

The Influence of an Adaptive Non-Formal Education Model on Student Learning Activity and Engagement

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Abstract: In the context of ongoing digitalization and the growing importance of non-formal education in Kazakhstan's higher education system, there is an increasing demand for adaptive educational models that address students' individual learning needs and broaden the scope of academic engagement. This study examines the effects of an adaptive non-formal education model on students' learning activity and engagement, and identifies the model components with the most significant impact. A quantitative quasi-experimental design was employed, involving pre- and post-intervention assessments using validated questionnaires. Key indicators included participation in supplementary educational activities, online learning platforms, external courses, and project-based or volunteer initiatives. The results indicate a statistically significant improvement in students' educational involvement in the experimental group, as demonstrated by increased participation in external learning events, greater self-directed learning, and the development of

personalized educational trajectories. The study highlights the potential of adaptive non-formal education as a strategic tool to enhance institutional flexibility and student motivation. Its novelty lies in testing a context-sensitive adaptive non-formal education model tailored to Kazakhstan's institutional realities. The findings contribute to the global discourse on flexible education strategies and suggest directions for scaling and integrating the model into digital academic ecosystems.

Index Terms: Adaptive Model, Educational Activity, Higher Education, Non-Formal Education, Student Involvement

1. Introduction

Non-formal education (NFE) is gaining increasing significance both globally and in Kazakhstan due to the shift towards a knowledge-based society and the growing relevance of lifelong learning initiatives [1]. One of the main advantages of NFE is its inherent flexibility, which allows it to adapt to ongoing social, technological, and economic changes. This adaptability is enhanced through active methods of knowledge acquisition and transfer, such as learning-by-doing, teamwork, and intercultural learning [2]. These methods help students better prepare for real-world market demands, thereby increasing their competitiveness in the labor force.

In recent years, the concept and application of non-formal education have expanded considerably. Researchers now view NFE not only as a supplement to formal education but as a broader educational system encompassing professionally oriented and general cultural training, additional education programs, and personalized learning pathways [3]. As a more flexible and learner-centered approach, NFE responds to modern professional training needs and helps develop students' socio-cultural, motivational, communicative, cognitive, and creative capacities [4, 5].

The non-formal educational environment is shaped through personalized learning routes that require multi-positional roles from teachers and a high degree of autonomy from students [6]. Despite its potential, significant disparities in administrative practices, digital infrastructure, and institutional readiness hinder the standardized implementation of NFE across university systems [7-9]. There remains a gap between the opportunities offered by external educational platforms (e.g., MOOCs, internships, volunteering) and the universities' capacity to integrate and support these opportunities within existing frameworks.

In Kazakhstan, the need for flexible educational models has grown in the context of ongoing digitalization and higher education reform [10]. NFE is increasingly seen as a means of extending the learning process beyond formal academic boundaries. However, the integration of NFE into higher education practice remains fragmented, and the principles and tools for its assessment are still underdeveloped compared to those in more mature educational systems.

Moreover, no adaptive NFE models have been empirically tested in Kazakhstan that reflects local institutional characteristics. Quantitative data on how such models influence students' learning activity, engagement, and self-organization are lacking [11-13]. As such, this study seeks to address both theoretical and practical gaps in the strategic development of NFE in higher education.

The novelty of this research lies in the development and empirical testing of an adaptive non-formal education model based on systemic interaction among the student, the university, and the external learning environment. Unlike existing models that often isolate learner autonomy or platform-centered flexibility, this model integrates formal and non-formal settings through a triadic interaction framework. It also incorporates co-regulation mechanisms and a feedback-driven digital environment tailored to Kazakhstan's educational context. The model has strong practical implications for enhancing student engagement, personalizing educational trajectories, and informing policy development in higher education.

1.1. Research questions

1. How does an adaptive model of NFE, based on interaction among the student, the university, and the external educational environment, influence students' educational activity and engagement? Which components of the model exert the most significant influence?

1.2. Purpose of the study

The purpose of this study is to assess the impact of an adaptive non-formal education model on student engagement and learning activity in higher education. Specifically, it aims to identify which components of the model—student-centered learning strategies, institutional support, and the integration of external educational opportunities—most significantly contribute to improved academic performance, self-regulation, and learner autonomy.

2. Theoretical Framework

2.1. The concept and characteristics of NFE

Non-formal education refers to structured and purposeful learning that occurs outside the boundaries of formal and

supplementary education systems [14, 15]. Its primary distinction lies in its accessibility to all individuals, regardless of age, gender, or educational background. NFE involves organized educational activities designed to meet the specific learning needs of individuals and the broader priorities of societal development. Unlike formal education, NFE is characterized by high flexibility in its content, delivery methods, and instructional approaches. It often includes creative, participatory methods that empower learners to pursue goals aligned with personal and professional development. Due to its decentralized and modular nature, NFE may consist of diverse and sometimes even contradictory components, forming a mosaic of opportunities that can be tailored to individual trajectories. Implementing non-formal learning strategies requires an educational paradigm shift that embraces innovation in content, formats, technologies, and organizational structures [16, 17].

2.2. The relationship between formal, non-formal and informal education

The integration of formal, non-formal, and informal learning is central to the modern lifelong learning paradigm [18-22]. Together, these three forms of education support the holistic development of individuals and enable them to shape personalized educational and professional pathways. Formal education typically refers to structured, institutionalized learning that follows standardized curricula and leads to recognized qualifications. It is delivered by certified professionals in officially accredited settings [23]. Non-formal education, while often complementing formal systems, remains distinct in its adaptability and learner-driven orientation [24, 25]. Unlike formal education, it operates outside centralized regulations and caters to specific community or individual needs. [26]. Informal education, on the other hand, encompasses unstructured learning experiences that occur in daily life—through media, interactions, work, or personal exploration. Though lacking formal recognition, informal learning fosters the cultural and cognitive development of individuals and plays a crucial role in addressing self-development and professional burnout [27-30].

2.3. Adaptability as a pedagogical category

Adaptability in education is defined as the system's capacity to respond to students' individual characteristics, learning needs, and life circumstances [31]. Adaptive learning environments are built on flexible curriculum design, personalized teaching methods, and the use of digital tools that enable continuous feedback and learner support [32]. In today's rapidly evolving educational landscape, adaptability is no longer a peripheral attribute—it is a core competency for both learners and institutions. Adaptive educational systems are capable of adjusting pace, content, and learning formats based on individual profiles and progress trajectories [33]. These models emphasize differentiated instruction, learner autonomy, and contextual responsiveness, making them especially relevant in the era of digital and hybrid education.

2.4. Adaptive model of non-formal education

Synthesizing the above theoretical insights, the proposed adaptive model of non-formal education integrates individualization, multimodal instruction, and responsiveness to the external environment. It is built around a triadic structure comprising the student, the university, and the external educational environment (see Figure 1).

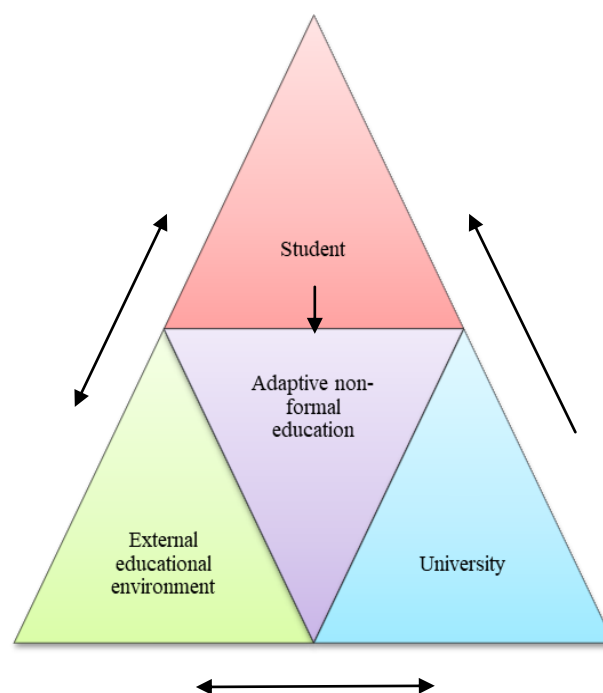


Fig. 1. Adaptive model of NFE

Key components of the model:

Student — positioned at the center of the model, the student is viewed as an active agent in their own educational development. The model responds to individual needs, motivations, and interests, fostering critical thinking, creativity, self-organization, and autonomy.

University — provides a formal academic foundation, offering not only curricular content but also institutional support for integrating non-formal educational practices. This includes mentoring, extracurricular activities, and ongoing assessment.

External educational environment — encompasses online platforms, professional networks, internships, workshops, and community projects. It enhances opportunities for independent learning, real-world skill development, and lifelong learning competencies.

This triadic structure enables the formation of personalized learning trajectories while improving student motivation, academic self-regulation, and engagement in diverse learning settings—particularly in the context of digital transformation and the growing demand for transferable 21st-century skills.

The conceptual alignment between the model's components and the measured constructs is presented in Table 1.

Table 1. Conceptual Mapping of the Adaptive NFE model

Model component	Description	Related scale in questionnaire
Student	Internal learner attributes: intrinsic motivation, self-regulation, goal orientation.	Learning motivation - self-regulation & time management
University	Institutional academic support: teacher involvement, academic opportunities, formal engagement.	Academic engagement
External educational environment	Non-formal learning spaces: MOOCs, webinars, internships, etc.	Adaptive NFE
Adaptive NFE	Central integrative construct describing how students combine internal and external resources to enhance learning.	All four scales (composite construct)

3. Method

This study employed a quantitative quasi-experimental research design involving an experimental group (EG) and a control group (CG) [34]. The experimental group participated in a structured NFE program based on the proposed adaptive model, while the control group continued with the standard curriculum without additional interventions. Data collection was organized across three stages: (1) a pre-test to establish baseline data; (2) an intervention period for the EG only; and (3) a post-test followed by comparative statistical analysis of both groups. This design enabled the identification of causal relationships between the implementation of the adaptive NFE model and changes in student engagement and academic activity.

3.1. Sample Size

The study was conducted at D. Serikbayev East Kazakhstan Technical University. After receiving institutional approval, invitation letters were distributed to eligible students who met the following inclusion criteria: (1) currently enrolled in a full-time undergraduate program; (2) willing to provide informed consent and complete the survey voluntarily. Initially, 440 students responded. After data screening for completeness and quality, 410 responses were retained for analysis. Stratified random sampling was applied to ensure demographic and academic diversity across year levels and faculties. Both EG and CG were balanced in terms of gender, academic background, and study program. Faculty assignments were also aligned to avoid instructor-related bias. No external interventions occurred during the study period apart from the experimental implementation. Table 2 presents the sample characteristics, including distribution by group, gender, and year of study.

Table 2. Sample Distribution and Demographic Characteristics

Characteristic	Category	Frequency (n)	Percentage (%)	Mean $\pm$ SD
Experimental group	EG	205	50.0	-
Control group	CG	205	50.0	-
Gender	Male	250	61.0	-
	Female	160	39.0	-
Year of study	1st year	110	26.8	Age: 18.2 $\pm$ 0.5
	2nd year	105	25.6	Age: 19.3 $\pm$ 0.6
	3rd year	95	23.2	Age: 20.4 $\pm$ 0.7
	4th year	100	24.4	Age: 21.5 $\pm$ 0.8
	All years	410	100.0	Age: 19.8 $\pm$ 1.2
				Course: 2.45 $\pm$ 1.13
Mode of study	Full-time	410	100.0	-
	Part-time	0	0.0	-

3.2. Measures

A structured questionnaire was developed to measure four latent constructs across 27 items using a 5-point Likert scale (see Appendix A). Internal consistency was evaluated using Cronbach's alpha (see Table 3). All subscales demonstrated acceptable to high reliability, with total scale $\alpha = 0.91$.

Table 3. Internal Consistency Reliability of the Survey

Scale	Number of items	Cronbach's α
Learning motivation	8	0.87
Academic engagement	7	0.84
Self-regulation and time management	6	0.81
Adaptive NFE	6	0.79
Total scale	27	0.91

Note: Items 1–8 correspond to learning motivation; 9–15 to academic engagement; 16–21 to self-regulation and time management; 22–27 to adaptive NFE

Content validity was established through expert review by five specialists in higher education and pedagogical innovation. Items were revised based on their feedback to improve clarity, alignment with theoretical constructs, and representativeness of the model's components.

3.3. Procedure

The research took place from March to May 2024 in a natural classroom setting. Participation was voluntary, and all respondents provided informed consent. The experimental group engaged in an 8-week adaptive NFE program, while the control group followed the regular curriculum. Data were collected through pre- and post-intervention surveys administered both in paper and digital formats, using unique anonymous codes to match responses over time.

3.4. Implementation of the adaptive model in the EG

The experimental group underwent an 8-week intervention consisting of weekly sessions totaling 32 academic hours. Each session focused on developing specific cognitive, self-regulatory, and motivational competencies through a variety of instructional formats, including workshops, masterclasses, case studies, and project-based learning. Sessions were supported by digital modules and gamified tools that enabled real-time feedback. Weekly self-assessment checklists allowed participants to reflect on their progress. The detailed weekly structure of the intervention is outlined in Table 4.

Table 4. Week Subject and Content of Intervention Classes

Week	Session focus and learning objective	Instructional format	Contact hours (per week)
1	Introduction to the program: setting learning goals and cultivating motivation for academic growth	Interactive lecture and guided discussion	4
2	Developing self-organization and time-management skills	Experiential workshop	4
3	Exploring digital tools and platforms for autonomous learning	Master class	4
4	Enhancing communication and academic presentation skills	Practical session	4
5	Collaborative problem-solving and teamwork through case-based tasks	Group-based learning activity	4
6	Project planning and implementation: from idea to execution	Project-based learning session	4
7	Reflecting on personal learning strategies and outcomes	Structured reflection and peer dialogue	4
8	Final session: synthesis, feedback, and planning for continued engagement with NFE	Round-table discussion	4

3.5. Data Collection

Data Collection Format:

Surveys were administered in classroom settings and completed anonymously. Trained research assistants ensured clarity of instructions and responded to participants' questions. The estimated completion time per survey was 20–25 minute. Consistency in the data collection environment minimized external variability, contributing to the reliability of the results.

3.6. Data Analysis

Data were analyzed using SPSS Statistics v.26. Descriptive statistics were calculated for all variables. Normality was assessed using Shapiro–Wilk and Kolmogorov–Smirnov tests. Intergroup comparisons were conducted using independent samples t-tests. To control for baseline differences, ANCOVA was performed with pre-test academic scores as covariates. Tests confirmed comparability of groups at baseline ($p > 0.05$), justifying the use of ANCOVA for post-test comparisons.

4. Results and Discussion

Descriptive statistics for all key variables across the EG and CG are presented Table 5.

Table 5. Descriptive Statistics of Variables by Group

Variable	Group	M	SD	SEM	Min	Max
Age (years)	CG	19.6	1.3	0.09	18	23
	EG	19.7	1.2	0.08	18	23
Academic score before intervention	CG	68.2	10.5	0.73	40	90
	EG	67.9	10.2	0.71	42	91
Academic score after intervention	CG	69.0	11.0	0.77	38	92
	EG	74.5	9.8	0.68	50	95
Learning motivation	CG	3.6	0.8	0.06	1	5
	EG	3.8	0.7	0.05	2	5
Academic engagement	CG	3.5	0.7	0.05	1	5
	EG	3.9	0.6	0.04	2	5
Self-organization and time management	CG	3.3	0.8	0.06	1	5
	EG	3.8	0.7	0.05	1	5
Adaptive NFE	CG	3.2	0.9	0.06	1	5
	EG	3.7	0.8	0.06	1	5

The groups were comparable in age ($M \approx 19.6 - 19.7$ years) and pre-intervention academic performance, confirming baseline equivalence. Post-intervention results demonstrated a notable improvement in academic outcomes for the EG ($M = 74.5$, $SD = 9.8$) compared to the CG ($M = 69.0$, $SD = 11.0$). Similarly, higher mean scores were observed in the EG across learning motivation, academic engagement, self-regulation, and adaptive NFE indicators.

Table 6 displays the results of the Shapiro–Wilk and Kolmogorov–Smirnov tests. All p-values exceeded 0.05, confirming the assumption of normality across variables and validating the use of parametric statistical tests.

Table 6. Tests of Normality for Key Variables (Shapiro–Wilk and Kolmogorov–Smirnov)

Variable	Shapiro–Wilk (p)	Kolmogorov–Smirnov (p)
Age	0.078	0.092
Academic score before intervention	0.101	0.121
Academic score after intervention	0.085	0.110
Learning motivation	0.051	0.060
Academic engagement	0.070	0.082
Self-organization and time management	0.095	0.088
Adaptive NFE	0.048	0.055

Independent samples t-tests (see Table 7) revealed statistically significant differences across all key variables, with moderate effect sizes. The largest effects were observed in: self-organization and time management (Cohen's $d = 0.665$), academic engagement ($d = 0.614$), adaptive NFE ($d = 0.587$), indicating strong impacts of the adaptive model on student behavior.

Table 7. Independent Samples t-Test results for CG vs. EG

Variable	<i>t</i>	<i>p</i>	Cohen's <i>d</i>
Academic score after intervention	-5.345	<0.001	0.528
Learning motivation	-2.694	0.007	0.266
Academic engagement	-6.212	<0.001	0.614
Self-organization and time management	-6.735	<0.001	0.665
Adaptive NFE	-5.945	<0.001	0.587

To account for baseline academic differences, ANCOVA was performed using pre-test academic scores as covariates (see Table 8). All group differences remained statistically significant ($p < 0.001$), confirming the robustness of the observed effects.

Table 8. Group Differences in Key Variables

Variable	Group means (CG / EG)	<i>t</i> (df = 408)	<i>p</i> -value	ANCOVA <i>F</i> (df = 1, 407)	ANCOVA <i>p</i> -value
Academic score after intervention	69.0 / 74.5	-5.49	< 0.001	28.36	< 0.001
Learning motivation	3.6 / 3.8	-2.62	0.009	7.02	0.008
Academic engagement	3.5 / 3.9	-4.68	< 0.001	21.91	< 0.001
Self-organization and time management	3.3 / 3.8	-4.96	< 0.001	24.63	< 0.001
Adaptive NFE	3.2 / 3.7	-4.31	< 0.001	18.74	< 0.001

Figure 2 presents the mean scores for the CG and EG across all key variables. As shown, the EG consistently outperformed the CG in each category, with the most notable differences observed in academic score after intervention, academic engagement, and self-organization.

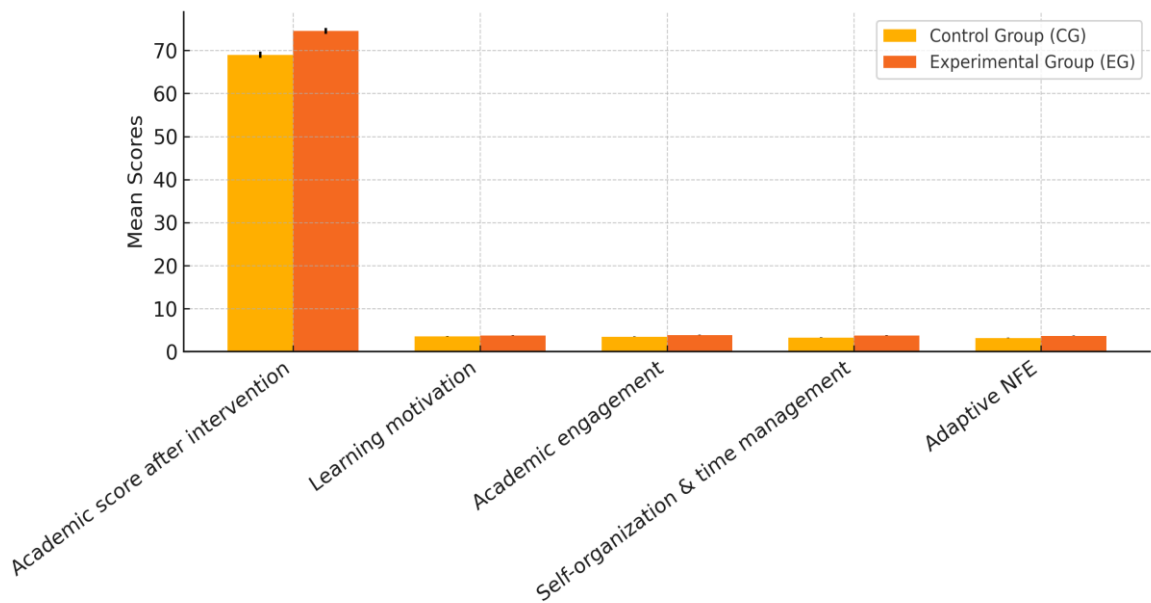


Fig. 2. Mean scores for CG and EG across academic and behavioral outcomes.

Visualizations (see Figures 3–7) illustrate distribution patterns across groups. The EG consistently demonstrates higher medians and reduced variance, confirming the positive impact of the intervention. These data visualizations offer deeper insights into group-level differences in score distributions and variability:

(i) Academic score after intervention (see Figure 3). The EG demonstrated a higher median academic score with a more compact distribution, indicating consistently improved academic outcomes following the intervention. In contrast, the CG showed a lower median and greater variability, suggesting mixed results in academic performance without the adaptive model.

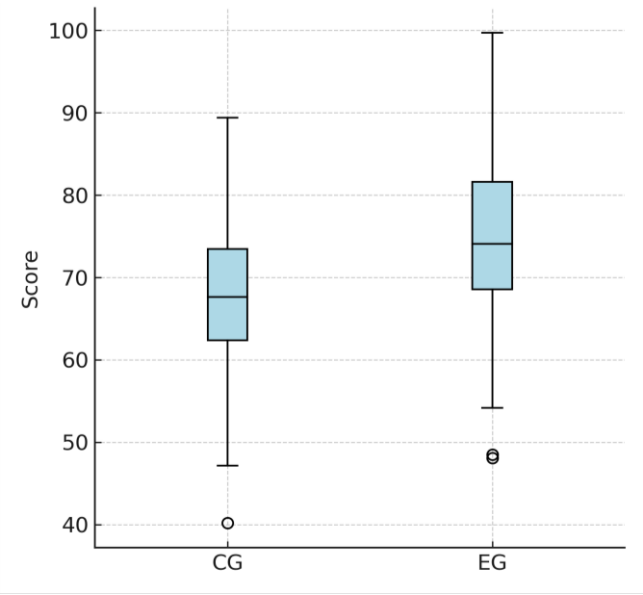


Fig. 3. Academic score after intervention

(ii) Learning motivation (see Figure 4). The EG displayed a higher median and a more compressed distribution, suggesting consistently strong motivation among participants. In contrast, the CG exhibited a lower median and a wider spread, indicating greater variability and generally lower motivation levels.

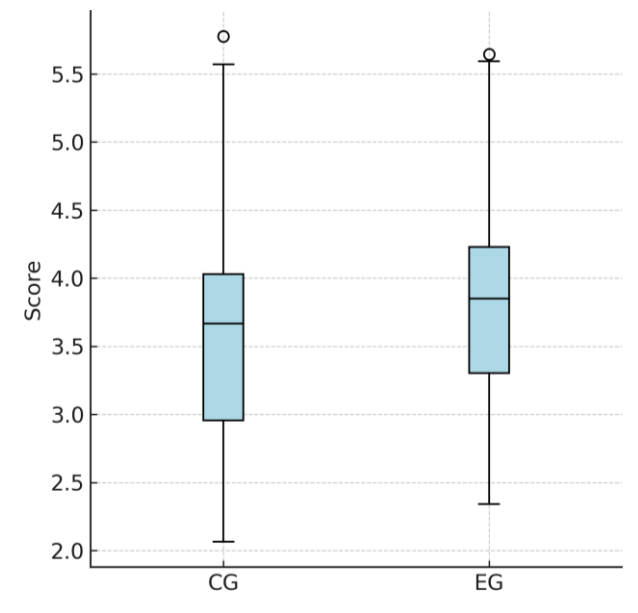


Fig. 4. Boxplot of learning motivation scores for CG and EG

(iii) Academic engagement (see Figure 5). The EG showed a tighter, more centralized distribution with fewer outliers, indicating stable and sustained engagement. The CG had a broader spread and downward outliers, possibly reflecting disengagement among some participants.

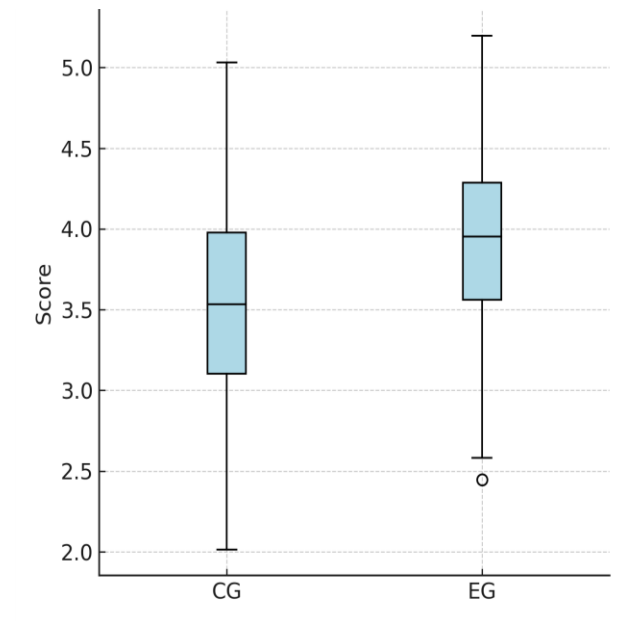


Fig. 5. Academic engagement

(iv) Self-organization and time management (see Figure 6). The EG demonstrated higher central values and a more symmetrical distribution, supporting the conclusion that the intervention effectively enhanced students' self-regulatory skills. The CG's distribution was shifted downward, with a concentration of lower-performing individuals.

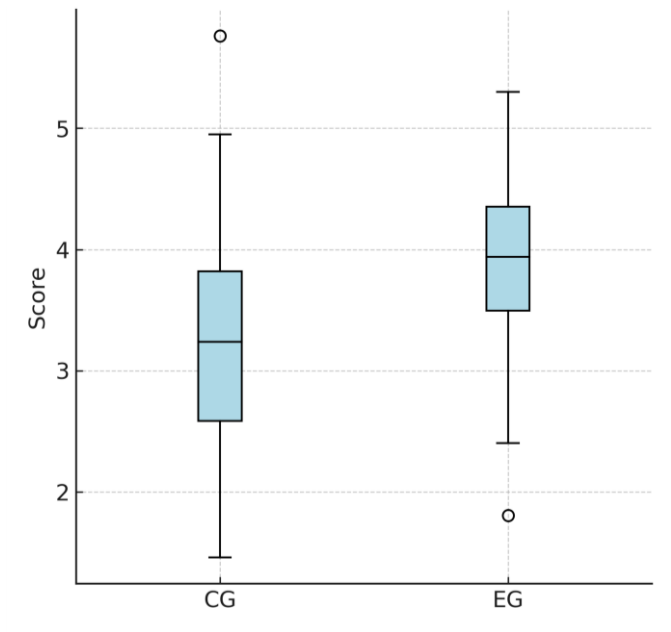


Fig. 6. Self-organization and time management

(v) Adaptive NFE (see Figure 7). The EG exhibited a denser distribution and a higher median, reflecting stronger integration of non-formal learning resources. The CG displayed a wider interquartile range and a lower median, indicating inconsistency in adaptive NFE skill development.

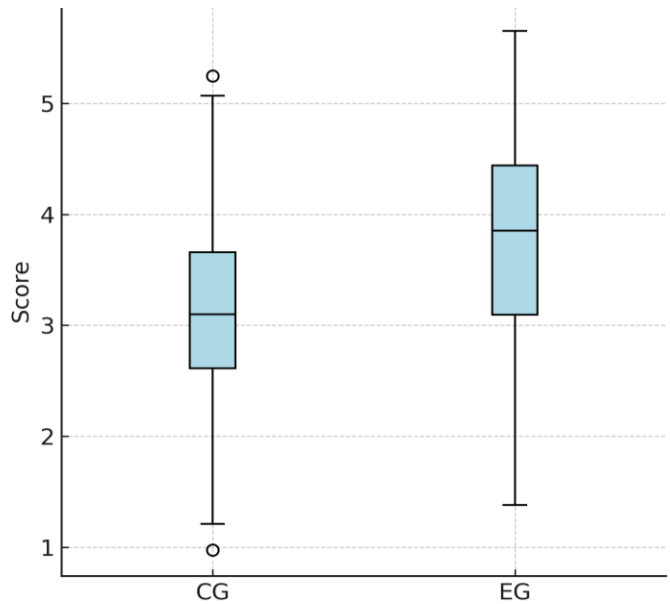


Fig. 7. Adaptive NFE.

These visual results corroborate the statistical findings from the t-tests and ANCOVA, reinforcing the conclusion that the adaptive NFE intervention had a positive and consistent impact on multiple dimensions of student learning behavior. The findings suggest that the adaptive NFE model had a substantial impact on student learning behavior, particularly in terms of academic engagement, time management, and integration of external educational resources. The intervention also led to modest but statistically significant improvements in intrinsic learning motivation. The triadic interaction framework—emphasizing synergy between students, universities, and external environments—appears to facilitate more effective educational behavior. This supports earlier findings by Al-Said [35], who emphasized the role of learner autonomy and external support in boosting student motivation. Similarly, Darling-Hammond et al. [36] highlighted the importance of practice-based learning beyond formal classroom boundaries. The observed improvements in engagement and self-regulation align with blended learning studies, such as those by Caldana et al. [37], which demonstrated the benefits of integrating formal and informal modalities. Our results also echo Van Schalkwyk’s [38] assertion that institutional support is essential in sustaining student-driven educational models. Notably, the most substantial effect was observed in self-organization and time management, indicating that the model

fosters autonomous academic habits. Although the improvement in motivation was comparatively small, it remains meaningful given the short intervention duration. Thus, the adaptive model appears to be an effective mechanism for enhancing flexibility and responsiveness in higher education. It contributes to building students' capacity for independent learning, and its implementation is particularly timely given the demands of digital transformation and lifelong learning.

5. Limitations of the Study and Directions for Future Research

Despite the promising results, this study has several limitations that should be acknowledged. First, the research was conducted at a single institution, which may limit the generalizability of findings to other educational contexts or regions. Future studies should include multi-site or cross-national comparisons to validate the model's applicability across diverse institutional environments. Second, the intervention period was limited to eight weeks. While short-term outcomes were significant, longer-term effects on academic persistence, skill retention, and professional development remain unclear. Longitudinal studies are recommended to assess the sustained impact of adaptive NFE. Third, the assessment relied primarily on self-reported data, which may be subject to social desirability bias or inaccuracies in self-perception. Future research should incorporate more objective data sources such as learning analytics, academic records, and behavioral indicators from digital platforms. Fourth, the study did not explicitly address emotional, psychological, or cognitive load factors, which are critical to understanding student well-being and motivation in adaptive learning environments. Further research should consider these dimensions to ensure that NFE models do not inadvertently contribute to burnout or disengagement. Fifth, the model was not compared against alternative interventions or pedagogical frameworks, limiting the ability to evaluate its relative effectiveness. Future studies should include comparative designs to position the model within the broader educational landscape. Finally, institutional readiness—such as faculty training, digital infrastructure, and administrative support—was not systematically evaluated. Future research should explore these enabling conditions through mixed-method approaches, including interviews with educators and IT staff, to ensure sustainable implementation.

6. Conclusions

This study examined the impact of an adaptive non-formal education model on student learning engagement and academic behavior. The results demonstrate that the model significantly improved academic engagement, time management, and the integration of external learning resources. Although gains in intrinsic motivation were more modest, they were nonetheless statistically significant. The adaptive model's effectiveness is attributed to its triadic structure, which fosters coordinated interaction among students, universities, and external learning environments. The model supports the development of independent learning strategies and aligns well with the goals of modern, learner-centered education. These findings highlight the value of embedding adaptive NFE models into broader institutional strategies to promote flexibility, self-regulation, and personalized educational pathways. The model is suitable for scaling and adaptation across diverse academic settings and holds promise for integration into digital education ecosystems. Further research is recommended to evaluate long-term impacts, explore comparative effectiveness, and assess institutional conditions necessary for sustainable implementation.

Appendix A

Questionnaire

No.	Item
Scale 1: Learning motivation	
1.	I strive to study in order to achieve high results and obtain a good profession.
2.	I enjoy learning new things beyond the required academic curriculum.
3.	I believe that education will help me succeed in life.
4.	I feel an internal need to continuously improve my knowledge and skills.
5.	It is important for me to receive positive feedback from teachers and peers.
6.	I am motivated to participate in projects and competitions related to my studies.
7.	I actively seek additional information on subjects independently.
8.	I have clear educational goals for this academic year.
Scale 2: Academic engagement	
9.	I regularly participate in additional seminars and workshops outside the core curriculum.
10.	I use external educational platforms (e.g., Coursera, Khan Academy) to deepen my knowledge.
11.	I actively collaborate with teachers and peers when completing academic tasks.
12.	I participate in student research or creative groups.
13.	I look for internship or practicum opportunities related to my field of study.
14.	I enjoy applying acquired knowledge in practice.
15.	I believe that extracurricular activity helps me better understand academic material.
Scale 3: Self-regulation and time management	
16.	I plan my study time one week in advance.
17.	I can effectively balance academic and non-academic activities.

18.	I try to complete all academic assignments in advance rather than at the last minute.
19.	I use various time management techniques to increase productivity.
20.	I am able to set priorities between academic and personal matters.
21.	I monitor my study process and independently adjust my plans.
Scale 4: Adaptive NFE	
22.	I integrate knowledge from online courses, webinars, or internships into my university studies.
23.	I feel that the university supports my involvement in external educational opportunities.
24.	I adapt my learning path using external resources to achieve my personal academic goals.
25.	I feel more engaged when I can choose from multiple formats (online/offline, formal/non-formal).
26.	I believe that informal education plays a key role in my academic and professional development.
27.	I feel confident initiating independent learning paths based on my interests and needs.

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