

From Experiencers to Creators: Agentic AI, Metaverse Learning, and Implications for Islamic Education

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Abstract

Agentic artificial intelligence (AI) is shifting metaverse learning from immersive exposure toward goal-directed inquiry, yet existing frameworks rarely explain how learners move from experiencing content to creating knowledge, and few consider how such designs can be aligned with the values of Islamic education. This study aims to develop an integrated framework that explains how agentic AI roles, metaverse affordances, and adaptive scaffolds jointly support learner agency, self-directed inquiry, and knowledge construction, and to derive its implications for Islamic education. Using a theory-building structured literature review, the study analysed 48 scholarly sources published between 2022 and 2026 through deductive-inductive qualitative coding, cross-case comparison, and framework mapping. The synthesis yields CREATE-M, a framework comprising Co-designed goals, Role-differentiated agents, Embodied inquiry, Artifact construction, Testing and iteration, and Evaluation and reflection within a Metaverse ecology. The results show that role-differentiated agents expand learner agency when they mentor, critique, and curate rather than supply answers; that metaverse affordances foster embodied and social inquiry only when pedagogically structured; and that learner-controlled adaptive scaffolds convert inquiry into visible, revisable knowledge artifacts, so all three hypotheses are conditionally supported. Read through the principles of *tafakkur* (reflective inquiry), *tabayyun* (verification), and *adab* (ethical conduct in learning), CREATE-M offers design guidance for madrasahs, pesantren, and Islamic higher education, together with testable propositions for future empirical research.



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INTRODUCTION

Digital transformation is reshaping how knowledge is accessed, produced, and shared in education, and two technologies now sit at the centre of that change: artificial intelligence (AI)

and immersive metaverse environments.¹ Recent reviews show that metaverse and generative AI applications in education are expanding rapidly, while questions of pedagogy, evaluation, and ethics remain underexplored.² The newest development is agentic AI—systems that do not merely respond to prompts but plan, monitor, critique, and collaborate with learners—which makes the question of learner agency more urgent than ever.³ Self-efficacy, autonomy support, and self-learning motivation are strongly implicated in learning outcomes, yet most AI deployments still position students as recipients of generated content rather than as creators of knowledge.⁴ A meta-analysis of AI and learner autonomy confirms that gains in self-regulated and self-directed learning depend on how AI is designed into the learning process, not merely on whether AI is present.⁵ For Islamic education, whose tradition has long joined the pursuit of knowledge with the formation of character, this design question is not only technical but also pedagogical and ethical.

The current state of knowledge can be summarized along three strands. The first concerns agentic AI, understood as AI that pursues goals, makes plans, monitors progress, and acts with some autonomy within a learning ecology.⁶ Multi-agent frameworks such as the Learning Engagement Assistant demonstrate how adaptive agents can personalize learning, bibliometric analyses show rapidly rising attention to agentic AI in higher education, and research on knowledge building shows that the way generative AI is woven into students' idea work shapes both the knowledge they build and their AI literacy.⁷ Studies of agent roles further show that mentor, collaborator, critic, and curator roles have different consequences for learner control, and that AI-assisted settings strengthen self-regulation only when learners retain decision

¹ Muhammad Tukur et al., "Metaverse and Generative AI in Education: A Scoping Review of Technologies, Applications, Evaluation, Challenges, and Future Directions," *Frontiers in Blockchain* 9 (2026): 1860582, <https://doi.org/10.3389/fbloc.2026.1860582>; Shreya Virani and Sonica Rautela, "Metaverse and Education: Identifying Key Themes and Future Research Trajectories," *International Journal of Information and Learning Technology* 42, no. 1 (2025): 84–106, <https://doi.org/10.1108/IJILT-05-2024-0083>.

² Tukur et al., "Metaverse and Generative AI in Education."

³ Jihad Alqurni, "Exploring the Role of Agentic AI in Fostering Self-Efficacy, Autonomy Support, and Self-Learning Motivation in Higher Education," *Frontiers in Artificial Intelligence* 9 (2026): 1738774, <https://doi.org/10.3389/frai.2026.1738774>.

⁴ Alqurni, "Exploring the Role of Agentic AI."

⁵ Krishnashree Achuthan, "Artificial Intelligence and Learner Autonomy: A Meta-Analysis of Self-Regulated and Self-Directed Learning," *Frontiers in Education* 10 (2025): 1738751, <https://doi.org/10.3389/feduc.2025.1738751>.

⁶ Sugeng Rifqi Mubaroq et al., "The New Educational Frontier: Agentic AI's Evolutionary Journey through the Lens of SPAR-4-SLR," *VOCATECH: Vocational Education and Technology Journal* 7, no. 2 (2025): 227–42, <https://doi.org/10.38038/vocatech.v7i2.249>; A. Mukherjee and S. Chattopadhyay, "Uncovering the Generative AI (GenAI) to Agentic AI (AgAI) Shift for Business School Education," *Journal of Global Information Management*, 2025, <https://www.igi-global.com/article/uncovering-the-generative-ai-genai-to-agentic-ai-agai-shift-for-business-school-education/389920>.

⁷ Teri Rumble et al., "Learning Engagement Assistant (LEA): A Multi-Agent AI Framework for Adaptive and Personalized Learning with Simulated Student Agents," in *Proceedings of the 18th International Conference on Agents and Artificial Intelligence (ICAART 2026)* (SciTePress, 2026), 512–23, <https://doi.org/10.5220/0014418900004052>; Irfan Saleem, "Agentic Artificial Intelligence in Business Higher Education – A Bibliometric Analysis to Highlight the Current Insights and Future Trends," *Higher Education, Skills and Work-Based Learning* 16, no. 1 (2026): 219–36, <https://doi.org/10.1108/HESWBL-08-2025-0330>; Bodong Chen, Xinran Zhu, and Fernando Díaz del Castillo H., "Integrating Generative AI in Knowledge Building," *Computers and Education: Artificial Intelligence* 5 (2023): 100184, <https://www.sciencedirect.com/science/article/pii/S2666920X23000632>.

rights over goals and strategies.⁸

The second strand concerns metaverse learning, defined here as immersive, embodied, and socially situated learning in virtual environments that support presence, interaction, and artifact sharing.⁹ Virtual laboratories, multi-agent urban planning platforms, and constructionist imagineering models show how the metaverse can host experimentation, civic problem-solving, and creative design.¹⁰ A meta-analysis of K–12 STEM learning reports positive effects of metaverse integration, but effect sizes depend on instructional design, and systematic reviews emphasize that these opportunities are realized only when teachers structure activities and assessment.¹¹ The third strand concerns self-directed inquiry and knowledge construction: the learner-driven process of formulating questions, gathering evidence, and refining ideas into artifacts. Evidence from community-of-inquiry research, ADDIE-based implementation roadmaps, wearable multi-agent frameworks, and GPT-driven feedback in virtual reality indicates that inquiry in immersive settings flourishes when it is scaffolded rather than assumed.¹²

⁸ Serap Uğur, “A Bibliometric Analysis of Agentic AI and the Agentic Pedagogical Agency Framework,” *International Journal of Educational Technology and Learning* 20, no. 1 (2026): 1–18, <https://doi.org/10.55217/101.v20i1.1048>; Lei Yang, “Empowering the Autonomous Learner: How AI-Assisted Language Learning Environments Shape Self-Regulation, Autonomy, and Self-Directed Behaviors,” *Language Teaching Research*, 2026, <https://doi.org/10.1177/13621688261422129>; Tutik Lestari et al., “Toward Human-Centered Agentic AI in Education: A Systematic Review and Multi-Layer Integration Framework,” *Proceeding of International Conference on Pesantren* 3, no. 1 (2026), <https://doi.org/10.61159/mgz7jn37>.

⁹ Xinli Zhang et al., “The Metaverse in Education: Definition, Framework, Features, Potential Applications, Challenges, and Future Research Topics,” *Frontiers in Psychology* 13 (2022): 1016300, <https://doi.org/10.3389/fpsyg.2022.1016300>; Echo G. W. Hui, Martin M. T. Choy, and William K. W. Cheung, “MetaClues: Constructivist Learning via Progressive Clues from Generative AI in a Metaverse Environment,” in *Proceedings of the 2025 International Conference on Metaverse Computing, Networking and Applications (MetaCom)* (Seoul: IEEE, 2025), 356–64, <https://doi.org/10.1109/MetaCom65502.2025.00061>.

¹⁰ Pinanta Chatwattana et al., “The Virtual Laboratory Learning Environment: VLLE on Metaverse for University in Thailand,” *International Journal of Engineering Pedagogy* 13, no. 5 (2023): 30–41, <https://doi.org/10.3991/ijep.v13i5.38565>; Mete Kemal Özkök, “Urbanist Metaverse: A Multi-Agent Platform for Knowledge-Building in Urban Planning,” *Journal of Metaverse* 6 (2026): 26–40, <https://doi.org/10.57019/jmv.1682515>; Suputtra Sapliyan, Pinanta Chatwattana, and Prachyanun Nilsook, “Constructionism Imagineering Learning Model via Metaverse to Enhance Young Innovators,” *Journal of Education and Learning* 12, no. 4 (2023): 81–91, <https://doi.org/10.5539/jel.v12n4p81>.

¹¹ Xingyu Geng and Yu-Sheng Su, “Enhancing K-12 Students’ STEM Learning through the Integration of the Metaverse into Online and Blended Environments: A Meta-Analysis,” *International Journal of Science and Mathematics Education*, 2024, <https://doi.org/10.1007/s10763-024-10484-0>; Gayatri Panda et al., “Application of Metaverse in Higher Education: A Systematic Literature Review and Bibliometric Analysis,” *The TQM Journal* 36, no. 4 (2024): 861–89, <https://doi.org/10.1108/TQM-11-2023-0361>; Zümrüt Varol Selçuk and Gamze Mercan, “The Role of Metaverse Technology in Education: A Systematic Review of Opportunities, Challenges, and Educational Potential,” *Sakarya University Journal of Education* 14, no. 2 (2024): 360–75, <https://doi.org/10.19126/suje.1376341>.

¹² Manpreet Singh, Daner Sun, and Zhizi Zheng, “Enhancing University Students’ Learning Performance in a Metaverse-Enabled Immersive Learning Environment for STEM Education: A Community of Inquiry Approach,” *Future in Educational Research* 2, no. 3 (2024): 288–309, <https://doi.org/10.1002/fer3.56>; Yu Shi, Wei Wei Goh, and N. Z. Jhanjhi, “A Roadmap to Implement Metaverse in Education Field Based on ADDIE Model: A Systematic Review,” *Computers and Education Open*, 2026, <https://www.sciencedirect.com/science/article/pii/S2666557326000339>; Jiaqi Xu et al., “Integrating AI-Driven Wearable Metaverse Technologies into Ubiquitous Blended Learning: A Framework Based on Embodied Interaction and Multi-Agent Collaboration,” *Education Sciences* 15, no. 7 (2025): 900, <https://doi.org/10.3390/educsci15070900>; Wei-Sheng Wang et al., “Boosting Self-Directed Learning in Virtual Reality: The Role of GPT-Driven Feedback for Low Achievers,” *Education and Information Technologies* 31, no. 14 (2026): 5423–59, <https://doi.org/10.1007/s10639-026-14015-y>; Alisha Waquar et al., “From Traditional to

These strands are interpreted through a theoretical framework that combines learner agency theory, metaverse affordances, and knowledge-building pedagogy, read through three principles of Islamic education. *Tafakkur*—reflective contemplation of signs in creation—frames inquiry as disciplined thinking rather than passive reception.¹³ *Tabayyun*—verifying information before acting upon it—offers a normative basis for requiring learners to check AI-generated claims against evidence.¹⁴ *Adab* and right intention (*niyyah*), articulated classically by al-Zarnūjī and reconceptualized by al-Attas as the core of *ta’dīb*, locate the purpose of knowledge in the formation of character, not only in performance.¹⁵ Table 1 summarizes the framework.

Table 1: Synthesis of the Theoretical Framework

Concept	Definition	Key aspects	Implication for CREATE-M
Agentic AI and learner agency	Goal-oriented AI that plans, monitors, and collaborates	Mentor, collaborator, critic, curator; autonomy support	Agents share control and change roles across the inquiry cycle
Metaverse learning	Immersive, embodied, social virtual learning	Presence, simulation, collaboration, exhibition	Tasks require embodied investigation and public artifacts
Self-directed inquiry and knowledge construction	Learner-driven questioning, investigation, and idea refinement	Goals, evidence, discourse, artifacts, reflection	Inquiry culminates in revisable knowledge products
Islamic pedagogical values	Tafakkur, tabayyun, adab, and niyyah in learning	Reflection, verification, ethical conduct, purposeful intention	Evaluative lens for agent roles, evidence checks, and reflection

Source: *Analysed from the reviewed literature (authors’ synthesis).*

Previous studies have advanced each strand, but they rarely converge into an integrated design model. Research on student agency in AI-assisted learning has produced measurement scales and engagement constructs, scoping reviews have clarified the boundaries between self-regulated and self-directed learning, and Q-methodology research shows that agentic and ethical use of generative AI differs sharply across learners and therefore has to be taught explicitly.¹⁶ Reviews of generative and agentic AI agents map a wide range of educational

Virtual Classrooms: Unravelling Themes and Shaping the Future of Metaverse Education,” *Interactive Technology and Smart Education* 22, no. 2 (2025): 266–303, <https://doi.org/10.1108/ITSE-02-2024-0032>.

¹³ Q. Āl ‘Imrān 3:190–191; see also Q. al-‘Alaq 96:1–5, where the first revelation frames reading and learning as active engagement.

¹⁴ Q. al-Ḥujurāt 49:6; Q. al-Isrā’ 17:36.

¹⁵ Burhān al-Dīn al-Zarnūjī, *Ta’līm al-Muta’allim: Ṭarīq al-Ta’allum [Instruction of the Student: The Method of Learning]*, trans. G. E. von Grunebaum and Theodora M. Abel (New York: King’s Crown Press, 1947); Syed Muhammad Naquib al-Attas, *The Concept of Education in Islam: A Framework for an Islamic Philosophy of Education* (Kuala Lumpur: Muslim Youth Movement of Malaysia (ABIM), 1980).

¹⁶ Y. Dai et al., “Redefining and Measuring Student Agency in AI-Assisted Learning: Development and Validation of the Agentic Engagement with AI (AE-AI) Scale,” *Computers & Education*, 2026, <https://www.sciencedirect.com/science/article/pii/S0360131526001260>; N. Gupta et al., “Beyond Autonomy: Unpacking Self-Regulated and Self-Directed Learning through the Lens of Learner Agency—A Scoping Review,” *BMC Medical Education* 24, no. 1 (2024): 1519, <https://doi.org/10.1186/s12909-024-06192-6>; Y. Chaaban et al.,

roles—tutor, peer, critic, and co-designer—and trace a shift from rule-based assistance to goal-oriented workflows.¹⁷ Yet none of these studies specifies how agentic AI roles and immersive metaverse tasks should be combined so that learners move from experiencing content to producing knowledge. Table 2 maps these clusters, their limitations, and the innovative aspect of the present article.

Table 2: Map of Previous Studies and the Innovative Aspect of This Article

Research cluster	Main focus	Limitation	Innovative aspect of this article
Agentic AI and learner agency	Autonomy, self-efficacy, agentic engagement, AI roles	Fragmented constructs; limited metaverse integration	Couples role-differentiated agents with inquiry and artifact creation
Metaverse education	Immersion, presence, collaboration, virtual laboratories	Mixed outcomes; weak pedagogical scaffolds	Embeds self-directed learning and knowledge-building scaffolds in immersive tasks
Self-directed learning and inquiry	Self-regulation, autonomy, inquiry processes	Under-specified in AI-metaverse contexts	Treats inquiry as a pathway to visible knowledge artifacts
Generative and agentic AI agents	Feedback, tutoring, collaboration, motivation	Few frameworks for creator agency	Positions agents as mentor, collaborator, critic, and curator
Metaverse and AI in Islamic education	Technology acceptance, religious moderation, academic integrity	Few pedagogical models; weak link to inquiry design	Aligns creator-oriented design with Islamic pedagogical values

Source: *Analysed from the reviewed literature (authors' synthesis).*

The gap is sharper in Islamic education. Research on metaverse use for teaching Islamic sciences has concentrated on technology acceptance, showing that motivation, ease of use, and expected performance drive intention to adopt metaverse tools for teaching Hadith and the Prophetic biography.¹⁸ A bibliometric mapping of 2020–2025 publications finds that studies linking Islamic education and religious moderation with metaverse technologies remain fragmented.¹⁹ Research on generative AI in Islamic religious education shows that students negotiate the ethics of AI use through personal judgment and teacher guidance, and that

¹⁷ “Examining Student Teachers’ Agency in an AI-Supported Learning Environment: Q Methodology Research,” *International Journal of Artificial Intelligence in Education* 35 (2025): 4083–107, <https://doi.org/10.1007/s40593-025-00529-y>.

¹⁸ Xingchang Liu et al., “GenAI-Agents in Education: A Systematic Review of Macro-Level Trends, Educational Roles, Theoretical Foundations and Future Agendas,” *Interactive Learning Environments*, 2026, <https://doi.org/10.1080/10494820.2026.2672562>; Firuz Kamalov et al., “Evolution of AI in Education: Agentic Workflows,” *arXiv preprint arXiv:2504.20082*, 2025, <https://doi.org/10.48550/arXiv.2504.20082>.

¹⁹ Sabah Zekhnini and Mohamad Alnakawa, “Factors Influencing the Acceptance of Metaverse Technology in Teaching Islamic Sciences (Hadith and Prophetic Biography as a Model) in Light of the UTAUT2 Model,” *Millah: Journal of Religious Studies* 25, no. 1 (2026): 389–456, <https://doi.org/10.20885/millah.vol25.iss1.art11>.

²⁰ Lasmi Anisa Putri, Martin Kustati, and Bashori Bashori, “Bibliometric Mapping of Religious Moderation Research in Islamic Education and Metaverse Technologies (2020–2025),” *Unisia* 43, no. 2 (2025), <https://doi.org/10.20885/unisia.vol43.iss2.art26>.

process-based assessment helps reconcile efficiency with character formation.²⁰ What remains missing is a pedagogical design model that explains how agentic AI and metaverse environments can cultivate learners who inquire, verify, and create knowledge responsibly.

The novelty of this article lies in addressing that gap with CREATE-M, an integrated framework that couples three design conditions usually studied in isolation: agentic AI roles that share control with learners, metaverse tasks that demand embodied inquiry, and scaffolds that make knowledge construction visible and revisable. The framework builds on evidence that generative AI-enhanced pedagogical agents in the metaverse can improve elementary students' conceptual understanding and cognitive engagement, but it goes further by specifying the division of labour among learner, agent, and environment and by aligning each design component with Islamic pedagogical values.²¹

Accordingly, the research problem is how agentic AI and metaverse environments can be designed so that learners become creators rather than experiencers of knowledge. Three hypotheses are examined: (H1) role-differentiated agentic AI expands learner agency when agents mentor, critique, and curate rather than supply answers; (H2) metaverse affordances enable embodied and social inquiry when immersion is structured by pedagogical tasks; and (H3) learner-controlled adaptive scaffolds convert inquiry into visible knowledge construction. The objectives are to conceptualize how agentic AI roles support learner agency, to identify the metaverse affordances that enable self-directed inquiry, to specify how adaptive scaffolds turn inquiry into knowledge artifacts, and to derive the implications of the resulting framework for Islamic educational settings.

Theoretically, the study contributes a mid-range design theory that integrates learner agency, metaverse affordances, and knowledge-building pedagogy with Islamic educational values. Practically, it offers design principles that teachers, instructional designers, and leaders of madrasahs, pesantren, and Islamic higher education institutions can use when adopting AI and immersive technologies. The remainder of the article describes the research method, presents and discusses the three evidence arguments and the CREATE-M framework, and closes with conclusions and directions for future research.

RESEARCH METHODS

This study uses a theory-building structured literature review because the research question concerns framework design across fragmented literatures rather than the effect of a single intervention.²² The “site” of the study is the documented case literature on agentic AI, metaverse learning, and self-directed inquiry, and the unit of analysis is the design claim or

²⁰ Nike Febrian Imelda et al., “Generative Artificial Intelligence and Academic Integrity in Islamic Religious Education,” *Tawazun: Jurnal Pendidikan Islam* 19, no. 2 (2026): 427–40, <https://doi.org/10.32832/tawazun.v19i2.23019>.

²¹ Tinghui Wu, Xuesong Zhai, and Yanjie Song, “The Effects of GAI-Enhanced Pedagogical Agents in the Metaverse (GPAiM) on Elementary School Students’ Conceptual Understanding and Cognitive Engagement Patterns,” *Computers & Education* 245 (2026): 105555, <https://doi.org/10.1016/j.compedu.2025.105555>.

²² C.-Q. Huang et al., “Effects of Artificial Intelligence Feedback on Students’ Self-Regulated Learning in Higher Education: A Three-Level Meta-Analysis,” *Educational Psychology Review*, 2026, <https://doi.org/10.1007/s10648-026-10166-z>; Nurzengky Ibrahim et al., “Education Sustainability through Interactive Modules and Learning Autonomy to Improve Self-Directed Learning among Middle School Students with PLS-SEM Random Forest and XGBoost,” *Discover Sustainability* 7 (2026): 166, <https://doi.org/10.1007/s43621-025-02508-8>.

pedagogical mechanism reported in each source. Meta-analytic evidence on AI feedback and studies of interactive modules and learning autonomy were used to judge outcome claims, not to generate new primary field data.²³ This design is appropriate because the article aims to integrate constructs and generate testable propositions rather than to estimate a pooled effect. The selection therefore prioritized peer-reviewed reviews, frameworks, and empirical cases that explicitly described AI roles, metaverse tasks, or knowledge-building processes.

The study is a qualitative, secondary-data synthesis combining systematic review procedures with deductive–inductive coding.²⁴ Sources were classified as primary empirical cases, systematic or scoping reviews, and framework papers; no human participants were recruited, so ethical approval was not required. A review of AI-empowered self-regulated learning from a learner-agency perspective and a study of IT mindfulness and AI literacy informed the coding of regulation and agency indicators.²⁵ Documented metaverse cases were treated as contextual evidence rather than as a statistically representative sample, because the goal is theoretical and design-oriented generalization rather than population inference. Table 3 summarizes the research loci represented in the corpus.

Table 3: Research Locus and Main Focus

Locus / documented case setting	Region	Institutional orientation	Main focus in the field
Thailand metaverse virtual laboratory and imagineering cases	Southeast Asia	Higher and secondary education	Virtual experimentation, immersion, artifact creation
China/Taiwan metaverse and AI feedback cases	East Asia	Higher education and K–12	Feedback, self-regulation, STEM inquiry
Turkey and Gulf metaverse education reviews	Europe/Middle East	Higher education	Opportunities, challenges, evaluation
International systematic and scoping reviews	Global	Cross-sector	Agentic AI roles, metaverse frameworks, self-directed learning

Source: *Analysed from the reviewed literature (authors' synthesis).*

Data collection used database searching, inclusion screening, backward citation tracing, and structured extraction of design claims, contexts, and outcomes.²⁶ Search terms were organised around the three core concepts—agentic or generative AI agents, metaverse and

²³ Huang et al., “Effects of Artificial Intelligence Feedback”; Ibrahim et al., “Education Sustainability through Interactive Modules.”

²⁴ Xiquan Qin and Haibo Yang, “Research Progress on AI-Empowered Self-Regulated Learning from a Learner-Agency Perspective,” *Journal of Psychological Science* 49, no. 5 (2026): 1121–33, <https://doi.org/10.16719/j.cnki.1671-6981.20260509>; Thean Pheng Lim and Wee Chuan Teh, “IT Mindfulness and AI Literacy Shape Lifelong Learning Orientation through Student Engagement and Learning Agency in AI-Enhanced Online Learning,” *Discover Education* 5 (2026): 192, <https://doi.org/10.1007/s44217-026-01219-0>.

²⁵ Qin and Yang, “Research Progress on AI-Empowered Self-Regulated Learning”; Lim and Teh, “IT Mindfulness and AI Literacy.”

²⁶ D. Weerlink et al., “Understanding What Supports Self-Directed Learning in Flexible Educational Contexts: A Scoping Review of Interventions and Underlying Mechanisms,” *Studies in Educational Evaluation*, 2026, <https://www.sciencedirect.com/science/article/pii/S0191491X26001306>; Y. Zhang and L. Chen, “Generative AI in Self-Directed Learning: A Thematic Scoping Review,” *Interactive Learning Environments*, 2025, <https://doi.org/10.1080/10494820.2025.2603431>.

immersive learning, and self-directed inquiry and knowledge construction—and records were screened first by title and abstract and then by full text against the inclusion and exclusion criteria described below. A scoping review of self-directed learning in flexible contexts and a thematic review of generative AI in self-directed learning guided the extraction of mechanisms such as choice, feedback, and reflection.²⁷ Inclusion required that a source address at least one of the three core concepts and report a pedagogical mechanism, framework, or empirical outcome. Exclusion removed opinion pieces without design detail and studies that mentioned AI or the metaverse only as background. This process produced a purposive corpus of 48 scholarly sources published between 2022 and 2026 (1 from 2022, 4 from 2023, 7 from 2024, 14 from 2025, and 22 from 2026), comprising 21 systematic, scoping, bibliometric, or meta-analytic reviews, 6 framework, conceptual, or design papers, and 21 empirical studies. The corpus is sufficient for conceptual synthesis but not for meta-analysis. Studies on Islamic education were consulted separately to frame the implications and were not part of the coded corpus.

Each source was read for explicit design features rather than for general claims about “AI” or “the metaverse.” A comparison of metaverse-based and chat-based collaboration and a learner-centered analysis of educational metaverse environments were used to identify indicators of social knowledge construction and value exchange.²⁸ Codes were assigned when a source described a mechanism that could plausibly shift agency from reception to creation, which allowed heterogeneous studies to be compared without erasing contextual differences. Table 4 lists the codes.

Table 4: Research Data Coding

No.	Data type	Code
1	Agentic AI role descriptions	AA-ROLE
2	Learner autonomy indicators	LA-AUTO
3	Metaverse immersion and embodiment	MV-IMM
4	Social presence and collaboration	MV-SOC
5	Self-directed inquiry tasks	SDL-INQ
6	Knowledge construction discourse	KC-DISC
7	Artifact creation and creator agency	CR-ART
8	AI feedback and scaffolding	AI-FDBK
9	Pedagogical design models	PD-ADD
10	Assessment and reflection	AS-REF
11	Ethical and technical challenges	CH-ETH
12	Educational context and level	CTX-LVL
13	Engagement and learning outcomes	OUT-ENG
14	Multi-agent collaboration	MA-COL

²⁷ Weerlink et al., “Understanding What Supports Self-Directed Learning”; Zhang and Chen, “Generative AI in Self-Directed Learning.”

²⁸ Suwandi Suwandi et al., “Comparing Students’ Social Knowledge Construction in the Metaverse-Based and Chat-Based Collaborative Learning,” in *Proceedings of the International Conference on Computers in Education* (Asia-Pacific Society for Computers in Education, 2025), <https://library.apsce.net/index.php/ICCE/article/view/5616>; Yun-cheng Tsai, “Learner-Centered Analysis in Educational Metaverse Environments: Exploring Value Exchange Systems through Natural Interaction and Text Mining,” *Journal of Metaverse* 3, no. 2 (2023): 121–32, <https://doi.org/10.57019/jmv.1302136>.

No.	Data type	Code
15	Collective learner agency	LA-COL

Source: Authors' coding scheme.

Analysis proceeded through deductive codes derived from the three core concepts and inductive codes emerging from the sources, followed by cross-case comparison and framework mapping.²⁹ A conceptual analysis of social participation and epistemic autonomy in extended reality learning and a survey of generative AI for immersive metaverse experience informed the comparison of discourse and immersion mechanisms.³⁰ The analytic question was not “does AI or the metaverse work?” but “which arrangement of roles, tasks, and scaffolds makes creator agency likely?” Codes were grouped into evidence arguments and then translated into CREATE-M design principles. The framework should therefore be read as a testable synthesis, not as a validated intervention.

ANALYSIS AND DISCUSSION

Role-Differentiated Agentic AI Expands Learner Agency

The first finding is that role-differentiated agentic AI expands learner agency when agents act as mentors, collaborators, critics, and curators rather than as answer providers. Studies of generative AI and metaverse-enhanced flipped classrooms show that AI can support discourse and reflection, while research on perceived algorithmic attraction in pedagogical agents shows that agent design affects trust and motivation.³¹ In the coded cases, agency increased when learners could ask agents to critique a plan, simulate an audience, or request alternative evidence; it did not increase when agents simply generated summaries. This finding locates the source of agency in the division of labour between learner and agent, not in the sophistication of the model alone.

The categories of this finding include goal negotiation, role switching, critique, and metacognitive prompting. Evidence on generative AI agents in STEAM learning shows that students perceive agents differently depending on whether they are framed as assistants, peers, or evaluators, and a focus-group study in business education shows that learners value agents that challenge their assumptions.³² In the coding, goal negotiation and critique were the

²⁹ Jörg Noller, “Social Participation and Epistemic Autonomy in Extended Reality Learning,” *Discover Education* 5 (2026): 579, <https://doi.org/10.1007/s44217-026-01800-7>; Vinay Chamola et al., “A Comprehensive Survey on Generative AI for Metaverse: Enabling Immersive Experience,” *Cognitive Computation* 16 (2024): 3286–315, <https://doi.org/10.1007/s12559-024-10342-9>.

³⁰ Noller, “Social Participation and Epistemic Autonomy”; Chamola et al., “Comprehensive Survey on Generative AI.”

³¹ Xiaoyan Chu et al., “Enhancing the Flipped Classroom Model with Generative AI and Metaverse Technologies: Insights from Lag Sequential and Epistemic Network Analysis,” *Educational Technology Research and Development* 73 (2025): 1539–67, <https://doi.org/10.1007/s11423-025-10457-2>; Fu-Song Hsu, Wei-Ting Pai, and I-Chia Tsai, “Perceived Algorithmic Attraction in GenAI-Generated Pedagogical Agents: Dimensions and Effects on Learner Trust and Motivation,” *Computers in Human Behavior* 184 (2026).

³² Yun-Fang Tu et al., “Roles and Impacts of Generative AI Agents in STEAM Learning: Insights from Students’ Perceptions and Learning Experiences Using Information World Mapping,” *Educational Technology Research and Development* 74, no. 2 (2026): 897–935, <https://doi.org/10.1007/s11423-025-10579-7>; Xuenan Huo and Keng Leng Siau, “Generative Artificial Intelligence in Business Higher Education: A Focus Group Study,” *Journal of Global Information Management* 32, no. 1 (2024), <https://doi.org/10.4018/JGIM.364093>.

strongest markers of creator agency because they required learners to justify decisions. Role switching prevented over-reliance by making the agent's authority temporary and task-specific, while metacognitive prompting helped learners monitor whether an artifact actually answered the inquiry question.

This pattern occurred in contexts where instructors framed AI use as inquiry support and where assessment valued process artifacts such as plans, drafts, and critiques. Studies using SEM and NCA show that metaverse education can improve knowledge retention and collaboration when tasks are structured, while a review of AI literacy shows that K–12 learners need explicit support to use AI critically.³³ When assessment focused only on final answers, agents became answer machines and learner agency narrowed; when it included revision histories and reflective notes, agents became partners in judgment.

The broader meaning of this result is that the value of agentic AI lies not in automation but in a reallocation of intellectual labour: learners must retain ownership of goals, evidence, and judgment while agents handle critique, simulation, and monitoring.³⁴ This reframes AI literacy as the capacity to direct and evaluate agentic support, not merely to prompt effectively. The hypothesis that role-differentiated agents increase learner agency is therefore supported only conditionally. Meta-analytic evidence shows that the effects of AI feedback depend on its type, timing, and how learners process it, and fluent AI responses can short-circuit inquiry when tasks reward speed.³⁵ The argument survives with a boundary condition: agent autonomy must be bounded by learner decision rights and by assessment that values revision.

Metaverse Affordances Enable Embodied and Social Inquiry

The second finding is that metaverse affordances enable embodied and social inquiry when immersion is tied to investigation tasks and public artifacts. A systematic review questioning AI as a collaborator in knowledge construction and a study of GAI-enhanced pedagogical agents in the metaverse show that AI can support conceptual understanding and cognitive engagement when it is embedded in a structured scenario.³⁶ In the coded cases, embodiment mattered because learners had to move through a virtual space, gather evidence, and explain decisions to peers, and social presence mattered because artifacts were presented to an audience. Immersion alone produced novelty; immersion combined with inquiry produced knowledge construction.

The relationships among these factors are conditional: immersion increases presence, presence supports discourse, discourse supports artifact revision, and revision supports knowledge construction when agents scaffold reflection. Agentic AI contributes by prompting

³³ Fazeelat Aziz, Cai Li, and Asad Ullah Khan, "Immersive Learning in Virtual Worlds: A Two-Step Analysis SEM and NCA for Assessing the Impact of Metaverse Education on Knowledge Retention and Student Collaboration," *Technology in Society* 81 (2025): 102871, <https://doi.org/10.1016/j.techsoc.2025.102871>; Q. Tan and X. Tang, "Unveiling AI Literacy in K-12 Education: A Systematic Literature Review of Empirical Research," *Interactive Learning Environments* 33, no. 9 (2025), <https://doi.org/10.1080/10494820.2025.2482586>.

³⁴ Wang et al., "Boosting Self-Directed Learning."

³⁵ Huang et al., "Effects of Artificial Intelligence Feedback."

³⁶ Y. Wang, T. Pi, and B. Xie, "Questioning the Role of AI as Collaborator: A Systematic Literature Review of Generative AI-Supported Knowledge Construction," *Interactive Learning Environments*, 2026, <https://doi.org/10.1080/10494820.2025.2556808>; Wu, Zhai, and Song, "Effects of GAI-Enhanced Pedagogical Agents."

evidence checks and simulating stakeholders, but it can distract if it takes over the task; the metaverse contributes by making inquiry spatial and shareable, but it can add cognitive load if navigation is poorly designed. The coding therefore suggests a mediation model in which pedagogical structure mediates the effect of immersion on knowledge construction, and agent roles mediate the effect of AI on learner agency.

This relationship held most clearly in contexts that combined authentic problems, team roles, and exhibition or peer critique. Studies of AI and learner autonomy show that self-directed learning depends on goal ownership and strategy use, which are difficult to sustain in novelty-driven immersive environments without scaffolds.³⁷ When teams had defined roles and an external audience, learners used the metaverse to test ideas rather than to escape the task; when the metaverse was used only for lectures or tours, knowledge construction remained shallow.

Metaverse learning is thus valuable primarily as an inquiry infrastructure, not as a novelty environment. Generative AI can help learners plan and reflect, but it cannot substitute for the authentic problem that makes inquiry meaningful.³⁸ The hypothesis that metaverse affordances enable knowledge construction is supported when pedagogical structure mediates immersion. The systematic review questioning AI as a collaborator warns that AI-supported knowledge construction becomes superficial when learners do not interrogate AI contributions.³⁹ In the metaverse, social presence and shared artifacts create opportunities for such interrogation, but only if instructors design peer critique and evidence checks. The argument is therefore not that immersion causes learning, but that immersion affords the kinds of inquiry that produce knowledge when scaffolded.

Adaptive Scaffolds Convert Inquiry into Knowledge Construction

The third finding is that adaptive scaffolds convert inquiry into knowledge construction when feedback is timely, specific, and learner-controlled. Research on generative AI-enhanced pedagogical agents in the metaverse shows that agents can support scenario-based science learning, while agent autonomy must still be balanced with learner decision rights.⁴⁰ In the coded cases, scaffolds worked when they helped learners compare evidence, revise claims, and anticipate critique, and they failed when they supplied conclusions or bypassed the inquiry process. Knowledge construction became visible through artifacts such as models, reports, simulations, and presentations that could be examined and improved.

The resulting strategies include designing agent feedback around epistemic criteria, requiring artifact revision, and scheduling reflection before and after metaverse sessions. Multi-agent learning frameworks show that adaptive and personalized support can be distributed across agents, but coordination is essential to avoid conflicting messages.⁴¹ A practical strategy is to assign one agent to question framing, another to evidence critique, and a third to audience simulation, with the learner deciding which advice to accept. Another is to require a “revision memo” that explains what changed and why. These strategies turn feedback

³⁷ Achuthan, “Artificial Intelligence and Learner Autonomy.”

³⁸ Zhang and Chen, “Generative AI in Self-Directed Learning.”

³⁹ Wang, Pi, and Xie, “Questioning the Role of AI.”

⁴⁰ Wu, Zhai, and Song, “Effects of GAI-Enhanced Pedagogical Agents.”

⁴¹ Rumble et al., “Learning Engagement Assistant.”

into knowledge-building discourse rather than compliance, and they make creator agency assessable and teachable: learners show agency through the quality of their questions, the defensibility of their evidence, and the coherence of their revisions.⁴²

GAI-enhanced pedagogical agents in the metaverse improve conceptual understanding and cognitive engagement when they are integrated into the scenario rather than added on.⁴³ This supports a design principle: every AI feedback move should leave a trace in the learner's artifact or revision rationale, because without such traces knowledge construction remains invisible and difficult to assess. The hypothesis that adaptive scaffolds convert inquiry into knowledge construction is supported when feedback is learner-controlled and artifact-oriented. Research comparing metaverse and chat collaboration shows that social knowledge construction differs across modalities, which implies that scaffolds must be tuned to the environment.⁴⁴ The argument therefore holds with a design condition: scaffolds must be transparent, revisable, and aligned with the epistemic criteria of the artifact. This condition distinguishes creator-oriented frameworks from adaptive tutoring that seeks only correct answers. Table 5 synthesizes the three evidence arguments and the verdict on each hypothesis.

Table 5: Synthesis of Findings and Hypothesis Testing

Evidence argument	Key finding and mechanism	Verdict	Framework implication
Role-differentiated agentic AI	Agents expand agency when they mentor, critique, and curate; goal negotiation, role switching, metacognitive prompting	Supported (conditional)	Configure agent roles and learner decision rights; avoid answer-machine use
Metaverse affordances	Immersion supports inquiry when tied to investigation and audience; presence, embodiment, discourse, exhibition	Supported (conditional)	Design authentic problems and public artifacts
Adaptive scaffolds	Feedback converts inquiry into knowledge when learner-controlled; evidence checks, revision memos, reflection	Supported (conditional)	Assess revision traces and reflection

Source: *Analysed from the reviewed literature (authors' synthesis).*

The CREATE-M Framework and Its Implications for Islamic Education

Integrating the three arguments yields the CREATE-M framework summarized in Table 6. Each component specifies a design principle and the agent role that supports it, and the final column shows how the component can be read through the Islamic pedagogical lens outlined in the theoretical framework. The mapping is offered as a proposition for empirical testing rather than as a normative claim that Islamic values are reducible to design features.

⁴² Zhang et al., "Metaverse in Education."

⁴³ Wu, Zhai, and Song, "Effects of GAI-Enhanced Pedagogical Agents."

⁴⁴ Suwandi et al., "Comparing Students' Social Knowledge Construction."

Table 6: Components of the CREATE-M Framework

Component	Design principle	Supporting agent role	Islamic pedagogical lens
Co-designed goals	Learners negotiate inquiry goals with the teacher and agent	Mentor	Niyyah: learning begins with a sincere, owned intention
Role-differentiated agents	Agents switch roles across the inquiry cycle; learner keeps decision rights	Mentor, collaborator, critic, curator	The teacher remains the murabbī; AI assists but does not replace guidance
Embodied inquiry	Learners investigate authentic problems in the virtual space	Collaborator, stakeholder simulator	Tafakkur: reflective engagement with phenomena
Artifact construction	Inquiry culminates in public, revisable products	Curator	‘Ilm nāfi’: knowledge that yields benefit
Testing and iteration	Claims and AI outputs are checked against evidence and revised	Critic	Tabayyun: verification before acceptance
Evaluation and reflection	Revision memos and reflective notes make learning visible	Mentor	Muḥāsabah: self-accountability
Metaverse ecology	Norms for conduct, privacy, and collaboration in shared spaces	Learning manager	Adab: ethical conduct in learning communities

Source: Authors’ synthesis; the Islamic pedagogical lens draws on *al-Zarnūjī* and *al-Attas*.

For Islamic educational institutions, CREATE-M suggests three practical implications. First, metaverse initiatives for teaching the Qur’an, Hadith, or the Prophetic biography should move beyond technology acceptance toward inquiry tasks in which learners investigate, compare sources, and present artifacts, since acceptance studies show readiness but do not yet specify pedagogy.⁴⁵ Second, the critic role of agentic AI and the testing component of the framework give operational form to *tabayyun*: learners should be required to verify AI-generated claims—particularly on religious matters—against authoritative sources and the guidance of teachers, which is consistent with evidence that process-based assessment supports academic integrity in Islamic religious education.⁴⁶ Third, the metaverse ecology component points to the need for explicit norms of *adab*, privacy, and respectful dialogue in shared virtual spaces, which also opens a pathway for immersive learning to support religious moderation—an area that remains under-researched.⁴⁷ These implications remain hypotheses that require testing in madrasahs, pesantren, and Islamic higher education.

CONCLUSION

This study set out to explain how learners can move from experiencing content to creating knowledge in agentic AI-supported metaverse environments, and the synthesis shows that this shift depends on a three-way alignment among agent roles, immersive inquiry tasks, and artifact-oriented scaffolds rather than on the isolated adoption of AI or metaverse technology.

⁴⁵ Zekhnini and Alnakawa, “Factors Influencing the Acceptance of Metaverse Technology.”

⁴⁶ Imelda et al., “Generative Artificial Intelligence and Academic Integrity.”

⁴⁷ Putri, Kustati, and Bashori, “Bibliometric Mapping of Religious Moderation Research.”

The three hypotheses were conditionally supported: role-differentiated agents expand learner agency when learners keep decision rights; metaverse affordances support embodied and social inquiry when mediated by pedagogical structure; and adaptive scaffolds convert inquiry into knowledge construction when feedback is learner-controlled and leaves visible traces in artifacts. The resulting CREATE-M framework reframes the design problem from “which tool?” to “which division of labour among learner, agent, and environment?” and, read through the principles of *tafakkur*, *tabayyun*, and *adab*, offers Islamic educational institutions a value-aligned model for adopting agentic AI and the metaverse. Because the study relies on secondary literature and purposive coding, claims about prevalence and effect size remain provisional; future research should validate CREATE-M through classroom interventions, process analytics, and longitudinal artifact analysis across educational levels, including Islamic schools and universities, while examining equity, privacy, and over-reliance risks.

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