Learner-Centred Intelligence: Integrating Artificial Intelligence and Personalised Learning Pathways in Higher Education

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***Abstract*— Artificial intelligence (AI) is creating new possibilities for personalised and adaptive learning in higher education. AI-enabled educational systems can support learner profiling, customised learning resources, timely feedback, and adaptive learning pathways. However, the effective integration of these technologies requires attention to learner autonomy, data privacy, algorithmic bias, transparency, and the continuing role of educators.**

This conceptual paper examines how artificial intelligence can support learner-centred and personalised learning processes in higher education. Drawing on a critical synthesis of relevant literature, the paper proposes a Learner-Centred Intelligence Framework (LCIF) comprising five interconnected elements: learner profiling, AI-enabled personalization, intelligent feedback, human oversight and learner agency, and continuous evaluation. The framework positions AI as a supportive educational resource rather than a replacement for teachers or independent student learning.

The paper discusses the potential educational benefits of adaptive learning pathways while identifying implementation challenges associated with digital inequality, responsible data use, reliability of AI-generated feedback, and institutional readiness. It also outlines implications for educators, higher education institutions, and educational technology developers. The proposed framework offers a conceptual basis for future empirical research examining the relationship between responsible AI integration, learner engagement, and educational outcomes. As the framework has not yet been empirically validated, its effectiveness requires further investigation across diverse higher education settings.

***Index Terms*— Artificial intelligence, personalized learning, higher education, adaptive learning, intelligent feedback, learner-centred education, educational technology.**

I. INTRODUCTION

Higher education institutions are increasingly exploring digital technologies to improve teaching quality, student engagement, accessibility, and academic performance. Among these technologies, Artificial Intelligence has emerged as a significant development because of its capacity to analyse information, generate content, identify patterns, and provide automated assistance.

Traditional classroom teaching often follows a common syllabus, timetable, instructional approach, and assessment pattern for all students. Although this structure supports curriculum delivery, it may not adequately address individual differences in students' prior knowledge, learning speed, interests, language proficiency, and academic preparedness.

Personalised learning provides an alternative approach by adapting learning resources, activities, support, and pace to individual requirements. AI can contribute to this process through adaptive learning systems, intelligent tutoring applications, recommendation engines, learning analytics, and generative AI tools.

For example, a student learning programming may require additional explanations of variables and control structures, while another student may be ready for application development. An AI-enabled learning system could recommend different exercises and learning resources according to their demonstrated progress. Similarly, a management student studying statistical analysis could receive additional practice questions and explanations related to hypothesis testing.

Existing literature identifies personalised feedback, adaptive learning, intelligent tutoring, and educational

recommendations as important applications of AI in higher education. Research also highlights the need to evaluate educational effectiveness, system reliability, and ethical implementation rather than assuming that technological adoption automatically improves learning outcomes (Zawacki-Richter et al., 2019; Luo et al., 2025).

The central argument of this paper is that AI becomes educationally valuable when it is integrated into a learner-centred pedagogical process. Technology should help identify learning needs, support suitable learning pathways, provide feedback, and assist teachers in making informed instructional decisions.

II. STATEMENT OF THE PROBLEM

Students in higher education differ in their academic backgrounds, learning preferences, digital skills, interests, and levels of understanding. A uniform instructional approach may not provide sufficient individual support for all learners.

Although AI technologies can recommend learning materials, provide automated explanations, and support adaptive learning, their effective integration remains challenging. AI-generated information may be inaccurate, learning recommendations may be biased, and students may become overly dependent on automated assistance. Institutions must also address data privacy, unequal access to technology, faculty preparedness, and academic integrity.

Furthermore, personalised learning should not be reduced to automated content recommendations. Effective personalisation requires alignment between learning objectives, student needs, instructional strategies, feedback, assessment, and human guidance. Accordingly, the problem addressed in this paper is how AI can be integrated into higher education to create meaningful, personalised learning pathways while preserving student autonomy, teacher responsibility, academic quality, and educational fairness.

III. OBJECTIVES OF THE STUDY

The objectives of this paper are:

1. To examine the role of Artificial Intelligence in developing personalised learning pathways in higher education.
2. To identify AI technologies that support learner-centred and intelligent learning processes.
3. To analyse the potential benefits of AI-enabled personalisation for students and faculty members.
4. To examine the technological, pedagogical, and ethical challenges associated with AI-based learning.
5. To propose a conceptual framework for integrating AI into personalised learning pathways.
6. To identify future research directions for evaluating AI-supported learning in higher education.

IV. RESEARCH QUESTIONS

The paper addresses the following research questions:

RQ1: How can AI support the development of personalised learning pathways in higher education?

RQ2: Which AI applications can contribute to intelligent feedback, adaptive instruction, and continuous learning support?

RQ3: What educational and ethical challenges arise when AI is integrated into personalised learning?

RQ4: How can a learner-centred framework balance AI-driven personalisation with teacher supervision and student autonomy?

V. RESEARCH METHODOLOGY

5.1 Research Design

The paper adopts a conceptual, literature-based research design. It examines published research on AI in higher education, personalised learning, adaptive educational technologies, and intelligent tutoring systems.

The purpose is to synthesise relevant concepts, identify implementation challenges, and develop a conceptual framework. The paper does not claim to be a new systematic review or an empirical investigation.

5.2 Sources of Literature

The discussion draws on peer-reviewed journal articles, systematic literature reviews, and international guidance concerning AI in education. Relevant publications include research by Zawacki-Richter et al. (2019), Bayly-Castaneda et al. (2024), Luo et al. (2025), and UNESCO (2023).

These sources address AI applications in higher education, personalised learning pathways, learning tools, and responsible implementation.

5.3 Method of Analysis

The literature is organised around five themes:

- AI applications in personalised learning.
- Intelligent feedback and adaptive instruction.
- Benefits for students and teachers.
- Technological, pedagogical, and ethical challenges.
- Development of a learner-centred conceptual framework.

5.4 Scope of the Study

The paper focuses on undergraduate and postgraduate education, including management, computer applications, business studies, and other academic disciplines. It considers both classroom-based and digitally supported learning environments.

5.5 Methodological Limitation

This paper presents a conceptual synthesis of selected literature. It does not report an exhaustive database search, formal systematic screening, original questionnaire responses, or experimental results. Consequently, the proposed framework should be treated as a research proposition requiring empirical validation.

VI. REVIEW OF LITERATURE

6.1 AI Applications in Higher Education

Zawacki-Richter et al. (2019) systematically reviewed research on AI applications in higher education. Their work identified major areas including student profiling and prediction, assessment and evaluation, adaptive systems, and intelligent tutoring. The authors also highlighted the importance of considering educators' roles in AI-supported educational practice.

This review provides a foundation for examining AI as more than a technological tool: its educational value depends on how it is incorporated into teaching, learning, and assessment.

6.2 Personalised Learning Pathways

Bayly-Castaneda et al. (2024) reviewed research on AI-mediated personalised learning pathways. Their review covered 78 articles published between 2019 and 2024 and identified adaptive learning technologies as a prominent area of research, alongside growing interest in generative language models.

Their findings provide a basis for understanding how AI can support the design of learning pathways suited to individual goals and requirements.

6.3 AI-Based Learning Tools

Luo et al. (2025) reviewed the design and assessment of AI-based learning tools in higher education. Their study examined the features of AI applications and their effects on cognitive, skill-based, and affective learning outcomes.

This research is relevant because AI tools should be assessed not only according to their technological capabilities but also according to their educational purpose and impact.

6.4 AI and Personalised Learning: Recent Developments

Fortuna et al. (2025) conducted a systematic review of AI in personalised learning, examining 25 Scopus-indexed articles published between 2019 and 2024. Their analysis discussed the development of AI applications, including machine learning, natural language processing, intelligent tutoring systems, and large language models.

Farhood et al. (2025) also reviewed AI-based personalised learning across education sectors, analysing applications, algorithms, and implications for teaching, learning, and assessment.

Together, these reviews demonstrate the importance of examining how AI technologies can be adapted to educational needs while recognising differences in context and implementation.

6.5 Human-Centred AI in Education

UNESCO (2023) emphasises a human-centred approach to generative AI in education and research. Its guidance highlights data protection, ethical validation, appropriate pedagogical design, and the development of institutional policies.

This perspective supports the argument that personalised learning should preserve human judgement, learner agency, and educational responsibility.

6.6 Research Gap

Existing studies have examined adaptive learning systems, personalised learning pathways, AI-based

feedback, and intelligent tutoring. However, opportunities remain to integrate these dimensions into a coherent learner-centred framework that explicitly connects individual learning needs with adaptive resources, intelligent feedback, teacher supervision, and continuous evaluation.

Further research is also needed to examine how such a framework operates in specific higher education contexts, including Indian colleges, where students may differ in language proficiency, digital access, academic preparation, and institutional support.

The present paper addresses this conceptual gap by proposing an integrated framework. It does not claim that the framework is the first of its kind or that its effectiveness has already been established.

VII. ARTIFICIAL INTELLIGENCE AND PERSONALISED LEARNING PATHWAYS

7.1 Concept of Personalised Learning

Personalised learning is an approach in which educational activities and support are adapted to individual students' needs, goals, and progress. It may involve changes to learning content, pace, resources, practice activities, or feedback.

Personalisation does not necessarily mean that every student follows a completely different curriculum. Instead, students may work towards common learning outcomes through different combinations of instructional support and learning activities.

AI can assist teachers in identifying suitable adaptations and recommending resources, but these recommendations require pedagogical judgement.

7.2 Adaptive Learning Systems

Adaptive learning systems use information about student responses and progress to adjust the learning experience. Depending on their design, they may recommend easier exercises, additional explanations, revision materials, or more advanced activities.

For example, an MCA student who repeatedly makes errors in database normalisation could receive additional examples and practice exercises before progressing to more complex database design.

Such systems can support differentiated learning, although inaccurate recommendations may reinforce misconceptions or restrict students' opportunities to explore more advanced material.

7.3 Intelligent Tutoring Systems

Intelligent tutoring systems provide structured guidance, explanations, hints, and feedback during learning activities.

A student working on a programming task may receive guidance about a syntax error or a logical mistake. Rather than simply displaying the correct answer, a well-designed tutor can encourage the student to identify the error and understand the underlying concept.

The educational value of tutoring systems therefore depends on the quality of their feedback and the extent to which they encourage active problem-solving.

7.4 Generative AI and Conversational Learning

Generative AI tools can respond to questions, explain concepts at different levels, produce practice questions, and provide examples relevant to a student's course.

A student studying management may request a simple explanation of decision-making models, followed by a case study and application questions. Another student may request an advanced comparison of decision-making approaches.

However, generated explanations can contain inaccuracies or omissions. Students should verify important information against textbooks, scholarly sources, and teacher-approved resources.

7.5 AI-Based Recommendation Systems

Recommendation systems can suggest educational resources based on learning objectives, demonstrated performance, and student preferences.

Examples include recommending a revision video, a reading passage, a programming exercise, or a case study. Effective recommendations should remain transparent and allow students and teachers to select alternative resources.

7.6 Learning Analytics

Learning analytics examines information about educational activities and outcomes. AI-supported analytics may help identify repeated errors, incomplete learning activities, or topics that require additional instruction.

Such indicators should not be treated as definitive measures of intelligence, motivation, or future success. They should prompt further investigation and supportive intervention.

VIII. THE ROLE OF AI IN INTELLIGENT LEARNING PROCESSES

An intelligent learning process connects the identification of learning needs with instructional support, feedback, and subsequent improvement.

8.1 Identification of Learning Needs

Initial assessments and student interactions can help establish prior knowledge and identify topics requiring additional support.

8.2 Selection of Learning Resources

AI can recommend suitable explanations, examples, exercises, and supplementary materials according to learning objectives and identified needs.

8.3 Active Learning and Practice

Students engage in activities such as solving problems, analysing case studies, writing code, participating in discussions, and completing formative assessments.

8.4 Feedback and Correction

AI-supported systems can provide preliminary feedback, hints, and explanations. Teachers can clarify misunderstandings and address complex learning difficulties.

8.5 Monitoring and Adjustment

Learning progress is reviewed using assessments, student reflections, and relevant learning records. Recommendations are adjusted when necessary.

8.6 Independent Learning and Reflection

Students evaluate their own progress, identify remaining difficulties, and take responsibility for subsequent learning activities.

This process can be represented as a continuous cycle: Identify needs → Recommend learning activities → Practise and interact → Receive feedback → Evaluate progress → Adapt the learning pathway.

Human supervision and student choice should operate throughout the cycle rather than being added only at the end.

IX. PROPOSED CONCEPTUAL FRAMEWORK

This paper proposes the Learner-Centred Intelligence Framework (LCIF) as a conceptual model for integrating AI and personalised learning pathways in higher education.

The framework contains five interconnected components.

9.1 Learner Profile and Learning Goals

The first component establishes the student's learning objectives, prior knowledge, current progress, and areas requiring support. Information should be collected only when necessary and handled according to appropriate privacy safeguards.

9.2 AI-Enabled Personalisation

The second component uses suitable AI applications to recommend learning resources, practice activities, explanations, and alternative pathways. Recommendations should be relevant to course outcomes and should not unnecessarily restrict learner choice.

9.3 Intelligent Feedback and Learning Support

The third component provides explanations, hints, formative feedback, and opportunities for correction. Feedback should encourage understanding rather than simply supplying answers.

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.4 Human Supervision and Learner Agency

The fourth component preserves the role of teachers in validating content, interpreting learning needs, providing mentoring, and making important educational decisions. Students should remain active participants who can question recommendations and select appropriate alternatives.

9.5 Continuous Evaluation and Improvement

The fifth component evaluates whether the learning pathway supports the intended outcomes. Relevant indicators may include concept mastery, assessment performance, student engagement, independent problem-solving, accessibility, and student feedback.

Table 1. Components of the Learner-Centred Intelligence Framework

Component	Main function	Expected contribution
Learner profile	Identifies learning needs and goals	Better understanding of individual requirements
AI personalisation	Recommends learning resources and activities	Flexible learning pathways

Intelligent feedback	Provides explanations and corrective guidance	Support for conceptual understanding
Human supervision	Validates recommendations and supports learners	Responsible and pedagogically appropriate use
Continuous evaluation	Examines learning progress and system performance	Evidence-based improvement

Source: Conceptual framework proposed by the author.

The framework proposes a relationship between individual learning needs, AI-supported instructional adaptation, feedback, and learning evaluation. Its educational effectiveness remains to be tested through empirical research.

IX. POTENTIAL BENEFITS OF LEARNER-CENTRED AI

10.1 Greater Responsiveness to Individual Needs

AI can help provide additional support to students who need more practice and recommend advanced activities to students who have demonstrated mastery.

10.2 Timely Feedback

Automated feedback can help students recognise errors during practice rather than waiting until the completion of a formal assessment.

10.3 Support for Self-Directed Learning

Students may use AI tools to explore unfamiliar topics, revise concepts, and identify areas requiring further study.

10.4 Assistance for Faculty Members

AI can assist faculty members with lesson preparation, formative assessment questions, learning resources, and differentiated classroom activities.

10.5 Flexible Learning Opportunities

Students can access supplementary explanations and learning resources beyond scheduled classroom hours, subject to the availability and accessibility of the relevant tools.

10.6 Support for Diverse Learners

AI may offer alternative explanations, language support, and different formats of educational material. These features should be evaluated to ensure that they meet the needs of diverse students.

These benefits represent potential educational contributions, not guaranteed outcomes. Their realisation depends on system quality, instructional design, student engagement, and appropriate evaluation.

XI. CHALLENGES AND ETHICAL CONSIDERATIONS

11.1 Accuracy and Reliability

AI systems may produce inaccurate explanations, misleading information, or fabricated references. Academic content must be checked before it is used for teaching, assessment, or research.

11.2 Privacy and Data Protection

Personalised learning systems may process student performance records and interaction data. Institutions should minimise data collection, control access, and establish appropriate retention and security practices.

11.3 Algorithmic Bias

AI recommendations may be less suitable for students whose language, educational background, or learning needs are poorly represented in system design or training data.

11.4 Student Dependence on AI

Excessive reliance on AI may reduce opportunities for independent reasoning and problem-solving. Learning activities should require students to explain their reasoning and demonstrate their understanding.

11.5 Academic Integrity

Institutions should clarify when AI assistance is permitted, how it should be disclosed, and which forms of automated assistance are inappropriate in examinations and assessed work.

11.6 Digital Inequality

Differences in device availability, internet access, affordability, and AI literacy can create unequal learning opportunities.

11.7 Faculty Readiness

Teachers need training to select appropriate tools, design meaningful learning activities, verify AI outputs, and assess student learning in AI-supported environments.

11.8 Human Relationships in Education

Education involves mentoring, discussion, motivation, ethical development, and interpersonal understanding. AI can support selected activities but should not be treated as a complete substitute for meaningful teacher-student interaction.

XII. DISCUSSION

The literature reviewed in this paper suggests that AI can support personalised learning through adaptive instruction, intelligent tutoring, resource recommendations, and automated feedback. These applications offer opportunities to make learning more responsive to individual requirements.

However, effective personalisation requires more than the availability of AI tools. The recommended content must align with course objectives, the feedback must be reliable, and the learning activities must develop meaningful knowledge and skills.

The proposed Learner-Centred Intelligence Framework connects personalisation with human supervision and continuous evaluation. Its main contribution is the integration of these elements into one conceptual structure that can guide future research and institutional planning.

For example, in an MCA programme, an AI-supported pathway could identify difficulties in Java programming, recommend targeted practice, provide preliminary feedback, and help the teacher identify topics requiring additional explanation. The teacher would still assess the student's actual understanding and ensure that learning outcomes are achieved.

Similarly, in management education, students could receive different case studies and practice activities based on their familiarity with business concepts. The aim would be to support progression towards common course outcomes rather than create arbitrary differences in academic expectations.

The framework also highlights the need to examine fairness, privacy, and independent thinking as part of educational effectiveness. A personalised system should be judged not merely by how frequently students use it, but by whether it supports meaningful learning and equitable participation.

XIII. IMPLICATIONS FOR HIGHER EDUCATION INSTITUTIONS

The proposed framework has several implications for institutional practice.

First, institutions should integrate AI into course design according to defined learning objectives rather than adopting tools solely because they are technologically advanced.

Second, faculty development should include AI literacy, assessment design, responsible data use, and the verification of AI-generated content.

Third, students should receive guidance on effective prompting, source verification, academic integrity, and independent problem-solving.

Fourth, institutions should provide equitable access to suitable learning resources and consider students who may have limited digital access or require accessible formats.

Finally, AI-supported learning initiatives should be evaluated through transparent indicators and actual educational evidence. Institutions should revise or discontinue approaches that do not provide sufficient educational value or create unacceptable risks.

XIV. FUTURE SCOPE OF RESEARCH

Future studies can test the proposed framework through empirical investigations in colleges and universities.

Possible research directions include:

1. Examining the relationship between AI-supported personalised learning and academic performance.
2. Comparing student outcomes under traditional teaching and AI-supported learning.
3. Investigating faculty and student perceptions of intelligent tutoring systems.
4. Evaluating the influence of AI literacy on independent learning and academic integrity.
5. Examining the accessibility and fairness of AI-based learning recommendations.
6. Testing the proposed framework in MCA, MBA, and undergraduate programmes.
7. Investigating whether personalised feedback improves conceptual understanding and problem-solving.

Researchers may use questionnaires, interviews, classroom observations, or comparative educational interventions. Studies should report their actual sample, instruments, analysis procedures, findings, and limitations. The proposed framework should not be considered validated until appropriate empirical evidence is available.

XV. CONCLUSION

Artificial Intelligence offers significant opportunities to support learner-centred education through personalised learning pathways, adaptive resources, intelligent tutoring, learning analytics, and individualised feedback. These applications can help students receive additional explanations, practise at an appropriate pace, and identify areas requiring improvement.

Nevertheless, AI-supported personalisation does not automatically guarantee better learning. Its effectiveness depends on the quality of educational design, the accuracy of recommendations, faculty preparedness, equitable access, data protection, and students' active participation.

This paper proposes the Learner-Centred Intelligence Framework, which connects learner profiling, AI-enabled personalisation, intelligent feedback, human supervision, and continuous evaluation. The framework provides a conceptual foundation for planning and studying responsible AI integration in higher education.

The central conclusion is that AI should complement teachers' expertise and strengthen students' capacity for independent learning. Its successful integration requires a balanced approach that combines technological innovation with pedagogical judgement, ethical responsibility, and evidence-based evaluation.

Future empirical research can determine the extent to which the proposed framework improves learning outcomes and how it can be adapted to different educational disciplines and institutional contexts.

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