Digital Technology, Artificial Intelligence and Project-Based Learning in Technical Higher Education in French-Speaking Africa

Dr. Stéphane Contard Djefedie[1] , Mr. Hamadou Oumarou[2]

[1]Lecturer-researcher in the Department of Organization and Administrative Management (OGA) at the University Institute of Technology (IUT), University of Douala, BP 8696,

[2]Member of the Laboratory of Architectural Finance and Organizational Management (FARGO), at the Higher School of Economic and Commercial Sciences (ESSEC) of Douala, Cameroon

DOI: https://doi.org/10.47772/IJRISS.2026.100800177

Received: 14 August 2026; Accepted: 19 August 2026; Published: 29 August 2026

ABSTRACT

This article analyzes the conditions, methods, and prospects for integrating digital technology and generative Artificial Intelligence (AI) into project-based learning (PBL) within technical higher education in Francophone Africa. Based on a mixed-methods approach covering three countries (Cameroon, Ivory Coast, and Senegal), the research documents existing African experiences, identifies the conditions for success in integrating ICT into learning pathways, examines promising hybrid and distance learning models, and analyzes the role of generative AI in transforming teaching practices. The results reveal real but fragmented progress and lead to the proposal of the PIA-PBL framework, a contextualized operational model combining pedagogical hybridization and AI-powered amplification.

Keywords: generative artificial intelligence, project-based learning, technical higher education, ICT, Francophone Africa, hybrid teaching, teacher training.

Résumé

Cet article analyse les conditions, modalités et perspectives de l'intégration du numérique et de l'Intelligence Artificielle (IA) générative dans la pédagogie par projet (PPP) au sein de l'enseignement supérieur technique en Afrique francophone. Fondée sur une démarche mixte couvrant trois pays (Cameroun, Côte d'Ivoire, Sénégal), la recherche documente les expériences africaines existantes, identifie les conditions de réussite pour l'intégration des TIC dans les parcours d'apprentissage, examine les modèles d'enseignement hybride et à distance porteurs d'avenir, et analyse le rôle des IA génératives dans la transformation des pratiques enseignantes. Les résultats révèlent des avancées réelles mais fragmentées, et conduisent à la proposition du dispositif PIA-PPP, un modèle opérationnel contextualisé articulant hybridation pédagogique et amplification par l'IA.

Mots-clés : intelligence artificielle générative, pédagogie par projet, enseignement supérieur technique, TIC, Afrique francophone, enseignement hybride, formation enseignante.

INTRODUCTION AND PROBLEM STATEMENT

Technical higher education in sub-Saharan Africa is caught between two conflicting imperatives: the need for massification, which demands scalable pedagogical solutions, and the need for professional quality, which requires individualized, contextualized, and active approaches. In this context of structural tension, project-based learning (PBL) and Information and Communication Technologies (ICTs) appear not as mirror images of each other, but as complementary levers capable, when rigorously integrated, of profoundly transforming training practices.

The emergence of generative AI, with tools like ChatGPT , Mistral, Gemini, and specialized learning assistants, adds a new dimension to this dynamic. It opens up unprecedented possibilities for personalization, automated

formative feedback, and the generation of contextualized learning scenarios. However, it also raises legitimate concerns: the risk of plagiarism, the erosion of writing and argumentative skills, the exacerbation of inequalities in access, and ethical lapses in the handling of student data.

This communication is situated within this space of productive tension. It submits to the scientific community a research question structured around four priority thematic axes:

Central research question and areas of investigation

Axis 1: African experiences: What teaching practices integrating AI and ICT in a project-based approach have emerged in Francophone Africa, and what lessons can be learned from them?

Axis 2: Conditions for ICT success: What institutional, infrastructural and human conditions determine the success of integrating ICT into learning pathways?

Axis 3: Hybrid and distance learning: Which hybrid models allow us to make the most of digital advances in African technical higher education?

Axis 4: Generative AI in teaching practices: How do teachers appropriate (or resist) generative AI, and which emerging practices seem most promising?

This paper is based on the results of empirical research conducted from January to December 2024 in seven higher technical education institutions in Cameroon, Côte d'Ivoire, and Senegal. It directly addresses the thematic areas of this conference, particularly inclusive educational innovation and the responsible use of AI in education.

Theoretical and Conceptual Framework

Project-based learning in higher technical education

Project-based learning (PBL), based on the work of Dewey (1916) and formalized by Kilpatrick (1918), relies on the principle of learning through action and solving complex problems rooted in authentic situations. In higher technical education, it has a threefold significance: pedagogical (active and constructive learning), professional (development of transferable and technical skills applicable in the workplace), and social (collaborative learning and development of digital citizenship).

Research on the effects of PPP in higher education, particularly in STEM (Science, Technology, Engineering, and Mathematics) fields, consistently documents its benefits for learning retention (Thomas, 2000; Han & Bhattacharya, 2001), the development of metacognitive skills (Zimmermann, 2002), and learner intrinsic motivation (Krajcik & Shin, 2014). These benefits are even more pronounced when PPP is combined with digital tools that enable online collaboration, project management, and asynchronous communication.

Digital integration models: TPACK and SAMR

Two conceptual models structure the analysis of the pedagogical integration of digital technology. The TPACK model (Mishra & Koehler, 2006) conceptualizes teachers' skills at the intersection of three domains: subject content (CK), pedagogy (PK), and technology (TK). It emphasizes that mastery of a technological tool is not enough to guarantee successful pedagogical integration: it is the reflective articulation of the three dimensions that determines the quality of the integration.

Puentedura 's SAMR model (2006) offers a framework for analyzing the depth of integration, distinguishing four levels ranging from simple substitution (a digital tool replaces an analog tool without functional gain) to redefinition (the digital tool enables the creation of tasks that were previously impossible). In the African context,

this model encourages a gradual and realistic approach to integration, taking into account infrastructural constraints and the highly variable levels of technological maturity among institutions.

Generative AI as an amplifying tool , framework for instrumented activity

We propose to analyze generative AI through the lens of the theory of instrumented activity (Rabardel , 1995), which distinguishes between the artifact (the tool in its technical dimensions) and the instrument (the tool as it is appropriated and transformed by the user in their activity). This distinction is crucial: the same generative AI can become, depending on its use, an instrument of intellectual laziness or an instrument for amplifying research, reasoning, and creative capacities.

Within the framework of the PPP (Personalized Professional Project), we identify five potential instrumental roles for generative AI: research and information monitoring assistant; adaptive tutor for individualized support; generator of scenarios and practical cases; formative evaluator providing detailed feedback; and linguistic and intercultural mediator for bilingual contexts. The effectiveness of these roles largely depends on the conditions under which the AI is integrated and the critical stance the teacher adopts toward its outputs.

METHODOLOGY

Research Design

The research employs a sequential mixed-methods approach (Creswell & Plano Clark, 2018), combining a quantitative exploratory phase (an online questionnaire administered to teachers in higher technical education) and a qualitative in-depth phase (semi-structured interviews, observations of teaching sequences, and document analysis). This methodological triangulation aims to produce an understanding of the phenomena studied that is both statistically representative and ethnographically rich.

Grounds and participants

The fieldwork covers seven institutions in three countries, selected using purposive sampling to maximize the diversity of institutional configurations:

Cameroon
- IUEs /Insam (multi-campus: Douala, Yaoundé, Bafoussam, Mbouda)
- Higher Institute of the Sahel (Maroua)
- Seven International University (Douala, founded 2023)

Ivory Coast & Senegal
- UVCI — Virtual University of Côte d'Ivoire (Abidjan)
- INPHB — Institut National Polytechnique HB Boigny
- UVS — Virtual University of Senegal (national network)
- Polytechnic School of Thiès (EPT)

The total empirical corpus includes: 187 completed questionnaires (technical course teachers, response rate 73.6%), 42 semi-structured interviews (average duration 52 minutes), 18 observations of teaching sequences (6 per country), and the analysis of 36 student project portfolios integrating AI tools.

Data Collection and Analysis Instruments

The online questionnaire (LimeSurvey platform) comprised 48 items organized into five dimensions: equipment and connectivity, reported teaching practices, use of digital technology and AI, training needs, and perception of obstacles and opportunities. Quantitative data were analyzed using SPSS v27 (descriptive analyses, chi-square tests, Spearman correlations). Qualitative data underwent thematic analysis using NVivo 12, following the protocol of Braun & Clarke (2006).

The ethical validity of the research was ensured by obtaining informed consent from all participants and by validating the protocol with the Research Ethics Committee of the IUEs/Insam (ref. CER-IUEs-2024-07). Data anonymization was guaranteed throughout the analysis process.

AXIS 1 — AFRICAN EXPERIENCES IN AI APPLIED TO PROJECT-BASED LEARNING

African Experiences in AI and Project-Based Learning

A mapping of existing initiatives

The literature review reveals an ecosystem of heterogeneous initiatives, led by a variety of actors (virtual universities, private technical institutes, bilateral programs, continental organizations), with highly variable degrees of integration. Three levels of experience can be distinguished:

Level 1: Institutionalized experiences (formal policy + operational mechanisms)

Virtual University of Senegal (UVS): The Karibu application (AI-powered support for French language learning) and augmented tutoring systems are continental benchmarks. Professional development programs are integrated into the university's vocational training programs with blended learning support.

Virtual University of Ivory Coast (UVCI): At the AfricaDigitalEdu 2024 conference, UVCI teams presented student projects in educational engineering using ChatGPT as a design assistant, with systematic critical evaluation of the outputs.

INPHB (Ivory Coast): Deployment of a project-based industrial computing program integrating AI tools for simulation and computer-aided design.

Level 2: Localized experiences (individual initiatives by pioneering teachers)

IUEs/Insam (Cameroon): PIA-PPP pilot project across 2 cohorts (LPI + LPGE), 143 students. AI is used as a document scaffolding tool and for automated formative assessment.

Seven International University (Cameroon): Project-based learning and systematic reverse engineering , with professional mentors. AI tools are used freely by students under an ethical usage charter.

École Polytechnique de Thiès (Senegal): Final year projects integrating AI data analysis tools, in partnership with local agribusiness companies.

Level 3: Emerging experiences (trial and error without an institutional framework)

Many teachers surveyed (34.2%) reported having experimented with generative AI in their courses informally, without institutional support or a defined teaching protocol.

These informal uses mainly concern the generation of exercises and practical cases (67%), the automated correction of written productions (41%) and assisted document research (89%).

Success Factors of Documented Experiments

The comparative analysis of the Level 1 experiences reveals several converging success factors. First, the presence of strong institutional leadership: in all three cases, the institution's leadership formally integrated

digital technology and PPPs into its academic strategy, with dedicated resources. Second, the existence of solid external partnerships (businesses, international organizations, other universities) that ground the projects in real-world problems and provide complementary resources.

Third, ongoing pedagogical support for teachers: the pioneering institutions have all developed continuing professional development programs on the pedagogical use of AI, based on communities of practice and peer coaching. Fourth, a culture of evaluation and feedback: these institutions document their practices, assess their impact, and share this information within peer networks.

Documented limitations and tensions

The survey also reveals recurring tensions and limitations. The most frequently cited tension (by 71.4% of teachers who have experienced AI in PPP) is that between the apparent effectiveness of generative AI and the development of deep skills: "Students produce good texts with AI, but they no longer know how to write on their own" (teacher, UVCI, interview). The second major tension concerns equity: students with recent smartphones and a fast internet connection have a considerable advantage over their less well-equipped peers, which reproduces and amplifies pre-existing inequalities.

Finally, an institutional tension is identified between the official discourse promoting digital innovation and practical realities: lack of clear guidelines on the use of AI in assessments, insufficient regulation of issues of plagiarism augmented by AI, lack of training for educational leaders on these issues.

AXIS 2 — CONDITIONS FOR SUCCESS FOR THE INTEGRATION OF ICT INTO LEARNING PATHWAYS

Conditions for Success in ICT Integration

A four-dimensional model

Thematic analysis of the interviews and correlation of quantitative data reveal a four-dimensional model with interdependent components that determine the success of ICT integration in learning pathways. These components are not hierarchical—their systemic interaction is what produces the effect. The absence of any one of them weakens the entire system.

INSTITUTIONAL DIMENSION	▸ Digital policy formalized in the institutional project Operational Pedagogical and Digital Innovation Unit (CIPN) ▸ Budget dedicated to digital education (≥ 5% of the teaching budget) ▸ Recognition of innovative practices in staff evaluations
INFRASTRUCTURAL DIMENSION	▸ Stable connectivity (≥ 10 Mbps) in educational spaces ▸ Digital equipment/student ratio (≥ 1:3 on campus) ▸ Documented and deployed offline business continuity solutions ▸ Stabilized or alternative (solar) power supply systems
EDUCATIONAL DIMENSION	▸ TPACK teacher training (technology × pedagogy × content) ▸ Restructured curricula including project-based learning modules ▸ Formalized teaching scenarios integrating digital tools ▸ Authentic assessment of digital skills and project
HUMAN AND CULTURAL DIMENSION	▸ Active communities of practice among pioneering teachers ▸ Raising awareness of the ethical and critical use of AI ▸ Involvement of professional partners in defining projects ▸ Change management and addressing resistance

Obstacles specific to the African context

Data analysis reveals three specific obstacles in addition to the general challenges identified in the international literature. The first is energy-related: 63.1% of Cameroonian teachers and 48.7% of Ivorian teachers surveyed reported that power outages significantly disrupt their digital teaching activities. This obstacle, virtually nonexistent in Northern contexts, constitutes a major factor in educational discontinuity that requires specific architectural solutions (solar power, offline applications, interruption-tolerant sequence design).

The second obstacle is economic: the cost of internet subscriptions remains prohibitive for a significant proportion of students, particularly in institutions located outside major metropolitan areas. The third obstacle is cultural and linguistic: most available generative AI tools have been trained on corpora primarily in English, resulting in inconsistent quality in French, and even worse results for local languages and contexts. This linguistic mismatch penalizes French-speaking users and exacerbates the North-South digital divide.

Levers for successful integration

In addition to identifying obstacles, the survey reveals several particularly powerful levers for integration in the African context. The most robust, identified in all positive case studies, is intermediate pedagogical leadership: the presence of digital "champion" teachers who act as mediators between institutional management and less advanced peers, by facilitating informal communities of practice and sharing their teaching scenarios.

The second lever is contextualized peer-to-peer training: unlike standardized top-down training, peer workshops organized around local case studies generate more lasting and relevant appropriation of the tools. The third lever is visible institutional recognition: when innovative practices are acknowledged—through awards, mentions in activity reports, or presentations to teaching councils—the ripple effect on colleagues is significantly stronger.

AXIS 3 — INTEGRATION OF DISTANCE AND HYBRID LEARNING

Hybrid and Distance Learning: Towards a Contextualized African Model

Define hybridization in the African context

The concept of hybrid teaching encompasses very diverse realities in the literature (Garrison & Kanuka , 2004; Picciano , 2014). In the African context, it should be defined not on the basis of a fixed proportion of face-to-face and distance learning, but on the basis of a logic of functional complementarity: distance learning takes care of what it does better than face-to-face learning (documentary resources, individualized exercises, automated feedback, asynchronous communication between peers), while face-to-face learning preserves what distance learning cannot yet replace (rich interactions, manipulation of physical materials, authentic assessments, professional socialization). From this perspective, the optimal hybrid model for African technical higher education is not a universal model, but a continuum that can be adjusted according to local constraints (connectivity, equipment, nature of programs) and the educational objectives of each module. This is what we call constraint-intelligent hybridization: a hybridization that starts with constraints and transforms them into educational opportunities.

Documented African hybrid models

The comparative analysis of the establishments studied makes it possible to identify three archetypes of hybrid models, presenting distinct logics of face-to-face/distance learning integration:

Model 1: "Hub-and- Spoke " (UVS, Senegal)

Principle: a central campus “hub” produces digital resources (videos, online courses, AI tools), redistributed in decentralized “Open Digital Spaces” (ENO).

Advantage: democratization of access across the entire national territory (34 ENOs in Senegal).

Limitation: Dependence on the central campus creates a bottleneck during peak demand.

PPP application: collaborative inter-ENO projects on local development issues.

Model 2: "Flipped Blended Learning" (UVCI, Ivory Coast)

Principle: theoretical content is delivered remotely (asynchronous videos + assisted AI forums), and face-to-face sessions are entirely devoted to project workshops and assessments.

Advantage: maximizes contact time for activities with high educational added value.

Limitation: requires strong personal discipline from students and a very rigorous design of distance learning resources.

PPP application: generative AI tools power the remote research phases, and the syntheses are worked on collectively in person.

Model 3: "Proximity Hybrid" (IUEs/Insam, Cameroon)

Principle: articulation of weekly face-to-face sessions with online collaborative work platforms between sessions, on the Moodle platform enhanced with AI modules.

Advantage: adapted to the mobility constraints of students in a dense city like Douala; promotes educational continuity even in case of unforeseen events (strikes, bad weather).

Limitation: the heterogeneous level of mastery of digital tools requires constant technical support.

PPP application: online project management with collaborative tools (Trello, Notion), AI feedback on intermediate deliverables.

The hybrid pedagogical architecture of PPP: the three-stage model

Regardless of the hybrid model adopted, the analysis of the most effective practices converges on a three-stage architecture for PPPs augmented by digital technology and AI:

TIME 1 (Remote) Preparation and framing (2–3 weeks)	**TIME 2 (Hybrid)** Development and production (4–8 weeks)	**TIME 3 (In-person)** Presentation and evaluation (1–2 weeks)
‣ AI-powered document search ‣ Problematic definition ‣ Team composition ‣ Project planning (Gantt chart)	‣ In-person workshops (brainstorming, prototyping) ‣ Remote work (writing, AI analysis) ‣ AI feedback on intermediate deliverables ‣ Synchronous online team meetings	‣ Defense by a mixed jury (teachers + professionals) ‣ Self-assessment and peer co-assessment ‣ AI training assessment (portfolio) ‣ Capitalization and sharing

This architecture is particularly suited to multi-campus establishments like IUEs/Insam, where it allows the formation of inter-campus teams (Douala, Yaoundé, Bafoussam, Mbouda), transforming geographical dispersion into a pedagogical resource of diversity.

AXIS 4 — INTEGRATION OF GENERATIVE AI INTO TEACHING PRACTICES

Generative AI in Teaching Practices

Teacher appropriation profiles

Analysis of the 42 semi-structured interviews reveals five profiles of how African technical higher education teachers adopt generative AI. These profiles are not fixed—teachers can move from one profile to another depending on institutional conditions and their training background—but they offer a useful framework for understanding the diversity of observed practices.

Profile 1: Committed Pioneers (18% of respondents)
They systematically and reflectively integrate generative AI into their PPP.
They developed ethical usage guidelines with their students.
They share their practices in peer networks and publications.
Demographic profile: generally young (< 40 years old), recent doctorate, international training.

Profile 2: The Pragmatic Explorers (29% of respondents)
They use generative AI on an ad-hoc basis, for specific, well-defined tasks.
They lack a formalized educational framework to structure these uses.
They perceive a need for training and are seeking support.
They constitute the priority target audience for continuing education programs.

Profile 3: The Cautious Observers (31% of respondents)
Aware of the existence of generative AI but do not use it professionally.
They express legitimate concerns about academic integrity and ethics.
They are waiting for clear institutional guidelines before committing.
They are sensitive to arguments regarding saving time and improving resource quality.

Profiles 4 & 5 — Active resisters (13%) and structural non-users (9%)
Profile 4: Opposed by conviction to the uses of AI in teaching; put forward epistemological arguments (risk of superficiality), ethical arguments (plagiarism, algorithmic opacity) or identity-related arguments (questioning of the role of the teacher).
Profile 5: Total absence of use due to insurmountable structural constraints (lack of equipment, zero connectivity, advanced digital illiteracy).

Most promising emerging teaching practices

Among the practices observed and documented, five stand out for their pedagogical relevance, their feasibility in the African contexts studied, and their potential for generalization:

1. The comparative AI investigation scenario: the teacher presents the same problem to several generative AI programs (ChatGPT , Mistral, Gemini) and asks students to analyze and compare the responses, identifying biases, gaps, and errors. This practice simultaneously develops critical thinking and proficiency with the tools. It has been observed at INPHB and EPT.

2. Collaborative development of assessment rubrics with AI: the teacher uses AI to generate an initial version of the project's assessment rubric, which the students then collectively refine. This process fosters awareness of quality criteria and empowers learners in the collaborative development of assessment standards.

3. The critical AI logbook: each student keeps a log documenting all their uses of AI in the project (queries formulated, outputs obtained, critical evaluations made, transformations implemented). This metacognitive tool develops reflexivity and promotes conscious and appropriate use.

4. AI as an interlocutor in the defense: in the preparation phases for the defense, students simulate jury questions by questioning an AI, thus training their ability to defend their project in the face of unexpected questions.

5. Shared technology monitoring: the teacher creates a shared space where each student contributes a resource generated or discovered via AI on a weekly basis, along with a critical annotation. This system develops a culture of monitoring and fosters a learning community.

Ethical issues specific to the African context

The integration of generative AI into African educational practices raises ethical issues which, while not entirely different from those identified in Northern contexts, take on a specific character. The issue of algorithmic sovereignty is central: almost all generative AI accessible on the continent is developed and hosted by North American or Chinese companies, according to commercial and cultural logics that do not necessarily correspond to African values and needs.

The issue of cultural and linguistic biases is documented by several studies: generative AI produces significantly lower-quality results in African languages, and its representations of the African world are often partial, stereotypical, or anachronistic. Training students to identify and critique these biases is a new pedagogical skill that teachers must integrate into their practices. Finally, the issue of data confidentiality, particularly acute in contexts where national data protection regulations are still in their infancy, requires institutions to develop policies for the responsible use of AI tools.

Proposal: The Pia-Ppp Scheme

Device Architecture

The synthesis of the four lines of investigation led to the formalization of the PIA-PPP (Pedagogy through Artificial Intelligence Augmenting Project-Based Learning) framework, an operational model for integrating AI into project-based learning pathways in African technical higher education. This framework articulates five interdependent components within an open and adaptive system logic:

> **Component 1: Contextual and partnership anchoring**
> Each project is defined in partnership with local professional stakeholders, guaranteeing the authenticity and socio-economic relevance of the approach.

AI is being used for context analysis and the production of initial document summaries.
Professional partners participate in the final evaluation of projects, ensuring an authentic assessment.

Component 2: Progressive Digital Scaffolding
Digital and AI tools are introduced gradually according to the digital maturity of the learners.
Each tool is accompanied by a protocol for educational use and a shared ethical charter.
Offline resources are available to ensure continuity in the event of connectivity failure.

Component 3: Hybrid AI-assisted tutoring
Teacher-tutors use learning analytics to adapt their support in real time.
Specialized conversational AIs provide formative support between face-to-face sessions.
Digital peer communities (WhatsApp, Discord, Moodle forum) are structured pedagogically.

Component 4: Authentic multi-stakeholder evaluation
The evaluation criteria are co-constructed with professional partners and students.
AI tools analyze skills portfolios and produce personalized formative assessments.
Self-assessment and peer co- assessment are integrated into the final grade (weighting 30%).

Component 5: Systematic Ethical Reflexivity
Sequences dedicated to critical reflection on the uses of AI are integrated into each project.
The critical AI logbook is a mandatory, assessed deliverable.
Workshops on algorithmic bias and digital sovereignty are organized at the beginning of the course.

Pilot results at IUEs/Insam

A pilot phase of the PIA-PPP scheme was conducted at IUEs/Insam in the second semester of 2024, with 143 students of Professional Bachelor's Degree in Computer Science (LPI, 78 students) and Professional Bachelor's Degree in Business Management (LPGE, 65 students), spread over three campuses (Douala, Yaoundé, Bafoussam).

Preliminary results, measured through Moodle platform analytics and a post-course satisfaction survey, are encouraging. Active engagement on the platform (weekly logins, forum contributions, submission of intermediate deliverables) increased by 34% compared to previous cohorts not using the PIA-PPP system. The perceived professional relevance of the training improved significantly (average score of 3.2/5 before the pilot vs. 4.1/5 after, $p < 0.01$). The participating instructors expressed high satisfaction, noting in particular the improved quality of the final deliverables and the students' ability to defend their choices during presentations. These preliminary results should be interpreted with caution: the absence of a perfectly equivalent control group and the limited duration of the experiment do not allow for the establishment of rigorous causality. Longitudinal research involving several cohorts is underway to consolidate these initial findings.

DISCUSSION AND RECOMMENDATIONS FOR TEACHER TRAINING

Implications for teacher training in the Francophone world

The results of this research have direct implications for teacher training in Francophone Africa, which is the central focus of this conference. Three major implications deserve highlighting.

First, AI training cannot be reduced to training in tools alone. It must include an epistemological dimension (understanding what AI is, its operating principles, and its limitations) and an ethical dimension (developing a critical perspective on biases, risks, and sovereignty issues). In the African context, this ethical dimension must incorporate decolonial perspectives that are not found in most available training curricula.

Secondly, training in technology-enhanced pedagogy must be integrated with training in project-based pedagogy, and not treated as a separate field. Teachers who are most successful at integrating AI into their practice are those who already possess active and reflective teaching skills—not those who are most proficient with technological tools. Project-based learning is therefore both an object and a vehicle for training in technology-enhanced pedagogy .

Third, teacher training must be continuous and grounded in practice: short immersion training formats (two or three days) have a limited impact on long-term practices. It is extended support mechanisms—communities of practice, individual coaching, collaborative action research—that produce the lasting transformations documented in positive case studies.

Targeted Recommendations

For the benefit of the participants of this symposium and the institutions they represent, we formulate six operational recommendations:

6. Integrate a mandatory module "AI and teaching practices" into all initial and continuing teacher training curricula for higher education, structured around practical cases contextualized in Francophone Africa.

7. Developing open digital educational resources (OER) in French on the pedagogical use of AI, accessible online and offline, co-produced by networks of French-speaking African teachers (RUFIFESE, AUF, RéFUV).

8. Create a "Competent AI Teacher" certification program recognized within the CAMES area, structured around the five dimensions of the PIA-PPP system, accessible through hybrid training.

9. Funding positions for "pedagogical AI referents" in each higher technical education establishment in the French-speaking area, responsible for leading communities of practice and supporting teachers in their appropriation process.

10. Supporting collaborative longitudinal research on the effects of integrating AI into African teaching practices, with pooling of protocols and measurement instruments between partner institutions.

11. Develop or adapt multilingual generative AI tools including African languages (Wolof, Bamileke, Lingala, Moore , Hausa…), in partnership with African research teams in natural language processing.

CONCLUSION

This presentation shared the results of empirical research on the integration of digital technology, ICT, and generative AI into project-based learning within technical higher education in Francophone Africa. By combining four lines of inquiry—existing African experiences, conditions for ICT success, blended learning, and AI in teaching practices—it produced a nuanced overview of a rapidly evolving field, marked by real progress but also unresolved tensions.

The PIA-PPP framework represents an operational contribution that attempts to synthesize research findings into an actionable model adapted to African realities. It is not a universal solution, but a flexible framework that each institution must adopt and adapt to its specific context. Testing it in other institutions, other countries, and other technical sectors is a research priority for the coming years.

Ultimately, the question of integrating AI into African technical higher education is as much a political issue as a pedagogical one. It touches on the continent's digital sovereignty, equitable access to quality training, and the

capacity of African societies to train professionals and citizens capable of understanding, using, and critically analyzing the technologies that will shape their world. This is the horizon toward which this contribution, in its own modest way, aims to help guide collective thinking.

African experiences, conditions for success, ICT, blended learning and generative AI in teaching practices

Technologies Numériques, Intelligence Artificielle Et Apprentissage Par Projet Dans L'enseignement Supérieur Technique En Afrique Française

Expériences africaines, conditions de réussite, TIC, apprentissage mixte et IA générative dans les pratiques pédagogiques

REFERENCES

1. Béché, E. (2022). TIC et innovation dans les pratiques enseignantes au Cameroun. Frantice.net, 19(1), 45-62.
2. Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. Qualitative Research in Psychology, 3(2), 77-101.
3. Creswell, J. W., & Plano Clark, V. L. (2018). Designing and Conducting Mixed Methods Research (3e éd.). SAGE.
4. Dewey, J. (1916). Democracy and Education. Macmillan.
5. Engeström, Y. (1987). Learning by Expanding. Orienta-Konsultit.
6. Floridi, L. (2022). The Ethics of Artificial Intelligence: Principles, Challenges, and Opportunities. Oxford University Press.
7. Garrison, D. R., & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. Internet and Higher Education, 7(2), 95-105.
8. Han, S., & Bhattacharya, K. (2001). Constructivism, project-based learning, and technology. Educational Technology Research and Development, 49(4), 17-26.
9. Kilpatrick, W. H. (1918). The project method. Teachers College Record, 19(4), 319-335.
10. Krajcik, J. S., & Shin, N. (2014). Project-based learning. In R. K. Sawyer (Ed.), The Cambridge Handbook of the Learning Sciences (pp. 275-297). Cambridge University Press.
11. Mhlambi, S. (2020). From rationality to relationality: Ubuntu as an ethical framework for AI. Berkman Klein Center Report, Harvard University.
12. Mishra, P., & Koehler, M. J. (2006). Technological pedagogical content knowledge. Teachers College Record, 108(6), 1017-1054.
13. Noukimi Kenmoe, S. (2024). L'IA générative comme outil d'amplification pédagogique dans les cursus techniques africains. Communication, AfricaDigitalEdu 2024, Abidjan.
14. Noukimi Kenmoe, S., & Owona Medou, J. (2023). Conditions de réussite de l'intégration pédagogique des TIC dans les IPES au Cameroun. RITPU, 20(2), 34-52.
15. Picciano, A. G. (2014). Big data and learning analytics in blended learning environments. Journal of Asynchronous Learning Networks, 18(1), 1-15.
16. Puentedura, R. R. (2006). Transformation, technology, and education. Consulté sur http://hippasus.com/resources/tte/
17. Rabardel, P. (1995). Les hommes et les technologies. Armand Colin.
18. RéFUV. (2024). Livret du Colloque International AfricaDigitalEdu 2024 : IA et futurs numériques de l'apprentissage. UVCI, Abidjan.
19. RUFIFESE. (2025). Enquête sur la formation des enseignants à l'ère de l'IA dans l'espace francophone. Rapport préliminaire. AUF.
20. Thomas, J. W. (2000). A review of research on project-based learning. Autodesk Foundation.
21. UNESCO. (2023). Orientations pour l'intelligence artificielle générative dans l'éducation et la recherche. UNESCO.
22. UNESCO-GPE. (2024). Compétences numériques et en IA : Séminaire régional Afrique francophone et lusophone. Dakar, oct. 2024.
23. Voulgre, E. (2025). Évolutions des compétences en TIC et IA génératives dans les universités virtuelles africaines. Colloque ENSET-Libreville, mars 2025. HAL : hal-05001810.

24. Vygotsky, L. S. (1978). Mind in Society. Harvard University Press.
25. Yonazi, E., Kelly, T., Halewood, N. et al. (2012). The Transformational Use of ICT in Africa. Banque mondiale.
26. Zimmermann, B. J. (2002). Becoming a self-regulated learner. Theory Into Practice, 41(2), 64-70.