

GAMIFICATION AND AI-PERSONALIZED LEARNING PATHWAYS: REDEFINING STUDENT MOTIVATION AND ACADEMIC SUCCESS IN EBONYI STATE, NIGERIA

By

Ukamaka Maduagu

Department of Educational Foundations

Abstract

Gamification and artificial intelligence (AI) have become a disruptive solution in education to boost the student motivation and achievement, especially in resource-deprived areas such as Ebonyi State in Nigeria. This paper examines how the combination of gamified figures, including points, badges, and leaderboard, used with AI-programmed customized learning pathways can transform the nature of education in secondary school students. The study which will utilize both a quantitative and a qualitative approach to examine the interaction on motivation, engagement and performance in computer education subjects is based on a mixed-method design relying on a primary data sample of 300 students in secondary schools in Ebonyi State including public and private. The results indicate that learners who were subjected to gamified AI systems were found to be more motivated by 25 percent and academically developed by 18 percent, as opposed to the conventional practices. The effects of demographic analysis show that female students in the rural region had more advantages and the level of motivation increased by 32 percent. The disadvantages identified in the study include the insufficient internet response and educator training, and as advice, guidelines on the interventions of policy-wide use are suggested. It has theoretical foundation, namely, Self-Determination Theory which underlines autonomy, competence and relatedness in the learning process. The article adds to the discussion of technology-enhanced learning in developing environments and underlines how gamification and AI may address educational disparities and promote equal academic achievement.

Keywords: gamification, AI-personalized learning, student motivation, academic success, Ebonyi State, Nigeria, computer education

Introduction

The combination of gamification and artificial intelligence (AI) in the dynamic educational environment is a pivot of a new reality in the context of more participatory and tailored learning. As a trend that can be described as the practice of utilizing the elements of the game outside of the game, gamification has gained acknowledgment as an activity that can be used to enhance motivation and engagement in the learning environment (Deterding et al., 2011). Combined with AI, which allows customizing and shaping the learning process, this method has a certain potential in overcoming long-standing issues in student engagement and academic success, particularly in underdeveloped countries such as Nigeria.

Ebonyi state that is situated in the southeastern part of Nigeria is an example of most of the challenges to education encountered by the sub-Saharan African nations. The state was founded in 1996 and it has a population of about 2.9 million people with the literacy level of 69.8 and

91.9 percent of adults and youth respectively as of 2010 (National Bureau of Statistics, 2010). Ebonyi State is endowed with a blend of both government and non-government schools with the secondary schools being the most important portals to education and economic prospects. Nevertheless, problems like classroom congestions, poor infrastructure and lack of motivation in teachers lead to poor performance by the students. As an example, student achievement in junior secondary school certificate in basic science subjects has been reported to be discouraging with a large number of them being below the national standards (Odoemelam & Okoro, 2015). Students have a tendency to lack motivation in the field of computer learning which has become very essential in the digital era because of abstract concepts and low access to technology.

The history of the current research is connected with the world tendency to digitalization in the education sector and its increase brought by the COVID-19 pandemic that revealed the necessity of new solutions to support learning (UNESCO, 2020). Some policies such as National Policy on Education are being initiated in Nigeria to promote integration of information and communication technology (ICT) to improve teaching and learning (Federal Republic of Nigeria, 2013). However, in Ebonyi State, the implementation is unequal, with the rural regions being left behind by the urban ones. Researchers have indicated that socioeconomic backgrounds and the level of education and family income have a strong correlation with student achievement in the state (Anyanwu and Odo, 2018). Besides, there are still gender inequalities, and female students have other challenges, including cultural demands and resource inaccessibility (Hunduma, 2023).

The problem statement focuses on the decreasing student motivation and achievements in computer education in Ebonyi State. Historical pedagogical approaches which focused on rote learning and prescribed learning curriculums do not embrace many styles of learning, thus disengaging and leaving the learners in large numbers. Ebonyi State national assessments show that the proportion of Primary 3 students affecting reading on the level of Primary 2 students in English is only 28%. The gaps in the foundational literacy context are reflected in the technical subjects (RISE Programme, 2023). Motivation is also compromised in the case of computer education, in which skills such as programming and digital literacy are critical, as there are no interactive features. According to existing literature, gamification can be used to improve the intrinsic motivation (Hamari et al., 2014), whereas the needs of individuals are met using AI personalization (Zeng et al., 2024). Nonetheless, in Nigeria, more specifically, in Ebonyi State, there is a shortage of local research involving the combination of such technologies.

There is current literature that justifies the effectiveness of gamification in learning. This was based on early researches that identified challenges and feedbacks as elements of games that encourage learning through a sense of competition and accomplishment (Kapp, 2012). Later meta-analyses also affirm beneficial effects on academic performance and a thorough review of studies published between 2008 and 2023 has provided moderate effect sizes on engagement (Zeng, 2024). Gamification is also associated with better retention in an e-learning setting in higher education (Rodrigues et al., 2023). In the case of AI-personalized learning, the consideration of Artificial Intelligence (AI) platforms such as Code.org has been reported to improve achievement and motivation at the level of computer science in Nigeria, including Abuja Municipal Area (Adeyemi and Ojo, 2024). Adaptive systems driven by AI have been

demonstrated to be able to customize content according to real-time performance to achieve improved results internationally (Chen et al., 2021). Earlier studies in the literature, such as Skinner (1958) on operant conditioning, carry an underlying implications of reward-based learning, which is in line with the game mechanics of gamification.

This integration is further brought out through theoretical frameworks. Self-Determination Theory (SDT) introduced by Deci and Ryan (1985) argues that motivation breeds well in case the individual needs individualism, competence and associatedness. Competence is met through badges and levels in gamification and Autonomy through the introduction of AI personalization so that the student runs at his/her own pace. Recent advancements, including the Integrated Gamification-AI Learning Theory (IGALT), combine these factors in order to develop the skills of the 21st century (Roopaei and Roopaei, 2024). These frameworks ought to take into consideration cultural aspects in the Nigerian context based on studies on parental motivating influence on academic performance (Eze & Ugwu, 2022).

The purpose of this study is to explore the impacts of gamification and AI-individualized paths towards defining motivation and achievement in computer education in Ebonyi State. It tries to combine theoretical assumptions with practical facts in order to give practical advice to teachers and policymakers.

The history of gamification in education has a long evolution as far back as behavioral psychology up until the recent digitalized field. The initial viewpoints on games thought about them as means of reinforcement, based on the law of effect in which Thorndike (1911) found that rewards reinforced behaviors. Malone (1981) recognized challenge, fantasy, and curiosity as the main motivators in the educational games in the 1980s. In the 2010s, gamification has become a kind of movement, with Deterding et al. (2011) describing it as the application of game mechanisms such as points and leaderboards to non-games to improve user experience.

Empirical research has been inconclusive, but has an overall positive impact. Sailer et al. (2017) conducted a meta-analysis that reported that badges and leaderboards caused motivation, but effects depended on context. However, Zimmerling et al. (2019) found better learning with gamified methods in science education. Current reviews like that of Bai et al. (2020) pool more than 100 studies and indicate that gamification increases engagement during online studies, especially in case of pandemics. Landers et al. (2019) found that goal-setting theory led to better performance related to gamification in higher education.

In case of AI in education, the outcome is on individualized focus. The first AI systems such as intelligent tutoring systems of the 1970s (Carbonell, 1970) were responsive. The current AI is based on machine learning to generate dynamic routes, such as adaptive platforms, such as DreamBox or Khan Academy (VanLehn, 2011). According to a systematic review of literature on the topic by Chen et al. (2021) AI is useful in fulfilling various needs, and personalized

content yields retention rates of 15-20. In the developing world, AI reduces resource scarcity; in India, Math scores were improved due to AI tutors (Muralidharan et al., 2019).

The merger between the gamification and AI is a developing field. Roopaei and Roopaei (2024) suggest an AI-based game-based Interactive Greasier Assistant to Anger, which is referred to as IGALT. As it has been demonstrated, this synergy facilitates critical thinking (IEEE, 2024). There is also a restricted literature on the topic in African countries, yet Nigerian research suggests that AI personalization can enhance interaction in a multilingual environment (Ariyo, 2024). The local literature on motivation in Ebonyi State focuses on the example of parents and teachers (Nwafor and Onyia, 2021), which implies that gamified AI may help to supplement them.

The literature gaps are context-specific applications of rural Nigeria and long-term effects. This paper will be dealing with this by referring to the case of Ebonyi State.

Theoretical Framework

The presented research is based on Self-Determination Theory (SDT) (Deci and Ryan, 1985) that underlies motivation with references to the factor of intrinsic and extrinsic motivation. The three pillars of SDT (autonomy (self-directed learning), competence (mastery experiences), and relatedness (social connections)) correspond to gamification and AI. Competence is achieved through gamification with rewards and challenges and through AI autonomy is maintained through adaptive paths. Collaborative factors such as leaderboards are connected to relatedness.

In addition to SDT, there is Flow Theory (Csikszentmihalyi, 1990) in which challenges are set at the relevant skills- met by AI modification. Behaviourism also provides reward systems that have been included in the framework (Skinner, 1958). Technology Acceptance Model (Davis, 1989) is a predictive model in educational technology that can be applied to Nigerian contexts in which tech access is different.

This combined system informs the hypothesis that the ability of gamified AI pathways to increase motivation and success can be achieved through psychological needs satisfaction.

Methodology

This paper utilized a quasi-experimental mixed-method design that could be applied to assess the effects of gamification and AI-personalized learning on student motivation and academic performance. The design involved pre- and post-intervention observation that incorporated quantitative survey and qualitative interview to have a detailed insight. Gamified AI interventions were applied to the experimental and the traditional methods were used in the control group. The latter technique is typical of computer education studies (e.g., Adeyemi & Ojo, 2024).

The sample included secondary schoolchildren of Ebonyi State, which made a total of about 59,976 in the 2020/2021 session (Ebonyi State Ministry of Education, 2021). Stratified random

sampling method was used to choose 300 students in 10 schools (5 urban-public and 5 urban-private) in urban and rural areas (Abakaliki). The formula used in determining the sample size was established by Yamane (1967) formula, and it allowed a 95% confidence level.

Demographic factors: The respondents were 52/48% males and females between the ages of 14-18 (Mean Age 16.2 years). 60 per cent rural students and 40 per cent urban students. There was also differences in socioeconomic background with 45 percent being of low income households(annual income less than N500,000). The population was composed majorly of Igbo (85%), others were minority groups. Parent education: 35 percent were obtained secondary education, 20 percent tertiary, 45 percent primary or below.

Primary data was collected with the help of a validated questionnaire on motivation (based on Intrinsic Motivation Inventory, Ryan, 1982) and tests of academic achievement in computer education (including programming basics, digital literacy). Reliability: The alpha of the motivation scale = 0.87. Artificial intelligence utilized was a modified open source application that was simulating the Khan Academy with gamification features (badges, points). Qualitative data were given through interviews on 30 students.

The duration of intervention was 8 weeks: Pre-tests (Week 1-2); Gamified AI sessions (3x a week, 45 minutes, Week 3-6); post-tests (Week 7-8). Ebonyi State University Institutional Review Board ethics. Informed consent obtained.

Data analyzed in SPSS: Paired t-tests of the differences in pre and post, ANOVA of the differences in demographics. NVivo coded qualitative themes available in ResultsTable 1 below demonstrates demographics.

Table 1
Demographic Profile of Participants

Variable	Category	Frequency	Percentage
Gender	Male	156	52%
	Female	144	48%
Age	14-15	120	40%
	16-17	135	45%
	18	45	15%
Location	Rural	180	60%
	Urban	120	40%
SES	Low	135	45%
	Medium	120	40%
	High	45	15%

The incidence of motivation was also improved ($t(299) = 8.45, p < .001$), with means of 3.2 changing to 4.0 on a 5-point scale. There was also an increase of academic achievement by 18 percent(pre- mean 55, post-mean 65).Table 2 indicates comparisons across groups.

Table 2

Pre- and Post-Intervention Scores

Group	Motivation Pre	Motivation Post	Achievement Pre	Achievement Post
Experimental	3.1	4.1	52%	70%
Control	3.3	3.4	58%	60%

The greatest improvement was seen in the rural females (32% increase in motivation). The themes in qualitative data were the fun learning and personal progress.

Conclusion

Findings are consistent with the literature: gamification positively affects motivation (Hamari et al., 2014), AI personalization positively affects achievement (Chen et al., 2021). The findings in Ebonyi showed the impact to be increased by demographic elements such as rurality in line with Anya and Odo (2018). Difficulties involve infrastructure as well as UNESCO (2020).

Motivation and success are redefined through gamification and AI-based personalized pathways in the computer education of Ebonyi State, which are empirically proven to be efficient. The policymakers ought to make investments in AI infrastructure and education of teachers. Gamified platforms are implemented in schools. Subsequent longitudinal effects studies.

References

- Adeyemi, O., & Ojo, A. (2024). Impact of AI-powered personalized learning platforms on academic achievement and motivation of computer science students. *Global Academic Journal of Humanities and Social Sciences*, 6(5), 203-209.
- Anya, A. O., & Odo, I. J. (2018). Socio-demographic determinants of social studies knowledge among students. *International Journal of Development Research*, 10(12), 18027-18035.
- Bai, S., Hew, K. F., & Huang, B. (2020). Does gamification improve student learning outcome? Evidence from a meta-analysis and synthesis of qualitative data in educational contexts. *Educational Research Review*, 30, 100322.
- Carbonell, J. R. (1970). AI in CAI: An artificial-intelligence approach to computer-assisted instruction. *IEEE Transactions on Man-Machine Systems*, 11(4), 190-202.
- Chen, L., Chen, P., & Lin, Z. (2021). Artificial intelligence in education: A review. *IEEE Access*, 8, 75264-75278.
- Csikszentmihalyi, M. (1990). *Flow: The psychology of optimal experience*. Harper & Row.
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319-340.

- Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. Plenum.
- Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). From game design elements to gamefulness: Defining gamification. *Proceedings of the 15th International Academic MindTrek Conference*, 9-15.
- Ebonyi State Ministry of Education. (2021). *Annual education report*.
- Eze, T. I., & Ugwu, C. N. (2022). Parental motivation and students' academic achievement in social studies. *Ebonyi Journal of Educational Research*, 1(1), 58-65.
- Federal Republic of Nigeria. (2013). *National policy on education* (6th ed.).
- Hamari, J., Koivisto, J., & Sarsa, H. (2014). Does gamification work? A literature review of empirical studies on gamification. *2014 47th Hawaii International Conference on System Sciences*, 3025-3034.
- Hunduma, T. (2023). Behavioral and relationship influences on academic outcomes among female students. *Journal of Research in International and Intercultural Education*, 9(4), 1-10.
- Kapp, K. M. (2012). *The gamification of learning and instruction: Game-based methods and strategies for training and education*. Pfeiffer.
- Landers, R. N., Bauer, K. N., & Callan, R. C. (2019). Gamification of task performance with leaderboards: A goal setting experiment. *Computers in Human Behavior*, 71, 508-515.
- Malone, T. W. (1981). Toward a theory of intrinsically motivating instruction. *Cognitive Science*, 5(4), 333-369.
- Muralidharan, K., Singh, A., & Ganimian, A. J. (2019). Disrupting education? Experimental evidence on technology-aided instruction in India. *American Economic Review*, 109(4), 1426-1460.
- National Bureau of Statistics. (2010). *Nigeria literacy survey*.
- Nwafor, C. E., & Onyia, M. N. (2021). Relationship between motivation and job satisfaction of teachers. *Middle-East Journal of Scientific Research*, 24(12), 1-8.
- Odoemela, L. E., & Okoro, C. O. (2015). Comparative study of students' academic performance in basic science. *Global Academic Group Journal.RISE Programme*. (2023). *Measuring learning in Nigeria*.
- Rodrigues, L., Palomino, P. T., Toda, A. M., Klock, A. C., Pessoa, M., Pereira, F. D., Oliveira, E. H., Oliveira, D. B., Cristea, A. I., Isotani, S., & Carvalho, L. S. (2023). Gamification of e-learning in higher education: A systematic literature review. *Smart Learning Environments*, 10(1), 1-25.
- Roopaei, M., & Roopaei, M. (2024). Gamification and artificial intelligence in education: A review of innovative approaches. *IEEE Xplore*.
- Ryan, R. M. (1982). Control and information in the intrapersonal sphere: An extension of cognitive evaluation theory. *Journal of Personality and Social Psychology*, 43(3), 450-461.
- Sailer, M., Hense, J. U., Mayr, S. K., & Mandl, H. (2017). How gamification motivates: An experimental study of the effects of specific game design elements on psychological need satisfaction. *Computers in Human Behavior*, 69, 371-380.

- Skinner, B. F. (1958). Reinforcement today. *American Psychologist*, 13(3), 94-99.
- Thorndike, E. L. (1911). *Animal intelligence: Experimental studies*. Macmillan.UNESCO. (2020). *Education in a post-COVID world*.
- VanLehn, K. (2011). The relative effectiveness of human tutoring, intelligent tutoring systems, and other tutoring systems. *Educational Psychologist*, 46(4), 197-221.
- Yamane, T. (1967). *Statistics: An introductory analysis* (2nd ed.). Harper & Row.
- Zeng, J., Parks, S., & Shang, J. (2024). Exploring the impact of gamification on students' academic performance: A comprehensive meta-analysis. *British Journal of Educational Technology*, 55(3), 1-20.
- Zimmerling, E., Höflich, P., Sandner, P. G., & Welp, I. M. (2019). Exploring the impact of gamification on motivation and engagement in an enterprise collaboration system. *Hawaii International Conference on System Sciences*.