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Amanah and Tabayyun as Islamic Ethical Principles for Responsible Generative Artificial Intelligence (AI) use among Medical Imaging Students

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ABSTRACT

Generative artificial intelligence (GenAI) is increasingly used in higher education for learning, assessment, simulation, reflection and scholarly writing. In Medical Imaging education, GenAI may support learning but also raises concerns about factual reliability, fabricated references, academic integrity, overreliance, patient-data confidentiality and professional judgement. This study examined how Amanah and Tabayyun may guide responsible GenAI use among Medical Imaging students. A structured targeted review followed by Islamic ethical conceptual analysis was undertaken. Thirty appraised records identified through PubMed and Google Scholar search streams were organised into four evidence tiers: Medical Imaging and Radiography, health professions, higher education, and Islamic ethical and normative evidence. Findings showed that GenAI was relevant across academic, clinical and professional, and research and scholarly-writing contexts; although educational relevance did not establish effectiveness and human oversight remained necessary. Verification of claims, references, sources and context emerged as a recurring responsibility, while ownership of reasoning, disclosure, confidentiality and accountability remained human obligations. Amanah was interpreted as accountability for the purpose, conduct and consequences of GenAI use, while Tabayyun addressed verification of AI-mediated information. Maqasid-oriented reasoning further considered intention, method, outcome, benefit and harm, particularly Hifz al-'Aql. Responsible GenAI use therefore requires accountable conduct and verified information.

1. Introduction

Medical Imaging is a healthcare discipline in which imaging technologies are used to visualise internal anatomy and support diagnosis, treatment planning and patient management. X-ray and computed tomography use ionising radiation, whereas magnetic resonance imaging uses non-ionising magnetic and radiofrequency energy. Medical Imaging education therefore extends beyond acquiring technical knowledge. Students are prepared to evaluate imaging procedures and technical image quality, adapt imaging techniques to patient needs, communicate with patients, protect

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sensitive information, and exercise professional judgement within the scope of radiographic practice, including decisions related to image quality, patient care and radiation safety.

Generative artificial intelligence (GenAI) has entered this educational environment rapidly. Medical Imaging and Radiation Sciences students have reported using artificial intelligence for learning and assessment, including idea generation, explanation, writing assistance and literature-related tasks [1]. ChatGPT has also been tested directly in Medical Imaging higher education, with better performance in basic than advanced discipline-specific tasks [2]. These findings demonstrate educational relevance, but fluent output should not be equated with disciplinary knowledge.

This distinction becomes particularly important in clinical and professional learning. When ChatGPT-4o was tested in Medical Imaging evaluation, its performance did not support replacement of expert judgement [3]. Similarly, AI-generated reflections could align superficially with professional standards while still requiring educator interpretation of contextual depth, professional insight and accountability [4]. GenAI may therefore support learning and provide material for critique, but human oversight remains essential.

The handling of sensitive patient and imaging data raises additional ethical concerns. Imaging workflows may involve patient histories, medical images, research data and contextual information that extend beyond ordinary educational material. Translating imaging artificial intelligence into legitimate medical use requires attention to ethical and regulatory integrity, privacy and data management [5]. Students using general-purpose GenAI systems may not always recognise that apparently de-identified clinical information can remain sensitive or that platform data practices may not meet institutional and professional requirements.

The first problem concerns information reliability. Fabricated and inaccurate references have been identified in ChatGPT-generated medical content [6], while other medical questions have produced limited answers accompanied by fabricated citations [7]. Although these studies did not involve Medical Imaging students, they demonstrate a transferable risk: AI-generated information may appear authoritative even when the cited source does not exist or does not support the claim. The persuasive fluency of GenAI therefore cannot itself establish the reliability of the information produced.

The second problem concerns academic and professional accountability. ChatGPT has complicated established approaches to academic integrity because assistance may range from legitimate language support to substitution of student work [8]. Accuracy alone does not resolve this concern. Students may obtain a factually correct answer while still concealing substantial AI assistance, misrepresenting authorship, disclosing confidential information or replacing the reasoning that the educational task was intended to develop. In such circumstances, both the educational purpose and the trust placed in student work may be compromised.

The third problem concerns intellectual dependence. Doctoral students have reported productive uses of artificial intelligence in academic writing alongside concerns about verification, integrity and overreliance [9]. A systematic review in medical education similarly identified critical-thinking concerns associated with AI-generated content [10]. These concerns are particularly relevant to professional education, where students must develop the capacity to analyse uncertainty, evaluate information and justify decisions rather than delegate these processes to AI.

Taken together, these problems suggest that technical AI literacy is necessary but insufficient. Knowing how to operate or prompt an AI system does not determine whether its use is honest, whether its information has been verified, whether confidential data are protected or whether human responsibility has been retained. Responsible GenAI use therefore requires attention to both the conduct of the human user and the reliability of the information being accepted.

Amanah provides an Islamic ethical vocabulary for the first dimension. It is associated with trustworthiness, entrusted duty and responsibility. Shuhari *et al*., [11] linked al-Amanah with al-Mas'uliyyah, emphasising accountability for conduct. Similarly, Idham and Khairuldin [12] related trustworthiness and responsibility to research integrity, including honest data practices and transparency. In the present analysis, Amanah is therefore applied as an ethical basis for considering purpose, ownership of reasoning, disclosure, confidentiality, competence and responsibility for consequences in GenAI use.

Tabayyun provides a complementary ethical vocabulary for the second dimension. Qur'an 49:6 instructs believers to verify information before acting in ways that may result in harm and regret. The imperative fa-tabayyanu does not refer directly to artificial intelligence; rather, it establishes a normative concern with verification before judgement or action. Contemporary research has extended Qur'anic Tabayyun to algorithmically mediated information through clarification, comparison with credible sources and contextual evaluation [13]. Applied to GenAI, Tabayyun can therefore guide the verification of claims, references, source authority, context and uncertainty before AI-mediated information is accepted or acted upon.

The two principles overlap but are not interchangeable. Amanah without Tabayyun may result in responsible intentions accompanied by acceptance of inaccurate or fabricated information. Conversely, Tabayyun without Amanah may produce verified information that is nevertheless used dishonestly, improperly delegated or obtained through inappropriate handling of confidential data. The present study therefore proposes a contemporary practice-oriented analytical distinction: Amanah addresses accountable conduct, whereas Tabayyun addresses verified information. This distinction is not presented as a settled classical doctrine for artificial intelligence, but as a contemporary application of the two principles to recurring challenges associated with GenAI.

Maqasid al-Shariah provides a wider normative orientation for this analysis. A Maqasid-based bioethical approach considers intention, method and outcome together with maslahah, mafsadah, hierarchy of interests, inclusivity and certainty [14]. Applied cautiously to GenAI, this broadens ethical evaluation beyond whether an AI-generated answer is useful or technically correct. It also asks why AI is being used, whether the method of use is ethically acceptable and whether the likely outcome brings benefit or harm. Within this orientation, Hifz al-'Aql is particularly relevant because responsible GenAI education should preserve human reasoning, critical judgement and intellectual responsibility rather than replace them. Hifz al-Nafs may also become relevant where educational practices subsequently influence patient safety.

Within the reviewed evidence, no direct Medical Imaging study was identified that integrated Amanah and Tabayyun as complementary Islamic ethical principles for responsible GenAI practice. This gap is significant because Medical Imaging brings together complex learning, sensitive patient information, image interpretation and professional accountability within a single educational discipline. The objective of this study was therefore to examine how Amanah and Tabayyun can guide the responsible use of GenAI among Medical Imaging students, while clarify their distinct contributions and identify practice-oriented implications for students, educators and programmes.

2. Methodology

2.1 Review Design

A structured targeted review followed by Islamic ethical conceptual analysis was undertaken. This design was selected to integrate heterogeneous empirical, educational, methodological and normative evidence around a defined professional and ethical problem rather than estimate prevalence or conduct statistical synthesis. Integrative-review principles guided the combination of

diverse evidence [15]. Search reporting was informed by Preferred Reporting Items for Systematic Reviews and Meta-Analyses literature search extension (PRISMA-S) [16], while PRISMA 2020 principles supported record-flow organisation without classifying the study as a conventional systematic review [17].

2.2 Information Sources and Search Strategy

Structured searches centred on PubMed and Google Scholar. Publisher webpages, DOI records, PubMed citation records and institutional repositories supported bibliographic verification and full-text retrieval. SciSpace was used only for terminology development, known item checking and seed identification; generated summaries or rankings were not treated as evidence without verification against original publications.

Separate search streams covered four concept blocks: GenAI terms, including ChatGPT, large language models and AI chatbots; Medical Imaging and Radiography education, students, learners and trainees; responsible-use mechanisms, including integrity, verification, hallucination, fabricated references, critical thinking, overreliance, privacy, professional judgement and AI literacy; and Islamic ethical concepts, including Amanah, Tabayyun, Maqasid al-Shariah and Hifz al-'Aql. GenAI evidence was principally sought from 2022 to 6 August 2026, with earlier contextual and foundational literature retained where relevant.

2.3 Eligibility, Evidence Tiers and Record Management

Peer-reviewed empirical, review, conceptual, framework and normative papers addressing predefined educational, integrity, verification, privacy, professional or Islamic ethical mechanisms were eligible. Purely technical diagnostic-algorithm studies without educational or ethical relevance, unverifiable publications, retracted articles and superseded versions were excluded. The primary population comprised students in Medical Imaging, Diagnostic Radiography, Radiography, Radiologic Technology, Radiologic Sciences and Medical Radiation Sciences across educational levels. Supporting literature was retained only when mechanisms were transferable.

Thirty appraised records formed the analytic pool: Tier 1, direct Medical Imaging/Radiography evidence; Tier 2, health-professions evidence; Tier 3, transferable higher-education evidence; and Tier 4, Islamic ethical and normative evidence. Tiers represented contextual directness, not methodological quality. DOI, PubMed Identifier (PMID), title, author-year-journal and publication-version checks supported record management.

2.4 Critical Appraisal and Evidence Weighting

Critical appraisal was matched to study design. The Mixed Methods Appraisal Tool (MMAT) [18] was applied to relevant qualitative, quantitative descriptive and mixed-methods studies, while the Scale for the Assessment of Narrative Review Articles (SANRA) [19] was used for narrative and selected rapid-review evidence. Appropriate Joanna Briggs Institute (JBI) critical-appraisal tools were applied to qualitative, review and textual evidence. Additional design-specific criteria were used where necessary for AI performance evaluations, reference audits, framework or prototype studies, privacy-related evidence and Islamic normative analyses. No appraisal checklist was converted into a percentage quality score, and methodological quality was considered separately from study eligibility.

Of the 30 appraised records, six were judged to have moderate-to-high confidence, 18 moderate confidence and six low-to-moderate confidence. Evidence was subsequently weighted qualitatively according to disciplinary directness, methodological confidence and documented access limitations. The weighting informed the strength of interpretation rather than functioning as an exclusion threshold or numerical quality score.

2.5 Data Synthesis and Islamic Ethical Analysis

Evidence was extracted into a structured matrix and synthesised across academic learning, clinical/professional learning, and research/scholarly writing. Evidence-supported mechanisms included inaccurate output, fabricated references, integrity, overreliance, professional judgement, privacy and AI literacy. These mechanisms were then examined through Amanah and Tabayyun, while distinguishing source-derived Islamic claims from the present paper's interpretation and contemporary GenAI application. Maqasid-oriented reasoning provided a broader evaluative perspective rather than a pre-existing GenAI framework. Transferability was considered so that supporting health-professions, higher-education and normative evidence was not misrepresented as direct Medical Imaging student evidence.

3. Results

3.1 Characteristics of the Evidence Base

The final analytic evidence pool comprised 30 appraised records as shown in Table 1. 14 Tier 1 records representing direct Medical Imaging and Radiography evidence, six Tier 2 records from health professions and healthcare, five Tier 3 records from higher education and postgraduate contexts, and five Tier 4 records comprising Islamic ethical and normative evidence. The included literature encompassed student-perception and qualitative studies, model-performance evaluations, assessment studies, simulation pilots, reviews, competency and curriculum papers, reference audits, and normative analyses.

Table 1
Evidence composition and interpretive role

Evidence Tier	Role in the Analysis	Records	Interpretive Boundary
Tier 1	Direct Medical Imaging and Radiography evidence	14	Claims remain limited by study design, population, educational level and AI task
Tier 2	Supporting health-professions and healthcare evidence	6	Not reported as findings from Medical Imaging students
Tier 3	Transferable higher-education and postgraduate evidence	5	Disciplinary and educational-level transferability is stated explicitly
Tier 4	Islamic ethical and normative evidence	5	Used for normative reasoning, not empirical educational-effectiveness claims
Total	Structured targeted-review evidence pool	30	Used for conceptual synthesis rather than prevalence estimation

Direct disciplinary relevance did not necessarily correspond to methodological strength. Several Tier 1 studies were exploratory, pilot or task-specific, whereas some methodologically stronger reviews were less directly transferable to Medical Imaging students. The evidence tiers were therefore used to distinguish contextual directness rather than methodological quality.

The evidence contributed to three overlapping educational domains. Twenty records addressed academic learning, assessment or curriculum; five addressed clinical or professional learning; and eight addressed research or scholarly writing. Individual records could contribute to more than one domain. Across these domains, recurring concerns involved information accuracy, reference integrity, academic ownership, overreliance, professional judgement, privacy and data handling, and preparedness for responsible AI use.

3.2 GenAI in Academic Learning, Assessment and Curriculum

GenAI was used or evaluated across several academic activities, including explanation, revision, writing support, assessment, question generation and curriculum-related applications. Lewis *et al*., [1] reported that Medical Imaging and Radiation Sciences students used AI for learning and assessment, including idea generation, explanation and writing-related activities. Concerns regarding reliability and acceptable use were also identified.

Currie *et al*., [2] evaluated ChatGPT within Medical Imaging higher education and found stronger performance on relatively basic tasks than on more advanced tasks requiring discipline-specific reasoning. The findings indicated that performance varied according to the complexity and disciplinary demands of the task.

Evidence concerning AI preparedness and assessment provided additional educational context. Arif [20] reported interest among Radiologic Technology students in AI adoption and identified a need for educational preparation. This study concerned broader AI adoption and readiness rather than actual GenAI use. Emekli and Karahan [21] evaluated AI-generated multiple-choice questions in Radiography education and demonstrated potential for assessment use, although expert review and psychometric evaluation remained necessary.

A different educational approach was examined by Lewis [24], who used an AI-generated research concept paper as the object of student critique in Medical Imaging education. Students were required to identify weaknesses, examine claims and consider evidential quality rather than accept the generated material as a completed response. In supporting higher-education literature, Chee *et al.*, [25] conceptualised AI literacy as extending beyond operational competence to include critical evaluation and ethical awareness.

Taken together, the academic evidence demonstrated that GenAI has relevance to learning, assessment and curriculum development. However, student readiness, perceptions, AI-generated assessment material and task performance did not independently establish improved learning outcomes. The evidence therefore supported educational relevance rather than uniform educational effectiveness.

3.3 GenAI in Clinical and Professional Learning

Clinical and professional applications included radiographic evaluation, simulated patient communication, case-based learning and generated reflection. Arruzza *et al*., [3] evaluated ChatGPT-4o in Medical Imaging evaluation and found that its performance did not support replacement of expert judgement. The study demonstrated limitations in using generated responses for tasks requiring discipline-specific image-evaluation capability. Nabasenja *et al*., [4] examined AI-generated reflections against professional standards in Diagnostic Radiography. Although elements of the generated reflections could be aligned with professional standards, interpretation remained dependent on educator assessment of contextual depth, person-centredness and professional insight.

GenAI was also investigated as a tool for simulated learning. Bonfitto *et al*., [22] explored ChatGPT-based dialogue for MRI claustrophobia education, demonstrating its potential to provide repeatable communication practice. However, the study did not establish transfer of this performance to actual patient encounters. Zhong and Chow [23] investigated GenAI clinical case-based simulations in Radiography education and similarly demonstrated educational potential within a pilot setting, while limitations remained regarding realism, study design and outcome measurement.

Across these studies, GenAI demonstrated potential as a resource for simulation, rehearsal, reflection and critique. The available evidence did not establish autonomous professional competence, replacement of expert judgement or improved patient outcomes.

3.4 GenAI in Research and Scholarly Writing

Research and scholarly-writing evidence demonstrated concerns regarding the reliability of AI-generated information and references. Bhattacharyya *et al*., [6] identified fabricated and inaccurate references in ChatGPT-generated medical content. Similarly, Gravel *et al*., [7] reported fabricated citations in ChatGPT responses to medical questions. Although these studies did not involve Medical Imaging students, they demonstrated a transferable mechanism relevant to scholarly work: an apparently plausible AI-generated reference may not exist, may contain inaccurate bibliographic information or may not support the claim with which it is associated.

Direct disciplinary evidence was provided by Lewis [24], whose use of an AI-generated research concept paper required Medical Imaging students to engage critically with generated claims and evidential quality. Rather than treating GenAI output as a completed scholarly product, the generated material functioned as an object for evaluation. Transferable postgraduate evidence provided a further perspective. Pratiwi *et al*., [9] reported that doctoral students used AI for purposes including drafting, language support and idea development, while also identifying concerns regarding manual verification, academic integrity and overreliance. Because the population consisted of doctoral students outside the direct Medical Imaging context, these findings were treated as transferable rather than direct disciplinary evidence.

Taken together, the evidence indicated that GenAI may support aspects of scholarly activity while simultaneously introducing challenges concerning source reliability, academic integrity and intellectual ownership. Reference verification and retained ownership of interpretation emerged as particularly relevant concerns within this domain.

3.5 Recurring Ethical and Professional Risks

Seven recurring concerns were identified across the reviewed evidence. First, information reliability was challenged by inaccurate, unsupported or insufficiently authoritative AI-generated content. The variable performance reported in discipline-specific Medical Imaging tasks [2,3] demonstrated that fluent responses did not necessarily indicate reliable disciplinary reasoning. Second, reference integrity emerged as a distinct concern. Fabricated and inaccurate citations were documented in medical GenAI outputs by Bhattacharyya *et al*., [6] and Gravel *et al*., [7], demonstrating that apparent scholarly form did not guarantee the existence or relevance of the underlying source.

Third, academic integrity and ownership were implicated when AI assistance substituted for student work or obscured authorship. Cotton *et al*., [8] described the challenges that ChatGPT presents to established approaches to academic integrity, particularly where the boundary between

legitimate assistance and inappropriate substitution becomes unclear. Fourth, overreliance and reduced critical engagement were identified as concerns in supporting literature. Pratiwi *et al*., [9] reported concerns regarding overreliance among doctoral students using AI for academic writing, while Li *et al*., [10] identified critical-thinking concerns associated with AI-generated content in medical education.

Fifth, professional judgement and human oversight remained relevant in clinical and professional learning. The limitations observed by Arruzza *et al*., [3] in Medical Imaging evaluation and the educator-dependent interpretation reported by Nabasenja *et al*., [4] indicated that generated output could not be equated with professional competence. Sixth, privacy and the handling of sensitive information were relevant where AI use intersected with patient, imaging or research data. Pesapane *et al*., [5] identified ethical and regulatory integrity, privacy and data management as important considerations in translating imaging artificial intelligence into medical use.

Seventh, educational preparedness remained uneven. AI-readiness evidence indicated a need for curricular preparation [20], while AI-literacy evidence emphasised critical evaluation and ethical awareness alongside technical competence [25].

These concerns were interconnected but not identical. Information accuracy and reference reliability primarily concerned the trustworthiness of AI-mediated information. Academic ownership, confidentiality and accountability concerned the conduct of the human user. Overreliance and professional judgement intersected both dimensions because they involved both the evaluation of information and the retention of human reasoning and responsibility.

The findings across the three educational domains are synthesised in Table 2. The table distinguishes the principal GenAI-supported activities identified within each domain, the responsibilities that emerged from the reviewed evidence, and the interpretive boundaries of the available literature. Across academic learning, clinical and professional learning, and research and scholarly writing, GenAI demonstrated educational relevance, but it's appropriate use remained dependent on critical engagement, human oversight, source verification and retained ownership of reasoning.

Table 2
Synthesis of findings across the three educational domains

Educational Domain	Evidence-Supported Uses	Principal Responsibility	Interpretive Boundary
Academic learning, assessment and curriculum	Explanation, writing support, question generation, critique, readiness and curriculum planning	Critical engagement, ownership and transparent assessment	Relevance was established; uniform effectiveness was not
Clinical and professional learning	Scenario coaching, reflection, communication simulation, case-based learning and image evaluation	Human oversight, contextual judgement and competence	No autonomous decision-making or patient-benefit claim
Research, thesis and scholarly writing	Literature-related work, drafting, concept-paper critique and reference generation	Source verification, research integrity and ownership of interpretation	Postgraduate evidence was treated as transferable where appropriate

3.6 Islamic Ethical and Normative Evidence

Five Tier 4 records contributed Islamic ethical and normative evidence to the review. These sources were analysed as normative and conceptual evidence rather than as empirical evidence of student behaviour or educational effectiveness. Shuhari *et al*., [11] linked al-Amanah with al-Mas'uliyyah, emphasising trustworthiness and responsibility for conduct. Idham and Khairuldin [12] similarly examined trustworthiness and responsibility in relation to research integrity, including honest scholarly practices and transparency.

Evidence relevant to Tabayyun focused on the verification of information and the authority of knowledge sources. Fepriani and Ratnasari [13] related Qur'anic Tabayyun to the evaluation of algorithmically mediated information, including clarification, comparison with credible sources and contextual assessment. This normative evidence was considered alongside Qur'an 49:6, which provides the foundational textual basis for verification before judgement or action.

A broader ethical orientation was provided by Ibrahim *et al*., [14], who presented a Maqasid al-Shariah-based bioethical approach that considers intention, method and outcome together with maslahah, mafsadah, hierarchy of interests, inclusivity and degree of certainty. The article also situated ethical evaluation within al-daruriyyat al-khams, including Hifz al-'Aql. These sources did not address GenAI use among Medical Imaging students directly; rather, they provided the normative concepts subsequently examined in relation to the empirical and educational concerns identified across the other evidence tiers.

4. Discussion

4.1 From AI Literacy to Ethical Responsibility

The findings indicate that responsible GenAI use in Medical Imaging education cannot be addressed through technical AI literacy alone. Existing educational approaches appropriately emphasise AI literacy, academic integrity, critical evaluation and responsible use. Chee *et al*., [25], for example, conceptualised AI literacy as extending beyond operational competence to include critical evaluation and ethical awareness. These dimensions remain important, but the present synthesis suggests that they encompass different forms of responsibility that benefit from clearer conceptual distinction.

Two broad dimensions emerged from the reviewed evidence. The first concerns the reliability of AI-mediated information, including inaccurate claims, fabricated references, inadequate source authority and loss of context [6,7]. The second concerns the conduct of the human user, including ownership of reasoning, disclosure, confidentiality and responsibility for final work [1,5,8]. Overreliance intersects both dimensions because dependence on generated output may reduce critical verification while simultaneously transferring cognitive responsibility away from the learner [9,10].

This distinction matters because technically competent AI use is not necessarily responsible use. A student may be skilled at prompting an AI system but unable to determine whether its response is evidentially sound. Conversely, an AI-generated response may be factually correct while the way it was obtained or presented remains academically or professionally inappropriate.

The present analysis interprets these two dimensions through Amanah and Tabayyun. Amanah addresses accountability for how GenAI is used, whereas Tabayyun addresses responsibility for verifying information accepted from it. This represents a contemporary practice-oriented interpretation of the two principles rather than a claim that classical Islamic evidence established a formal two-part doctrine for artificial intelligence.

4.2 Tabayyun and Responsibility for Information Verification

The information-reliability findings provide a strong basis for applying Tabayyun to GenAI-supported education. Qur'an 49:6 establishes a normative concern with verification before judgement or action. The imperative fa-tabayyanu does not refer directly to artificial intelligence, but the underlying requirement to examine information before acting upon it is relevant to AI-mediated knowledge. Fepriani and Ratnasari [13] similarly related Qur'anic Tabayyun to source clarification, comparison with credible references and contextual evaluation in algorithmically mediated information.

The need for such verification is reinforced by empirical evidence. Bhattacharyya *et al*., [6] identified fabricated and inaccurate references in ChatGPT-generated medical content, while Gravel *et al*., [7] similarly reported fabricated citations in responses to medical questions. Together, these studies demonstrate an important characteristic of GenAI: linguistic plausibility does not guarantee evidential reliability.

Tabayyun is therefore relevant to more than simple factchecking. Applied to GenAI, verification may involve treating generated output initially as a claim rather than authority, examining the factual claim, confirming that a cited source exists, determining whether the source actually supports the claim, considering the authority and relevance of the source, and evaluating context and uncertainty before the information is accepted, revised or rejected.

This distinction is particularly relevant in Medical Imaging education because technical and professional information is often context dependent. An answer may contain generally accurate information but remain inappropriate for a particular imaging procedure, patient circumstance or professional context. Verification should therefore extend beyond factual correctness to include disciplinary authority, contextual relevance and appropriate uncertainty. The present analysis consequently interprets Tabayyun as epistemic responsibility for what is accepted from AI. Its educational value lies not in rejecting AI-generated information, but in preventing fluency from becoming a substitute for evidence.

4.3 Amanah and Accountability for GenAI Use

Amanah addresses the corresponding question of responsibility for the human act of using GenAI. Shuhari *et al*., [11] linked al-Amanah with al-Mas'uliyyah, positioning trustworthiness alongside responsibility for conduct. Idham and Khairuldin [12] similarly connected trustworthiness and responsibility with research integrity, including honest scholarly practice and transparency. Applied to GenAI, Amanah does not imply that the technology itself possesses moral responsibility. Rather, it focuses attention on responsibilities that remain entrusted to the human user. Five dimensions are particularly relevant: purpose, ownership, disclosure, confidentiality and consequences.

Purpose concerns whether GenAI is being used consistently with the intended educational, clinical or research task. Ownership concerns whether the reasoning and interpretation remain genuinely defensible by the student. Disclosure concerns whether substantive AI assistance is represented honestly where disclosure is required. Confidentiality concerns the appropriate handling of patient, imaging and research information. Consequences concern responsibility for the final submission, communication or professional action.

The reviewed evidence illustrates why accuracy alone cannot resolve these concerns. Lewis *et al*., [1] demonstrated that AI use already extends across learning and assessment among Medical Imaging and Radiation Sciences students, while broader academic-integrity literature identifies uncertainty around the boundary between legitimate assistance and inappropriate substitution [8]. In the imaging context, privacy and responsible data management provide an additional concern [5]. A generated response may therefore be factually correct while still being used in a manner that

undermines the educational purpose, misrepresents student contribution or exposes sensitive information. The present analysis consequently interprets Amanah as accountability for what is done with AI. Human responsibility is not transferred merely because an AI system contributes to the final output.

4.4 Complementarity of Amanah and Tabayyun

The complementarity of Amanah and Tabayyun becomes clearer when the limitations of applying either principle in isolation are considered. Amanah, understood in relation to trustworthiness and responsibility [11,12], does not by itself ensure the reliability of information accepted from GenAI. A student may use GenAI for a legitimate educational purpose, disclose the assistance appropriately and retain responsibility for the final work, yet still reproduce an inaccurate explanation or fabricated citation. This concern is supported by evidence that GenAI-generated medical content may contain fabricated or inaccurate references [6,7]. Responsible intention and accountable conduct therefore do not remove the need to verify information.

Conversely, verification alone does not ensure responsible conduct. Tabayyun emphasises careful examination of information and has been associated with source clarification, comparison with credible references and contextual evaluation [13]. A student may nevertheless verify every factual claim and citation while concealing substantial AI assistance, bypassing the reasoning that an assessment was intended to develop or using sensitive information inappropriately. Such concerns are consistent with wider literature on academic integrity and responsible data handling in AI-supported environments [5,8]. Verified information can therefore still be used irresponsibly.

The present analysis consequently proposes that responsible GenAI use requires both accountable conduct and verified information. Within this contemporary practice-oriented interpretation, Amanah addresses responsibility for how GenAI is used, whereas Tabayyun addresses responsibility for verifying information accepted from GenAI. Their complementarity does not imply that they are the only Islamic ethical principles relevant to AI. Taqwa, Sidq, ‘Adl, Ihsan, Mas’uliyyah and Maqasid al-Shariah remain relevant within a broader Islamic ethical account. Rather, Amanah and Tabayyun are foregrounded here because they correspond directly to two recurring problems identified in the reviewed evidence: human accountability and information reliability.

The contribution of this distinction is not the creation of a new Islamic doctrine, but the operational clarification of two established ethical principles for a contemporary educational problem. Amanah identifies responsibilities that remain with the human user, while Tabayyun identifies the verification required before AI-mediated information can reasonably be accepted. This distinction provides greater analytical precision than a general instruction to use AI ethically. Fabricated references, for example, represent primarily a verification problem [6,7], whereas concealed assistance and inappropriate authorship primarily concern accountability [8]. Overreliance may involve both because it can weaken critical verification while simultaneously transferring reasoning away from the learner [9,10]. Educational responses can therefore be aligned more closely with the responsibility involved.

4.5 Relevance to Medical Imaging Education

Although many of these concerns apply across higher education, Medical Imaging provides a distinctive professional context because technical knowledge, patient interaction, sensitive information and radiographic judgement intersect within the same educational pathway. Medical Imaging students are not trained to make medical diagnoses in the manner of radiologists. Their

professional development involves the safe and appropriate conduct of imaging examinations, technical evaluation of image quality, adaptation of imaging techniques to patient circumstances, patient care, radiation protection and recognition of situations requiring further professional input. The concern is therefore not that GenAI will replace radiological diagnosis by students, but that inappropriate reliance on GenAI may interfere with the development of judgement required within radiographic practice.

The direct disciplinary evidence supports this distinction. Currie *et al*., [2] demonstrated weaker ChatGPT performance as Medical Imaging tasks became more advanced, while Arruzza *et al*., [3] found that ChatGPT-4o performance in Medical Imaging evaluation did not support replacement of expert judgement. Nabasenja *et al*., [4] further showed that apparently professional AI-generated reflection still required human interpretation of contextual and professional dimensions. These findings suggest that fluency should not be mistaken for competence. A verification failure may affect how technical or professional information is understood, while an accountability failure may involve inappropriate delegation of reasoning or unsuitable handling of patient-related information. Where both occur together, unreliable information may be acted upon without adequate human responsibility.

Responsible GenAI education in Medical Imaging should therefore remain connected to the professional capabilities students are expected to develop, rather than being addressed solely through generic university-level academic-integrity rules.

4.6 Maqasid al-Shariah and Hifz al-'Aql

Maqasid al-Shariah provides a broader normative orientation rather than a third operational principle competing with Amanah and Tabayyun. Ibrahim *et al*., [14] presented a Maqasid-based bioethical approach in which new technologies are considered through intention, method and outcome together with maslahah, mafsadah, hierarchy of interests, inclusivity and degree of certainty. Applied cautiously to GenAI, this perspective broadens the ethical question beyond whether an output is useful or technically correct. It asks three related questions: Why is AI being used? How is it being used? What consequences may follow? A correct output may still be produced through an inappropriate method, while a legitimate educational purpose may become problematic if the method bypasses the cognitive work that learning is intended to develop.

Within this orientation, Hifz al-'Aql has relevance to education. Preservation of intellect need not be interpreted only as protection against cognitive harm. In an educational context, it may also be understood positively as maintaining conditions in which reasoning, discernment, critical judgement and intellectual responsibility continue to develop. This interpretation is relevant to concerns about overreliance. Pratiwi *et al*., [9] identified both productive and problematic uses of AI among doctoral students, including the need for manual verification and concerns regarding dependence. Li *et al*., [10] similarly identified critical-thinking concerns in medical education, while Chee *et al*., [25] positioned critical evaluation as part of broader AI literacy.

The educational question is therefore not simply whether students are permitted to use GenAI. A more important question is whether the mode of use continues to exercise the intellectual capacities that the learning activity or assessment is intended to develop. Hifz al-Nafs may have secondary relevance where deficiencies in professional formation later affect patient safety. However, neither Hifz al-'Aql nor Hifz al-Nafs is presented here as an empirically demonstrated outcome of the reviewed studies. They function as normative considerations for evaluating the purpose and consequences of GenAI-supported education.

The relationship among these ethical perspectives is summarised in Table 3. Within the present analysis, Amanah and Tabayyun serve as complementary practice-oriented principles addressing accountable conduct and verification of AI-mediated information, respectively, while Maqasid al-Shariah provides a broader orientation for evaluating intention, method, outcome, benefit and harm. In the educational context, Hifz al-'Aql further directs attention to the preservation and continued development of human reasoning and judgement.

Table 3
Conceptual distinction between Amanah, Tabayyun and the Maqasid-oriented perspective

Dimension	*Amanah*	*Tabayyun*	*Maqasid*-Oriented Perspective
Central Question	Is GenAI being used responsibly?	Has AI-mediated information been adequately verified?	Are purpose, method and consequences ethically beneficial and defensible?
Primary Focus	Purpose, ownership, disclosure, confidentiality, competence and consequences	Claims, references, source authority, context and uncertainty	Intention, means, outcome, benefit, harm, hierarchy and certainty
Typical Failure	Dishonest delegation, concealed assistance or misuse of entrusted data	Acceptance of inaccurate, fabricated or decontextualised information	A useful output produced through an inappropriate method or harmful outcome
Educational Emphasis	Accountable conduct	Verified information	Preservation of reasoning and judgement, especially Hifz al-'Aql

4.7 Implications for Medical Imaging Education

The conceptual synthesis has implications at student, educator, clinical-supervision and programme levels. At student level, responsible GenAI use should begin with a defensible educational purpose. Ownership of reasoning should be retained, sensitive information protected, important claims and references verified, AI assistance disclosed where required, and final work understood sufficiently to be explained and defended. In this way, Amanah and Tabayyun can be translated from abstract ethical concepts into observable educational practices.

At educator level, reasoning and verification should be made visible through assessment. Evaluation should therefore extend beyond the correctness of the final answer. Rubrics may include justification of reasoning, evaluation of sources, identification of AI-generated errors and correction of unsupported claims. Critique-and-correct activities, annotated source trails, comparison with authoritative guidance and oral defense provide possible mechanisms. Lewis [24] provides a useful disciplinary example. Rather than asking students simply to produce work with AI, an AI-generated research concept paper was made the object of critique. Such an approach changes the role of GenAI from answer-provider to material for analysis and evaluation.

This approach is also compatible with higher-order learning. Students may be required to analyse an AI-generated response, evaluate the quality of its evidence and create a corrected or improved response. Bloom's taxonomy is relevant here as an educational implementation perspective rather than as an Islamic ethical foundation. The purpose is not to prohibit GenAI, but to design its use so that the cognitive work intended by the assessment remains active.

Within clinical supervision, GenAI may be positioned as a rehearsal, simulation or feedback aid. Communication simulation and case-based learning have demonstrated educational potential [22,23], but generated material should remain subject to comparison with patient context, institutional procedures and professional standards. Human validation remains especially important where inaccurate material could influence professional formation. At programme and institutional

levels, AI literacy should extend beyond prompting skills to include verification, disclosure, privacy, data governance, professional standards and accountability. Clear expectations are needed regarding permitted assistance, unsuitable data, approved platforms and responsibility for final work.

These implications can be condensed into ten practice-oriented principles: use GenAI for a legitimate purpose; retain ownership of reasoning; disclose assistance where required; verify generated claims; verify references independently; protect sensitive information; retain human professional judgement; teach critical and ethical AI literacy; design assessments that make reasoning visible; and evaluate intention, method, outcome, benefit and harm.

Table 4
Practice-oriented implications for responsible GenAI education

Level	Practice-Oriented Implication	Ethical Basis	Educational Action
Student	Retain ownership of reasoning and final work	*Amanah*	Explain and defend conclusions without transferring responsibility to the system
	Verify claims and references independently	*Tabayyun*	Open the source, confirm bibliographic details and check that it supports the claim
	Protect sensitive and entrusted information	*Amanah*	Do not place identifiable patient, imaging or research data in unsuitable tools
Educator	Make reasoning and verification visible	*Amanah* and *Tabayyun*	Use critique-and-correct tasks, source trails, justification and oral defence
Programme	Integrate critical and ethical AI literacy	*Amanah* and *Tabayyun*	Teach verification, disclosure, privacy, human oversight and professional accountability
Institution	Evaluate purpose, method and consequences	*Maqasid*-oriented reasoning	Review approved platforms, data practices, benefits, harms and uncertainty

4.8 Limitations and Future Research

Several limitations should be recognised. GenAI technologies evolve rapidly, and findings relating to one model or version may not transfer directly to subsequent systems. The direct Radiography literature remains emerging and includes pilot studies, performance evaluations, perception studies and task-specific investigations. These designs identify educational opportunities and risks but provide limited evidence concerning sustained learning, clinical transfer or patient outcomes.

The analysis also relied on supporting health-professions and higher-education literature for mechanisms that remain insufficiently examined in Medical Imaging, particularly reference integrity, metacognition and postgraduate scholarly writing. These findings were treated as transferable rather than as direct evidence from Medical Imaging students. Some records addressed general AI readiness rather than actual GenAI behavior.

A further limitation concerns the Islamic ethical synthesis itself. Amanah, Tabayyun and Maqasid were not empirically tested as educational interventions in the reviewed Medical Imaging literature. The distinction between Amanah as accountable conduct and Tabayyun as verified information represents the present paper's contemporary analytical interpretation. Similarly, the application of Hifz al-'Aql represents a Maqasid-oriented interpretation rather than a demonstrated educational outcome.

Future studies should therefore examine these principles among diploma, undergraduate, flexible-learning, postgraduate and clinical-placement students, as well as educators and clinical supervisors. Outcomes could include verification of AI-generated claims, detection of fabricated references, disclosure practices, ownership of reasoning, critical-thinking performance, protection of patient-related information, recognition of unsafe output, professional judgement and indicators of overreliance.

Qualitative studies could also explore how students and educators understand Amanah, Tabayyun and Hifz al-'Aql in everyday GenAI practice. Subsequent curriculum and assessment interventions could then determine whether explicit teaching of accountable use and verification changes observable behaviour.

5. Conclusions

The evidence showed that GenAI is relevant to academic learning, clinical and professional learning, and research and scholarly writing. It can support explanation, assessment, simulation, reflection and writing. However, educational relevance should not be confused with proven effectiveness, and fluent output should not be treated automatically as reliable knowledge or professional competence.

Amanah and Tabayyun contribute different but complementary forms of responsibility. Amanah concerns accountability for the purpose, conduct and consequences of using GenAI, including ownership of reasoning, disclosure, confidentiality, competence and responsibility for final work. Tabayyun concerns verification of AI-mediated claims, references, sources, context and uncertainty before information is accepted or acted upon. Amanah without Tabayyun can transmit false information; Tabayyun without Amanah can produce accurate but dishonest or irresponsible practice.

Maqasid-oriented reasoning strengthens this synthesis by extending the ethical test to intention, method, outcome, benefit and harm. Hifz al-'Aql is especially relevant because responsible GenAI education should preserve human reasoning and judgement rather than replace them. The resulting contribution is a practice-oriented conceptual synthesis, not a validated framework. Responsible GenAI education should ultimately make students answerable for both what is done with AI and what is accepted from AI.

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