# YOUNG GENIUSES PLATFORM: ADAPTIVE LEARNING, GAMIFICATION AND ARTIFICIAL INTELLIGENCE IN PRACTICE

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## ABSTRACT

Adaptive learning is an educational approach that uses advanced technologies to personalize teaching to the individual needs of students. The Brazilian platform Young Geniuses exemplifies this methodology by integrating artificial intelligence (AI) and gamification to enhance the educational experience. Founded in 2018, Young Geniuses has developed a platform that applies Item Response Theory (IRT) and AI algorithms to identify students' level of proficiency in various skills. With a bank of more than 70 thousand questions parameterized by IRT, the platform offers diagnostics by adaptive tests, allowing the personalization of learning and the reduction of educational gaps. In addition, gamification is used to increase student engagement, making the learning process more interactive and motivating. The platform also provides features for teachers, such as the creation of activities with automatic correction and real-time performance reports, making it easier to monitor student progress. Since its implementation, Jovens Gênios has served more than 300 thousand students and has been recommended by more than 700 partner educational institutions. The results indicate a significant increase in student engagement and improved proficiency in various disciplines. The platform demonstrates that the integration of AI and gamification can positively transform the educational landscape, offering a personalized and effective learning experience. It is concluded that adaptive learning, exemplified by Young Geniuses, represents a promising innovation in education, with the potential to meet the individual needs of students and improve educational outcomes significantly.

**Keywords:** Adaptive Learning, Young Geniuses, Artificial Intelligence, Educational Personalization, Gamification.

## INTRODUCTION

Communication, technologies and education constitute a relationship of great importance with regard to the processes of human development in the twenty-first century (CORTELAZZO, 1998). For Ferreira (2018), the interaction between the physical and virtual worlds attributes new meanings to the production of knowledge and influences the ways of understanding reality. In this context, this dynamic challenges the paradigms that underlie

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and structure the functioning of schools, also impacting the organization of pedagogical processes. In addition, the potential of digital technologies to promote the socialization of knowledge is highlighted.

According to Lévy (1996, p. 15),

> The virtual is a new modality of being, whose understanding is facilitated if we consider the process that leads to it: virtualization. This perspective makes it possible to think about simultaneous social relations and immediate access to any part of the world, inaugurating a new perception of time, space and social relations. It is in the virtual space that one can experience a new sociability, sharing a space marked by new relationships.

Also according to Ferreira (2018), it is evident that a new communication dynamic has been established, manifesting itself predominantly through the use of mobile devices connected to the internet. Whether synchronously (in real time) or asynchronously (with messages accessible later), digital technologies, driven by the internet, have become important mediators of social interactions. The speed of information circulation enables the reordering of *space-time* and the hybridization and deterritorialization of the far and near (COUTO, 2013). Circulation that reaches most spheres of human activities,

> from the forms and practices of social organization to the way of understanding the world, of organizing this understanding and of transmitting it to other people [...], [have been] instruments for thinking, learning, knowing, representing and transmitting the acquired knowledge to other people and to other generations (COLL; MONEREO, 2010, p. 17).

Undoubtedly, the emergence of digital technologies, with special emphasis on their network dynamics, has contributed to the intensification of the processes of resignification of the world. A process that makes the theoretical effort imperative so that we can "perceive/understand/reflect on the meanings of this technological emergency" (LIMA Jr., 2004, p. 2).

In this scenario, digital technologies have played a central role in the personalization and adaptation of educational processes, as discussed by Soler Costa; et al (2024). Modern technological tools make it possible to identify and respond to the individual needs of each student, taking into account their learning style, pace, and preferences. This potential for personalization transforms the relationship between the student and knowledge, while reinforcing the role of the teacher as a mediator and facilitator of learning. The ethical and conscious use of these technologies presents itself as a central challenge, ensuring that pedagogical practices respect diversity and promote digital inclusion, essential in an increasingly interconnected world.

In addition, the integration of digital technologies into pedagogical processes redefines the paradigms that underpin traditional education, encouraging the development of innovative practices. The network dynamics, with its interactive and collaborative characteristic, favors not only the socialization of knowledge, but also the collective construction of knowledge. Real-time access to diverse content, added to the possibility of revisiting materials asynchronously, expands learning opportunities, allowing knowledge to overcome geographical and temporal barriers. Thus, digital technologies are consolidated as mediators that enhance the understanding of the world and promote new ways of thinking, learning and teaching, essential to meet the demands of a globalized and digitized society.

In this context, adaptive learning emerges as an educational solution that leverages technological advances to personalize the teaching process effectively. According to Soler Costa et al. (2024), this approach uses data collected in real time to adjust content, activities, and assessments to the specific needs of each student. Artificial intelligence and advanced algorithms are the main tools that enable this adaptation, allowing students to receive more accurate and dynamic guidance, promoting greater engagement and more satisfactory educational results. This model represents a significant break with traditional teaching paradigms, in which the same content was transmitted in a homogeneous way to all students, disregarding their individualities.

## ADAPTIVE LEARNING AND YOUNG GENIUSES

Nowadays, in our view, it is necessary to personalize and innovate in the teaching-learning process. Our students, from the relationships with the world and with digital technology, produce knowledge, culture and resignify what they are. Costa (2005), for example, thinks of contemporary youth as an example of identities recreated in various ways that result in the emergence of new social actors. These students are a "new type of student, with new needs and new abilities" (GREEN; BIGUM, 1995, p. 209), subjects who transit through different space-times, who are connected in processes of constant interaction, located on the border between the material and the virtual, borders that are permeable, do not close and do not delimit the transit of these subjects (ROSÁRIO, 2013).

Ferreira (2018) argues that far beyond the idea of dissemination and propagation of content and information over the internet, the spaces created by it are collaborative spaces for the creation and production of culture between subjects in uninterrupted interaction processes. For Martin and Toschi (2014) *apud* Ferreira (2018), the possession of the cell phone ensures belonging to a group, the possession and use of these devices would be a

mark of this youth, evidencing the role of each one as a producer of meanings about the world, something that should not be ignored/minimized by the school. The author concludes that, according to the norm, mobile devices tend to be conceived as a means at the service of technology-mediated education and as instruments at the service of overcoming educational problems.

From this scope, it is understood that each student demands and responds in a unique way to learning stimuli, and that the process of constructing and obtaining knowledge must be carried out actively. As a result, adaptive learning not only respects differences in pace and style among students, but also expands learning opportunities for those who face specific barriers. The flexibility of the model allows students with difficulties to revisit the content until they reach full understanding, while students with greater ease can advance faster, exploring additional challenges. This adaptability contributes to a more inclusive educational experience, reducing learning gaps and promoting greater equity in access to knowledge.

In addition, adaptive learning platforms, such as those offered by educational initiatives such as **Young Geniuses**, illustrate in practice how personalization can be integrated into everyday school life. These tools not only identify learning gaps but also offer real-time feedback, creating an interactive and collaborative environment. The presence of monitoring dashboards for teachers and school managers also allows for more informed pedagogical decision-making, reinforcing the connection between technology and educational planning. This ensures that the use of digital technologies goes beyond technical support, becoming a strategic resource to enhance learning.

Finally, the impact of adaptive learning transcends the school sphere, as it prepares students for the challenges of a society driven by technology and innovation. By encouraging autonomy, critical thinking, and problem-solving skills, this educational model aligns with the competencies required by the twenty-first century. The ethical and conscious use of technology, combined with a personalized approach, not only enriches the educational experience, but also contributes to forming more capable citizens, prepared to deal with the complexity and rapid transformations of the contemporary world. Thus, adaptive learning is consolidated as an essential educational strategy to integrate digital technologies into human development in a meaningful and transformative way.

## HOW DOES YOUNG GENIUSES MAKE ADAPTIVE LEARNING AVAILABLE?

For the development of effective student learning, the Young Geniuses platforms use the premises of adaptive learning as one of their main pillars, making use of artificial

intelligence algorithms to personalize the teaching-learning process and making it possible **to provide each student with a different** experience on the platform. Educators are provided with didactic strategies, including the main active methodologies, as well as engagement and learning indicators generated based on the activities carried out directly on the Jovens Gênios platform, among other resources.

The personalization of the learning process is implemented on two levels. At the level of the syllabus, it occurs through the recommendation of specific skills and topics; at the question level, it consists of suggesting the most appropriate question for the student to solve at a given time. These processes are based on scientific and pedagogical theories, such as Deep Knowledge Tracing (DKT) and Item Response Theory (IRT).

Through an advanced Deep Learning algorithm, known as Recurrent Neural Networks (RNNs), it is possible to achieve an accuracy of more than 80% in predicting students' correct answers, even in skills with which they have not yet interacted directly. This is made possible by the algorithm's ability to autonomously identify latent relationships between BNCC skills, including interdisciplinary connections.

A significant differential of the system is genuine interdisciplinarity. For example, when carrying out a Mathematics activity, the student can have their skills evaluated and updated in other subjects, such as Portuguese Language. This approach reduces the number of questions required to assess and measure the student's skill level, minimizing potential frustrations and increasing learning efficiency.

The main function of algorithms is to position the student within their Zone of Proximal Development (ZPD), according to Vygotsky's theory. In this context, the recommended contents are challenging enough to avoid monotony, but also feasible to solve with the appropriate effort, providing an ideal balance between difficulty and ability. This system not only improves accuracy in assessing students' skills, but also promotes a more personalized and efficient learning experience by aligning technology with sound pedagogical principles.

In this way, it becomes feasible to recommend the most appropriate learning path for each student, taking into account their specific pedagogical needs. This process promotes more efficient and engaging learning. A particularly relevant aspect is the possibility of monitoring, in real time, the evolution of student learning through the platform for educators.

Students' interest in the platform's recommendations and their motivation to carry out the activities are encouraged through the incorporation of gamification elements. The **Gamification Based Learning** methodology is a core component of the Young Geniuses approach, implemented through the **Octalysis** framework, developed by Yu-Kai Chou. This

framework designs experiences aimed at student engagement, based on eight theoretical-scientific pillars that cover areas such as neurobiology, motivational psychology, and user experience design (CHOU, 2019).

The personalization of the learning process, made possible by Item Response Theory (IRT) and Computerized Adaptive Testing (CAT), allows us to recommend the most appropriate learning path for the pedagogical needs of each student. This results in optimized learning and increased student engagement. One of the main differentials of this method is the possibility of following the student's evolution in real time, using algorithms that select the most appropriate questions based on their proficiency and performance, ensuring continuous and efficient progress.

IRT, which is the basis of most of these strategies, establishes that the probability of a student getting a question right depends directly on their level of mastery of the subject. This approach surpasses the Classical Test Theory (TCT), which evaluates performance based on the number of correct answers, without considering the difficulty of the questions or the coherence of the answers. In IRT, the difficulty of each item is not defined by the teacher, but by the student's own performance, which allows for more accurate and fair analyses. This model is widely used in large-scale assessments, such as the National High School Exam (ENEM), due to its ability to measure proficiency in a detailed and individualized way.

Among the benefits of IRT, the more accurate assessment of the student's abilities, the lower probability of random answers, the adaptation of the level of difficulty based on the student's performance and more robust and reliable results stand out. In addition, the combination of IRT and CAT significantly reduces the time required to perform evaluations, maintaining or even increasing the accuracy of the results. This prevents students from facing excessively difficult or easy questions, reducing emotional distress and increasing the effectiveness of the assessment. Educational platforms such as Jovens Gênios use this technology to offer more accurate learning diagnoses, promoting a more personalized and effective teaching experience.

The Machine Learning algorithms present in the Young Geniuses platform continuously learn from the millions of interactions made by students with different profiles. These algorithms allow the recommendation of content at the most appropriate time, ensuring that the student remains in his Zone of Proximal Development, as described by Vygotsky. This concept ensures that activities are challenging enough to engage, but not so difficult as to generate frustration. In addition, the adaptive learning path automatically

adjusts based on students' successes and mistakes, promoting dynamic and individualized learning.

In summary, the personalization promoted by artificial intelligence in learning platforms such as Young Geniuses allows each student's response and interaction to contribute to adjusting their learning path. This approach is deeply individualized and adaptive, automatically adjusting to the student's progress. The data generated in real time is also made available to teachers, enabling immediate interventions on the platform or in the classroom. In this way, the model not only transforms the teaching experience, but also enhances learning outcomes, aligning with contemporary educational demands.

## ADAPTIVE LEARNING COMBINED WITH GAMIFICATION

Adaptive learning combined with gamification represents a powerful combination of educational strategies that have revolutionized teaching, especially in digital environments. While adaptive learning uses advanced technology, such as artificial intelligence algorithms, to personalize each student's educational journey, gamification applies game elements in the educational context to promote engagement, motivation, and interactivity. Together, these approaches create a learning experience that is both effective, engaging, and aligned with the individual needs of students.

Adaptive learning automatically adjusts content, challenges, and activities based on the student's specific performance and needs. When associated with gamification, this personalization becomes even more attractive to students. Game elements such as levels, rewards, rankings, and goals encourage engagement by turning learning tasks into immersive and fun experiences. Gamification not only motivates students to keep learning, but it also creates a sense of healthy competition and personal fulfillment. For example, platforms such as Young Geniuses use gamified frameworks, such as Octalysis, which integrate motivational pillars based on neuroscience and behavioral psychology, significantly increasing student retention and performance.

In addition, the integration of adaptive learning with gamification allows students' progress to be continuously rewarded, reinforcing positive behavior and encouraging continuity in the learning process. As students progress, they will unlock new levels or receive visible rewards such as medals or points, generating a sense of accomplishment that encourages persistence. This also promotes a more positive relationship with learning, especially in students who may initially have demotivation or difficulties with specific content.

Finally, the synergy between adaptive learning and gamification benefits not only students but also educators, who receive real-time data on student performance. This information allows for targeted and strategic interventions, maximizing the impact of teaching. By creating educational environments that are both personalized and fun, this combination has the potential to transform education, preparing students for future challenges while maintaining a focus on their well-being and integral development.

The Young Geniuses **platform** exemplifies the effective integration between adaptive learning and gamification, aiming to transform the educational experience of students and educators. The approach allows the student to advance at their own pace, facing challenges appropriate to their abilities, which optimizes the learning process and reduces frustrations. To increase student motivation, Young Geniuses incorporates gamification elements into its methodology. Using the Octalysis framework, as mentioned earlier, the platform designs experiences that engage students through rewards, challenges, and immediate feedback. This strategy makes learning more interactive and fun, encouraging active student participation.

## RESULTS: LEARNING GAIN VIA YOUNG GENIUSES

Since its foundation, Young Geniuses has impacted more than 300 thousand students and has the recommendation of more than 700 partner educational institutions. The platform goes beyond the simple personalization of teaching, offering educators advanced tools to monitor, in real time, the progress of students, enabling more assertive and effective pedagogical interventions.

Young Geniuses clearly exemplifies how the integration between adaptive learning and gamification can transform the educational landscape. By providing a personalized and engaging teaching experience, the platform meets the individual demands of students and strengthens the pedagogical practices of educators, promoting innovation and excellence in the learning process.

Costa (2023) presents a study of Learning Gain using Young Geniuses. Learning gain via Young Geniuses refers to the significant impact the platform has on the evolution of students' skills and competencies, as measured by standardized educational metrics such as Item Response Theory (IRT). The platform uses advanced technologies, such as Machine Learning and Computerized Adaptive Testing (CAT), to offer a personalized and adaptive approach to teaching, promoting a continuous and effective progression in learning.

Student performance is monitored in real time using the IRT scale, which calculates student ability based on the difficulty of the questions and the coherence of their answers. The platform recommends content and questions aligned with the student's level of proficiency, ensuring that learning takes place in their Zone of Proximal Development (ZDP). In 2022, students who followed the platform's recommendations achieved, on average, a gain of 9.91 points on the TRI scale, exceeding the annual goal of 8.5 points expected to indicate a full school year of progress.

There is also a difference by level of engagement, in which the consistent use of Young Geniuses is a decisive factor for learning gain. Students with high engagement (performing 10 or more questions per week) demonstrated 4.25 times greater progress than those in the control group, who answered fewer than 100 questions in the year. In addition, 71.18% of highly engaged students achieved adequate or advanced learning, while the medium and control engagement groups were below this goal.

An impact is perceived by Proficiency Range, where among the most engaged students, 37.49% reached the advanced learning level, while only 4.31% showed insufficient performance. This reflects the effectiveness of the platform in supporting continuous development and reducing learning inequalities. Personalization allows students to progress at their own pace, respecting their individualities and promoting significant evolution.

The learning gain promoted by Young Geniuses goes beyond the acquisition of basic knowledge, being an indicator of the efficiency of innovative educational practices. It reflects not only academic progress, but also the platform's ability to adapt to varied school contexts, from public networks to private institutions. This integrated approach contributes to meeting national learning goals, such as those proposed by the Todos Pela Educação movement, and offers a scalable and efficient solution to improve the quality of education in Brazil.

## CONCLUSION

The results obtained by Jovens Gênios indicate a significant increase in student engagement, associated with a considerable improvement in proficiency in several disciplines. The platform shows that the use of technologies such as artificial intelligence, combined with gamification strategies, can transform the educational process. By creating an adaptive and personalized learning experience, Young Geniuses meets the specific needs of each student, providing challenges aligned with their abilities and learning paces. This model not only facilitates academic progress but also encourages the development of

essential skills for the twenty-first century, such as autonomy, critical thinking, and problem-solving.

In addition, the positive impact of the platform can be seen in the ability to create a more inclusive and accessible educational environment. By allowing each student to advance at their own pace, Young Geniuses promotes equity in the teaching process, reducing learning barriers and ensuring that everyone has access to resources tailored to their needs. Gamification plays a crucial role in this context, by engaging students in innovative and motivating ways. Playful elements encourage the continuity of learning and create a pleasurable experience, while artificial intelligence ensures that pedagogical paths are adjusted in real time, ensuring greater efficiency in the development of skills.

It is concluded that adaptive learning, exemplified by the approach of Young Geniuses, represents a promising innovation in contemporary education. By strategically integrating AI and gamification, the platform offers an effective solution to improve the quality of education, promoting significant educational outcomes in diverse contexts, including public and private schools. This methodology has the potential to democratize access to quality learning, reducing educational gaps and meeting the demands of a globalized society. Thus, Jovens Gênios consolidates itself as a reference model in the use of educational technologies, pointing out ways for a more equitable and efficient education.

## REFERENCES


1. Chou, Y. K. (2019). *The Octalysis framework*. Octalysis: Complete gamification framework. https://yukaichou.com/gamification-examples/octalysis-complete-gamification-framework/

2. Coll, C., & Monereo, C. (2010). Educação e aprendizagem no século XXI, novas ferramentas, novos cenários, novas finalidades. In C. Coll & C. Monereo (Eds.), *Psicologia da educação virtual: Aprender e ensinar com as tecnologias da informação e da comunicação* (pp. 15–46). Porto Alegre, RS: Artmed.

3. Cortelazzo, I. B. C. (1998). Tecnologia, comunicação e educação: A tríade do século XXI. *S & TM Revista de Ciência e Tecnologia, Anais do I Congresso Internacional sobre Comunicação e Educação, 1*(2).

4. Costa, F. (2023). *Ganho de aprendizagem com o uso da Jovens Gênios*. [Publisher not specified].

5. Costa, M. V. (2005). Quem são, que querem, que fazer com eles? Eis que chegam às nossas escolas as crianças e jovens do século XXI. In A. F. Moreira, R. L. Garcia, & M. P. Alves (Eds.), *Currículo, cotidiano e tecnologia*. Rio de Janeiro, RJ: DP&A.

6. Couto, E. S. (2013). A infância e o brincar na cultura digital. *Perspectiva, 31*(3), 897–916.

7. Ferreira, L. M. da C. (2018). *As tecnologias na formação das (os) futuras(os) professoras(es) em um instituto de educação no estado do Rio de Janeiro/BR* [Dissertação de mestrado, Instituto de Educação]. Rio de Janeiro, RJ.

8. Lévy, P. (1993). *As tecnologias da inteligência: O futuro do pensamento na era da informática*. Rio de Janeiro, RJ: Editora 34.

9. Lima Jr., A. S. (2004). Tecnologias intelectuais e educação: Explicitando o princípio proposicional/hipertextual como metáfora para a educação e o currículo. *Revista Faeeba, 13*, 401–416.

10. Rosário, R. S. L. (2013). *Produção cultural do currículo e a sala de aula Revoluti: Entre tensões e negociações* [Dissertação de mestrado, Faculdade de Educação da Baixada Fluminense]. Universidade do Estado do Rio de Janeiro, Duque de Caxias, RJ.

11. Soler Costa, R., Tan, Q., Pivot, F., Zhang, X., & Wang, H. (2021). Aprendizagem personalizada e adaptativa: Prática educativa e impacto tecnológico. *Texto Livre, 14*(3), e33445. https://doi.org/10.35699/1983-3652.2021.33445