow channel represents a state where the user is highly engaged, focused, and excited in their interests. Game elements can help users remain in the flow zone, allowing them to fully utilize their abilities. The dynamics of gameplay can create an optimal balance between challenges and user skills, keeping individuals highly engaged and motivated.

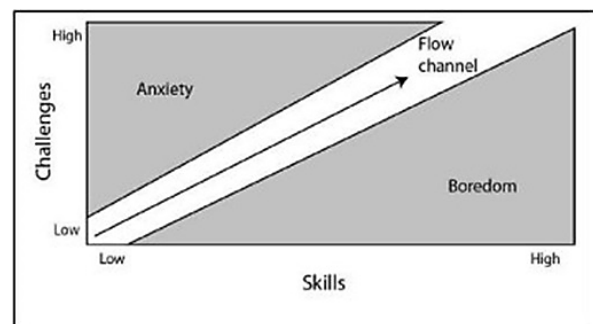


Fig. 1. Concept of Flow

1.2 Player Types:

1. Achievers
2. Explorers
3. Socializers
4. Killers.

These are four types of players as identified by researcher Richard Bartle.

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Achievers are individuals who strive to master every aspect of the game system. Explorers, on the other hand, are inclined to explore all of the game's content but are less interested in taking on challenges or seeking victories. Socializers focus primarily on interacting with others, engaging in conversations, and forming companionships. Finally, Killers not only aim to reach the top but also actively seek to defeat their competitors throughout the process. Thus, gamification can categorize individuals based on their normal instincts while playing. These distinct player types are motivated by different core drives, which can be incorporated into game design to better identify each player's type.

1.3 Self Determination Theory:

According to this theory, individuals are not solely motivated by rewards or punishment; instead, they are more effectively driven by three core elements: Competence, Relatedness, and Autonomy. Competence refers to the need for a sense of self-mastery and effectiveness. Relatedness encompasses the social aspect where individuals desire interaction, connection, and care among one another. Autonomy is fundamentally about having control over one's own choices and life.

The Self-Determination Theory provides a robust framework for fostering a long-term motivational environment for employees and can be effectively applied through gamification. However, this theory does not adequately address the need for short-term motivational boosts that can enhance productivity in the short run.

2. Literature Review

2.1 Gamification Construct development:

This is a framework as shown in Figure 2 based on the paper "Proposing a Theory of Gamification Effectiveness" by Bilal Amir, Sur University College, Paul Ralph, Lancaster University. [4]

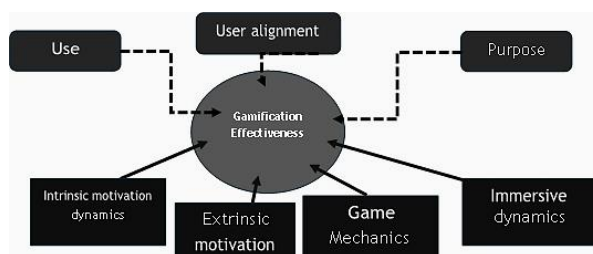


Fig. 2. Gamification Framework

In this framework Use, User alignment, and Purpose are a formative construct that forms and define the consumption of the outcome of the system. There are four Antecedents as described.

1. **Intrinsic motivation dynamics:** It is offered to users when they experience autonomy, competence, and

relatedness. Autonomy refers to the ability to choose their own tools and select varying levels of challenge. Competence is developed by gradually introducing more challenges and training users to enhance their confidence. Relatedness is provided to encourage collaboration and communication within teams.

2. **Extrinsic Motivator:** These are like points, badges or trophies, levels of achievements.

3. **Game mechanics:** It means the environment or ecosystem of the game, objects, actions, rules, etc.

4. **Immersive dynamics:** The player's immersion in the gamified system or activity which is mainly bound to the storytelling and aesthetics of the game.

The paper "Intelligence Unleashed: An Argument for AI in Education" elaborated on the importance of AI in the education domain.

First, it's essential to be empowered by a comprehensive grasp of what Artificial intelligence in education (AIEd) requires, what it offers, and the methods it employs to achieve those outcomes. Second, it requires a straightforward explanation of how the field of artificial intelligence can be integrated into the core of teaching and learning. This will help us avoid using general-purpose technologies in ways that fail to bring about significant improvements in learner outcomes that's what all are aiming for. For instance, smart technologies that adapt to preferences rather than focusing on learning, or that enhance administrative efficiency without improving learning efficiency. Third, we need tangible options that can help realize the potential of AIEd at the systemic level—meaning at a scale that can broadly support the teaching profession and positively influence the learning experiences of all students. Lastly, we must confront and address important ethical questions, such as what is considered acceptable in this evolving landscape.[5]

The paper describes how AI can influence three distinct levels of education: (1) at the micro level, it acts as a partner in exploration, learning, and individual expression; (2) at the meso level, it serves as a creative and collaborative member within team activities; and (3) at the macro level, it functions as both a mediator and an initiator of cultural changes. These roles are feasible because AI in education is transforming the concepts of 'knowing and doing' in conjunction with advanced computational resources.[5]

Personalized learning is a modern trend in the education sector, closely associated with the global digital changes impacting various aspects of socio-economic life. The incorporation of artificial intelligence technologies improves the efficiency and quality of education by addressing the needs and preferences of students. By using social networking platforms and chatbots in the educational process, teachers can make learning more

effective and accessible at any time, boost student engagement, and save valuable time. Expert systems also enhance educational effectiveness and ensure quality in areas such as curriculum design, decision-making, planning, management, and collaboration. Intelligent mentors and agents support customized learning paths tailored to each student's needs, interests, and previous academic experiences. Moreover, machine learning technologies enable educators to analyze large volumes of student data, build predictive models, monitor educational progress, and adjust learning approaches to align with students' needs,

ensuring high-quality education.

Personalized learning pathways enhance the quality of e-learning by offering students customized materials and resources, while also promoting interaction between students and instructors. Virtual learning environments create an engaging space for collaborative learning, interaction, information visualization, and real-time feedback.[8]

3. Technical Implementation of the framework.

The formative constructs are Use, User alignment, and Purpose which are application-oriented, and one has to define it through the use case as per application requirements. It can be implemented as a mobile app or web app with appropriate front-end and back-end technology. In this paper, our focus is on the AI empowerment of these applications.

In the discussed framework, there are four Antecedents as defined above; out of which the researcher's proposed system **Intrinsic motivation dynamics**, and **Immersive dynamics** are two vital aspects that will be handled by Generative AI platforms.

3.1 Comparative study of LLM platforms:

Researchers proposed to develop AI agents to associate the above antecedents using LLM i.e. Large Language model platforms. In a subsequent session of the paper; the researcher explores the practical implications of various open-source and commercial digital platforms like OpenAI, Meta, Google, Anthropic, Mistral AI, Cohere, etc. The comparative study on various parameters is expressed in the following plots.

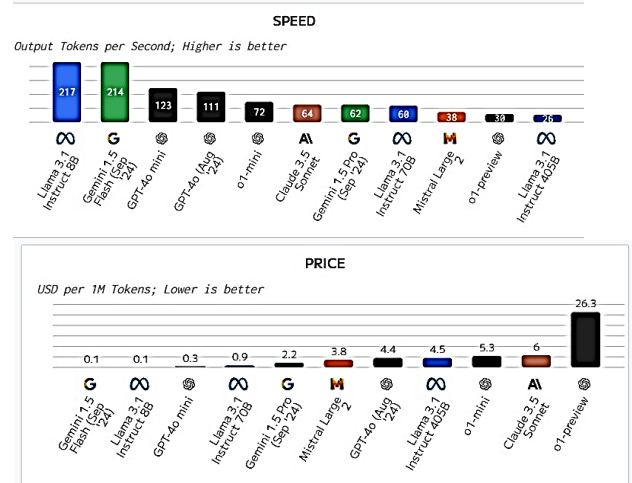


Fig. 3. LLM Models Comparison on various parameters

As per the plot analysis in Figure 3; OpenAI is commercially expensive but good in terms of quality and speed. But overall Google-based Gemini 1.5 Flash model is the best in terms of cost with good speed and quality. The above factors can be more generic but looking at the aspect of AI agents in the Gamification context following performance comparison is vital.

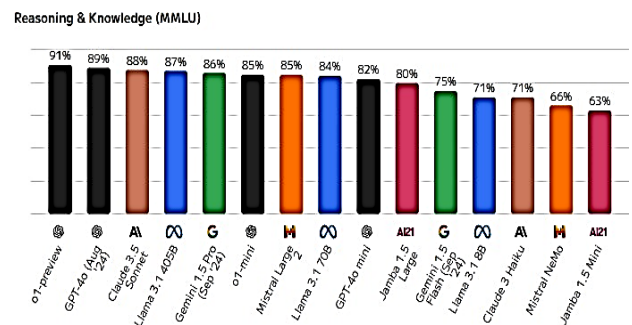


Fig. 4. Performance comparison of LLM model

ELO scores, originally developed for chess, have become an important tool for evaluating the performance of Large Language Models (LLMs). They indicate how effectively these models can respond to questions or tackle problems, placing them within a competitive framework. For instance, OpenAI's GPT-4 Turbo achieved an impressive Elo rating of 1263. However, this rating alone does not provide a complete picture of the model's abilities, as it does not have a corresponding MMLU score for a more comprehensive assessment.

In contrast, the Massive Multitask Language Understanding (MMLU) score provides a wideview by assessing a model's reasoning and comprehension skills across different topics. A striking example is Gemini Ultra, which has an impressive MMLU score of 90.0, showcasing its extensive knowledge and understanding. However, without an accompanying Elo rating for direct comparison, evaluating its complete capabilities remains somewhat unclear.

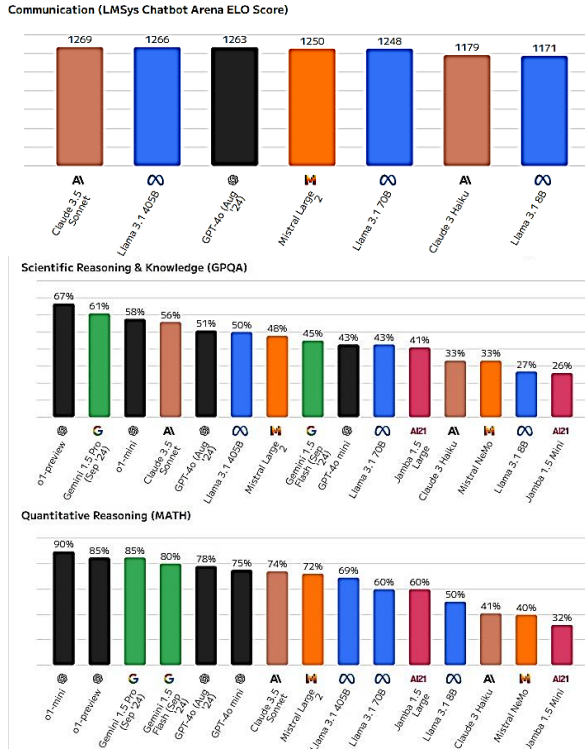


Fig. 5. Application based Quality performance of LLM Models

The above graphs in Figure 4,5 and the explanation express that there are several AI LLM platform options and hence developers can take a call based on the context of an application and requirement.

4. Practical Implementation

In this paper, researchers explain the OpenAI implementation of AI agents as an example.

4. 1 Key Concepts:

Text generation models: This is the basic capacity of these LLMs which are train to interpret and respond to natural and formal language. Open AI offers various models that can deliver this feature.

Table 1: Open AI models

MODEL	DESCRIPTION
GPT-4o	Our high-intelligence flagship model for complex, multi-step tasks
GPT-4o mini	Our affordable and intelligent small model for fast, lightweight tasks
o1-preview and o1-mini	Language models trained with reinforcement learning to perform complex reasoning.
GPT-4 Turbo and GPT-4	The previous set of high-intelligence models
GPT-3.5 Turbo	A fast, inexpensive model for simple tasks

- **Assistants:** This is an entity that interacts with the end user and performs tasks in response to the prompt entered. It makes use of pre-trained models to respond to prompts. They also have access to tools and functions that allow them to perform more complex tasks like embedded code executions or retrieving information from different source files.
- **Embeddings:** This is a vital aspect from a gamification and customization point of view. It is a vector representation of set of data files which is meant to preserve the aspects of the content and/or its meaning. This is means of fine tuning the generalized model to our customized context. It is useful for clustering, anomaly detection, classification, search etc.
- **Tokens:** It simply means chunk of text bundled into tokens wherein 1 token is approximately 4 character or 0.75 words for English text. This is important as costing of ChatGPT use this as a base unit.
- **API Key:** API keys is very vital for authentication and interface with Open AI. One can generate API keys with a user or service account level at <https://platform.openai.com/api-keys>. These accounts are bound to a respective Assistant or bots and should be used to provision access for production systems. This is key is vital and needs to be used securely.
- **Function calling:** This feature allows models to interact with external systems and empowers AI assistants with extra capabilities to build deep integration with application. It's vital and useful aspect for gamification integration. This is very useful to fetch data from various sources, to take appropriate actions, perform computation , pipelining with database, user interface etc. This is very important for development of gamification framework implementation especially for **Intrinsic motivation dynamics** and **Immersive dynamics**.
- **Model fine Tuning:** This is the best means of customizing the model to specific task and it can be done through API . This can give us better quality results than prompting, gives token saving, lower latency more perfections in responses.

4.2 AI Agent implementation:

After having a good understanding of concepts used for the development of AI agents (Assistants) , paper take it to more deeper level of implementation. Referring to figure 2 framework, researchers propose to build AI powered assistant for the respective task of four Antecedents but majorly Intrinsic motivation dynamics and Immersive dynamics. To develop assistants understanding the following three aspects is very important.

Thread: It is a dialogue session between an Assistant and a User. Threads keep Messages organized and manage truncation automatically to ensure the content fits within a model's context.

Message: A communication created by either an Assistant or a user. Messages can consist of text, images, and various file types. They are stored in a list within the Thread.

Run: An execution of an Assistant within a Thread. The Assistant utilizes its settings and the Messages from the Thread to complete tasks by invoking models and tools. During a Run, the Assistant adds Messages to the Thread.

4.3 Creation of AI Agent (Assistant):

- Sign up on the OpenAI platform with the link: <https://platform.openai.com/playground/assistants> with a minimum \$5 subscription fee.
- **Create API (Application Programming Interface) key**
- **Create a new assistant** (refer to the following screenshot)

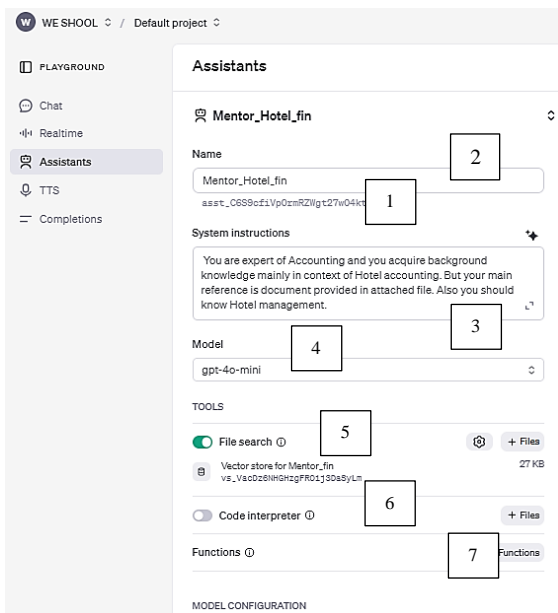


Fig. 6. Creating Assistant

Pointer-wise explanation for Figure 6.

1. Unique key for respective assistant or agent
2. Name of the assistant.
3. One can define the exact persona of the assistant.
4. LLM Model to be used by the assistant.
5. Various documents can be uploaded for fine-tuning in the context of gamification.
6. Define customized code to handle different game logic during interactions

7. Develop supporting functionality by defining specific functions.

4.4 Code Snippet for Implementation of AI agent in python:

1. Installing OpenAI libraries and creating client objects with API key for authentication.

```
pip install openai #installation of openai libraries
Show hidden output
Double-click (or enter) to edit
[ ] from openai import OpenAI
client = OpenAI(api_key="sk-proj-1lq3XtrvV6k8jP-X_Ak20afogHS1kzU52xg_Lpv0g5LRjeb1Fim1iiz")
```

2. Creating Thread

```
[3] thread=client.beta.threads.create()
print(thread)
Thread(id='thread_kbNfu8724rzl82uh673ynWlL', created_at=1727431516, metadata={}, object='thread',
```

3. Prompt implementation with thread and link it to assistant. Invoke the thread and retrieve a response from the AI agent.

```
[12] messages1=client.beta.threads.messages.create(
thread_id="thread_kbNfu8724rzl82uh673ynWlL",
role="user",
content= " Refer to the given pdf and generate MCQs with moderate difficulty level"
)
[13] run=client.beta.threads.runs.create(
thread_id="thread_kbNfu8724rzl82uh673ynWlL",
assistant_id="asst_rEfkbrj0h5U8fa19bncr7M50"
)
[ ] run=client.beta.threads.runs.retrieve(
thread_id=thread.id,
run_id=run.id
)
[ ] messages1=client.beta.threads.messages.list(
thread_id=thread.id
)
```

4. Final output response from AI agent.

```
for message in (messages1.data):
if message.content: # Check if message has content
print(message.role+" "+ message.content[0].text.value)
assistant:Here are 5 multiple choice questions (MCQs) with moderate difficulty based on Chapter 1 of your document:
1. **What type of endeavor is a project?
a) Technological
b) Scientific
c) Strategic
d) Temporary
**Answer:** (d) Temporary
2. **True or False: A project life cycle shows how the project moves from start to finish in different phases.**
a) True
b) False
**Answer:** (a) True
```

The above few lines of code are representative one; web app can give a dynamic interface between the End user and AI agent, but we need to incorporate this code with a front end in Web application or Mobile application.

5 Conclusion:

Personalization in gamification is very well possible with LLM Generative AI agents in the most cost-effective means. In the portal every individual logs in and interacts with the AI agent independently; hence it provides the user autonomy, competence, and relatedness which is **Intrinsic motivation dynamics**. Users can make use of agents for a great variety of tasks including content generation, conversation, summarization, creative writing, assessment, etc. This will handle **Immersive dynamics**.

Web developers can have a backend database to capture users' activities and progress to provide Extrinsic motivators like points, badges or trophies, and levels of achievements. **Game mechanics** can be built in the portal using different front-end tools and customized codes using Python.

There are other features of OpenAI LLM like Speech-to-text, text-to-speech, and Image generation which can bring in a more effective and creative interface for users with more personalization. AI is further evolving in terms of knowledge base, complexity, and accuracy, making it more powerful to provide better services.

Secondly, researchers would like to emphasize in this paper that all this can be developed with minimal effort; as the groundwork is very well done and developers must build upon it. Lastly, one can pay as per uses; making it cost-effective too.

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