

Engineering Education in the Age of AI: Protecting Learning Outcomes while Teaching Responsible Use

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ABSTRACT

Malaysian engineering education is now under two pressures at the same time. Accreditation instruments, chiefly the Engineering Accreditation Council's 2024 Programme Accreditation Standard (EAC 2024) and the Malaysian Qualifications Framework (MQF 2024) of the Malaysian Qualifications Agency, expect graduates to show more than technical competence: ethical judgement, teamwork, communication and sustainability awareness now count as outcomes in their own right. Over roughly the same period, generative artificial intelligence has made it possible for a student to hand in competent-looking coursework without doing the reading and reasoning the assignment was meant to require. The risk is concrete. A student can leave a course knowing less than the curriculum intended while the submitted work looks accomplished. We ask what these two shifts mean when read together, and what they imply for teaching and assessment. Drawing on 36 peer-reviewed, openly accessible sources published between 2019 and 2026, together with the EAC 2024 and MQF 2024 standards, we examine five curriculum strategies that recur in the literature: project-based learning (PBL), service-learning through Malaysia's SULAM framework, value-based education, integration of the UN Sustainable Development Goals (SDGs), and communication-skills instruction. We read them as related responses to one problem. Each depends on a process the student has to go through over time, which is harder to bypass than a single artefact handed in at the end, and each builds outcomes that current accreditation treats as central. Most existing studies treat these themes separately, both from each other and from the assessment concerns raised by AI. We propose an integrative reading in which SULAM-linked, SDG-framed PBL projects, assessed with explicit communication criteria and a documented reasoning process, give programmes a workable route to these outcomes that does not rest on trust alone. The paper ends with practical implications for curriculum and assessment design in Malaysian engineering faculties and points out where local evidence on AI-integrated assessment is still thin.

Keywords: engineering education, EAC 2024, project-based learning, service-learning, artificial intelligence

INTRODUCTION

Within roughly the same three years, Malaysian engineering faculties have had to absorb two changes, and neither was optional. The first came from the regulator. In 2024 the Engineering Accreditation Council revised its Programme Accreditation Standard, reducing twelve programme outcomes to eleven and giving "Individual and Collaborative Team Work" its own outcome, PO8, separate from project management [1]. Mat Isa, Jani and Mohd Pauzi, reporting how one course team reworked its constructive alignment for the new standard, read the revision as putting weight on "critical thinking, innovation, emerging technologies, and lifelong learning" alongside ethics, diversity and inclusion [2]. The second change came with less paperwork and more disruption. Generative AI tools can now draft the calculations, code and design documentation that engineering courses have long treated as evidence of learning. More to the point, a student can finish an assignment by prompting instead of working through the material it was set to teach. Teo treats this as an accreditation problem, which is more serious than a teaching inconvenience. Student work can look accomplished and still carry almost no trace of the reasoning behind it, a condition he calls the loss of observable cognitive ownership [3]. Saravanan, Meissner and Glenn heard the same worry in focus groups with engineering faculty.

Homework used to be fair evidence that a student had done the reading and worked the problems. It no longer is [4]. A related concern comes from graduates. In a qualitative study of fourteen recent engineering graduates, new engineers said their degree had not prepared them to use AI deliberately at work, and they described a gap between what the curriculum assumed and what employers expected from the first day [5]. That is a problem of preparation for work. The question we follow in this review comes one step earlier: are students still acquiring the knowledge and judgement a curriculum is meant to build, now that AI lets them submit competent-looking work without doing so?

The review began somewhere ordinary. The corresponding author has taught project-based learning in a manufacturing engineering programme for about a decade, and in 2021 she authored a study comparing PBL grades and peer assessment with students' own sense of what they had learned [6]. That study rested on data from a single semester. Revisiting it in light of the 2024 standard would have meant re-analysing data that no longer exists, or hedging every claim about what could not be re-checked, and neither seemed worth doing. We chose instead to step back from one course and one semester and ask a wider question. Given what EAC 2024 now expects of graduates, and given that AI makes it possible to pass engineering coursework without learning much from it, which curriculum strategies keep students doing the work that real understanding requires? We were interested in strategies that do this by design. Outcomes that AI simply happens to handle poorly today make a weaker foundation.

We answer it by examining five strategies that recur in recent literature, usually discussed one at a time: project-based learning; service-learning as implemented through Malaysia's SULAM (Service-Learning Malaysia University for Society) initiative; value-based education; deliberate integration of the Sustainable Development Goals into engineering coursework; and structured development of communication skills. Each has its own evidence base. What is mostly missing is any attempt to read them as parts of one response to the same accreditation and technological pressures. The paper takes up that gap in stages. Section II summarises what EAC 2024 asks of engineering graduates, and Section III describes the AI challenge as recent studies report it. Section IV reviews the five strategies against that background, one theme at a time, noting where the literature agrees and where it says nothing. Section V pulls the threads into a synthesis with practical implications for curriculum design, and Section VI concludes.

Fig. 1 shows how the argument fits together. EAC 2024 and MQF 2024 define what a curriculum must deliver, generative AI puts that delivery at risk, and the five strategies reviewed in Section IV all point toward the outcomes under threat.

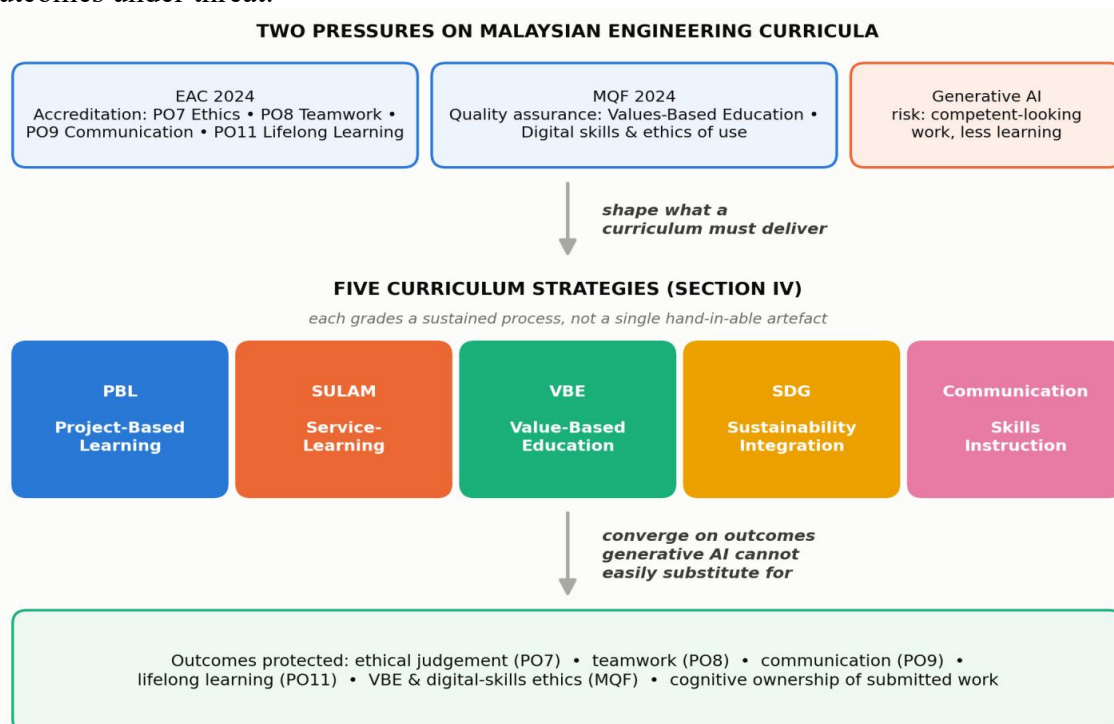


Fig. 1. How EAC 2024, MQF 2024 and AI-era assessment risk converge on five curriculum strategies and the graduate outcomes this paper argues they jointly protect.

WHAT EAC 2024 AND MQF 2024 ASK OF ENGINEERING GRADUATES

The Standard is plain about its purpose. Accreditation exists "to ensure that graduates of the accredited engineering programmes satisfy the minimum academic requirements for registration as a graduate engineer with the BEM," and, beyond that minimum, to make sure Institutions of Higher Learning practise Continual Quality Improvement (CQI) within an Outcome-Based Education (OBE) approach. So accreditation is meant to do more than check graduates at the exit. It should keep pushing programmes toward evidence-based improvement in the years between one accreditation cycle and the next.

That commitment shows up in eleven programme outcomes. The Standard aligns each of them with specific Washington Accord knowledge and complex engineering activity profiles (WK1 to WK9), and together they cover engineering knowledge, problem analysis, design, investigation, teamwork, communication, ethics, project management and life-long learning. Two outcomes are framed differently from the previous standard. Individual and Collaborative Team Work (PO8) now stands apart from project management and stresses working effectively as an individual, a member or a leader of diverse teams, whether in multidisciplinary, face-to-face, remote or distributed settings. Life-Long Learning (PO11) now takes in independent learning, adaptability to new and emerging technologies, and critical thinking in the context of technological change [1]. That attention to adapting to new technology is relevant today. The Standard was finalised in 2024, before generative AI became a major concern in engineering education, and yet it already named technological adaptability as a graduate attribute.

Looking across the eleven outcomes, what stands out is which of them are hardest to automate. Engineering Knowledge, Problem Analysis and Tool Usage describe capabilities that generative AI already assists with, sometimes well. Ethics, Individual and Collaborative Team Work, Communication and Life-Long Learning describe something different. They involve judgement exercised in a particular human setting, coordination with people who bring their own goals and blind spots, and a willingness to keep revising what one knows. A curriculum has to build these through experience, since instruction alone will not do it. They are also, and this is no coincidence, the outcomes that recent writing on AI in engineering education keeps returning to. Mat Isa, Jani and Mohd Pauzi arrive at a similar reading from practice. Reworking one course's constructive alignment around the 2024 Standard, they describe the revision as giving new weight to "critical thinking, innovation, emerging technologies, and lifelong learning" alongside ethics, diversity and inclusion [2].

Malaysian engineering programmes answer to a second instrument as well: the Malaysian Qualifications Framework (MQF), whose second edition the Malaysian Qualifications Agency released in 2024. EAC 2024 deals with engineering accreditation specifically, while MQF 2024 sets quality-assurance expectations for Malaysian higher education as a whole. The 2024 revision names Values-Based Education (VBE) as one of four areas of emphasis and describes it as an approach that "focuses on instilling moral and ethical values in learners" so that higher education providers can "ensure responsible, professionally competent and ethically sound graduates" [7]. This gives the value-based education strand in Section IV-C a national regulatory basis, one that sits with MQA and not with the EAC. The two frameworks come at the issue from different directions, yet both treat ethics and values as graduate outcomes that matter. MQF 2024 also has a "digital skills" outcome cluster covering the use of "information/digital technologies to support work and studies," including "sourcing and storing information, processing data, using applications for problem-solving and communication, as well as ethics in applying said skills" [7]. Artificial intelligence is not mentioned anywhere in the framework, a limitation we return to in Section V. Even so, its insistence on the ethical use of digital technology is a sensible starting point for thinking about AI use in engineering programmes, including how that use might be handled through a project rubric or a declaration.

THE AI CHALLENGE TO ENGINEERING EDUCATION

Three recent studies come at the problem from different directions. Teo's proposed "AI-Resilience Accreditation Framework" begins with one worry. An accreditation system that infers learning from the quality of submitted work stops working once a tool can produce high-quality work with little cognitive effort from the student who submits it [3]. His "Cognitive Ownership Ratio" tries to measure how much of a piece of student work reflects the student's own reasoning and how much came from AI. The metric is new and has not been

tested at scale. The diagnosis behind it is hard to dispute, though: assessment that looks only at the quality of the artefact no longer tells accreditors what it once did.

Saravanan, Meissner and Glenn ran focus groups with 16 engineering faculty at a U.S. research university. They found neither enthusiasm nor resistance and called what they saw "reluctant engagement". One participant summed it up: "it's here and we can't fight it." Faculty said homework no longer shows reliably whether a student understands the material. Some students now come to office hours with false confidence, carrying AI-generated answers they cannot explain, and attendance at office hours has fallen as students ask AI first and their instructors second [4]. The authors suggest responding with more visible problem-solving, in-class assessment and oral examinations, along with assignments that ask students to critique AI output instead of accepting it.

Martin and colleagues looked at the transition from the graduate's end, interviewing fourteen recent engineering hires in several industries. Most had met AI only informally during their degree and had to work out on the job how far to rely on it. They generally saw AI as a supplement to core engineering judgement and did not expect it to replace that judgement. Nearly all of them, however, described a mismatch between what their curriculum had assumed about AI and what their employer expected from the start. The authors call for closer collaboration between universities and industry to narrow that gap [5].

Evidence on how engineering students use generative AI, and what they gain from it, has grown quickly. Fan, Deng and Liu surveyed 148 engineering students in China and found a clear gap between perceived benefit and actual outcome. Most students said AI made their study more efficient and more engaging, and around half felt it supported their creativity and independent thinking. A similar proportion, though, felt their academic performance had not improved, and many worried about over-reliance and about AI's limits in specific domains. That gap between perceived and demonstrated learning matches what Saravanan and colleagues heard from classrooms [8]. Barari and colleagues give a more direct view of what this means for assessment. They compared programming and MATLAB coursework before and after generative AI became available. Mastery rates on programming assignments rose from around 70% to over 95%, with scores bunched at the top of the scale, while a modelling project that demanded more conceptual interpretation changed less. Their reading is that generative AI helps most with rule-based, procedural tasks and less with work that needs deeper domain reasoning. This raises the question of whether conventional programming assignments can still separate students who understand the material from those who do not [9]. Liu's quasi-experimental study of 91 students in a computer networks course suggests one way forward. Students who used AI inside a structured knowledge-construction process (topic structuring, modelling, interactive representation and evaluative reflection) showed better cognitive and competency outcomes than students who used the same tool with no such structure. On this evidence, the deciding factor may be how students are expected to use AI within the task, more than whether AI is allowed at all [10].

Ma and colleagues, writing on curriculum reform in general, propose three responses. Programmes should build tiered AI literacy into the curriculum; move teaching away from memorisation toward "problem-oriented and project-based learning" with higher-order thinking built in; and keep the curriculum dynamic through industry partnerships and modular design, instead of treating it as settled once accredited [11]. We follow their second point furthest, for the reason given above. A sustained project makes a student do the thinking that a single graded assignment can no longer compel. That tackles shortcut learning head on, which is a different thing from teaching AI-specific skills. For Malaysian engineering education, the question then becomes what kind of project-based learning, set in what kind of context, keeps students doing that thinking.

Martin and colleagues' graduates, and the first of Ma and colleagues' three responses, circle one question: did students leave university knowing how to use AI well? Teo, and Saravanan and colleagues, ask something that comes before it. Did students learn the material at all, or did AI let them skip the parts of a course that used to force learning to happen? This review follows the second question. Each of the five strategies examined next holds up against it for a practical reason. A project, a community placement or a reflective log is much harder to complete by prompting alone than a standalone assignment, because each is built around grading the process a student goes through as well as the artefact handed in at the end. Barari and colleagues' results give this design choice empirical support. AI pushed scores toward the ceiling on artefact-graded programming work

and left more conceptual tasks comparatively untouched. The outcomes this review follows are therefore, on evidence as well as argument, the ones an artefact-only assessment can no longer discriminate on [9].

CURRICULUM STRATEGIES FOR AI-RESISTANT, EAC-ALIGNED OUTCOMES

A. Project-Based Learning

Of the five strategies, PBL has been studied most, and the evidence for its main claims is fairly settled. Lavado-Anguera, Velasco-Quintana and Terrón-López reviewed PBL as an experiential methodology in engineering education and report consistent gains in problem-solving, motivation and retention of technical content across the studies they covered [12]. Hidayat and colleagues' meta-analysis of twenty-one years of PBL in engineering education reaches a similar conclusion from a larger body of evidence, although they note that implementation quality differs enough between institutions for effect sizes to vary [13]. Zhang and Ma's meta-analysis of PBL and student learning outcomes adds a methodological caution. PBL's advantage over conventional teaching tends to be larger for skills-based outcomes than for recall of content, which fits the argument we develop here [14].

Two more recent contributions sit near the concerns of this paper. Mota, Cabral, Braga and Lopes mapped a decade of PBL research (2014 to 2024) bibliometrically. The field has grown steadily but remains concentrated in a few countries and disciplines, and Southeast Asia contributes comparatively little [15]. Hsu, Chiang and Kehinde's systematic review of engineering education "in the digital era" examines what drives the acceptance of online learning in engineering. It does not deal with generative AI or with PBL assessment, and it does not connect its findings to accreditation frameworks [16]. An older study is still useful here. Zhang and colleagues describe how design-based learning combined with outcome-based education reshaped a basic industrial engineering course. It is one of the few studies that ties PBL directly to an OBE structure; most of the literature keeps the two apart [17]. Doolittle, Wojdak and Walters's restricted systematic review of "active learning" as a concept matters for another reason. It shows how loosely the term is defined from study to study. The same caution applies to any claim about what "PBL" achieves, because the studies reviewed here do not all define it the same way [18].

Applied studies point the same way. Pawar, Desai and Borotikar evaluated a PBL framework against overall skill development, looking beyond technical grades, and found gains in communication and teamwork as well as technical competence [19]. Eickholt and colleagues show how economical, reconfigurable learning spaces can support PBL even on a tight institutional budget, a real constraint for many Malaysian faculties [20]. Naseer and colleagues report on a PBL framework built around industry collaboration. Students in industry-linked PBL cohorts rated themselves better prepared for employment than peers in conventional cohorts, which speaks directly to the gap between curriculum and industry that Martin and colleagues found among graduates [21]. A review of PBL implementation across engineering programmes by Ramírez de Dampierre and colleagues broadly confirms these patterns. It also warns that many of the studies it covers rely on self-reported outcomes in place of independent assessment [22].

This body of work establishes PBL as an effective vehicle for the outcomes EAC 2024 treats as hardest to automate. It does so, however, with little reference to assessment in the age of AI, including whether a project's process should be graded and defended alongside its final report. It also says little about community or values-based context. The next three themes take up those gaps.

B. Service-Learning and SULAM

Service-learning brings something PBL research on its own rarely covers: a real external community as the client, in place of a simulated brief. Malaysia has had a national framework for this since 2019, SULAM (Service-Learning Malaysia University for Society). Govindaraju's recent account of how SULAM has been institutionalised across Malaysian higher education records the intended benefits, namely stronger partnerships between universities and communities and measurable gains in students' civic responsibility and critical thinking. It also records the obstacles: implementation that varies between institutions, thin resourcing, and faculty who are not equally ready to run service-learning components well [23]. That last obstacle matters to

any Malaysian engineering faculty thinking about SULAM-linked PBL. The framework exists nationally, but how well it works on the ground depends heavily on the effort of individual programmes.

Some of that effort can already be seen in our own faculty. Yusop and colleagues report a SULAM project in which a university team took a "3R Awareness of Milk Packaging" module to primary school pupils, with interactive sessions, waste-sorting demonstrations and a quiz afterwards to check what the children had retained. The scale is modest: one module, delivered to young children. What interests us is the translation work. The authors describe deliberately turning an engineering concept, Design for Environment, into steps simple enough for a young, non-technical audience, while still mapping the activity to specific SDGs [24]. Translating a concept in this way is close to a communication competency in itself. It also offers a concrete local counter-example to the point made in Section IV-A that SULAM and PBL research seldom meet. In one faculty's own project record, they do.

How SULAM is placed across this faculty's courses follows a similar programme-by-programme logic. It is a second, different kind of example, a decision about curriculum mapping where the previous one was a single project. In the Manufacturing Engineering degree (BMIG), SULAM is attached to Additive Manufacturing, an elective, and to Manufacturing Sustainability. An Additive Manufacturing SULAM project run under the same national framework, yet each asks students to bring different technical knowledge to a community partner.

López-Santiago and colleagues provide evidence from Spain of what well-run service-learning can do for engineering students working on environmental problems. At least 75% of their participants reported gains in every one of the eleven competencies assessed, among them creativity, self-confidence, emotional control and resilience, and 82% reported stronger environmental commitment afterwards. Since 88% of the sample had never done service-learning before, the format itself seems to account for much of the effect, more than repeated exposure would [25]. Tsutsumi's case study of a community-integrated PBL project sits where PBL and service-learning overlap. Three students at a Japanese technical college designed and built a rideable 5-inch gauge railway over 15 weeks and demonstrated it at public community events. It shows what a SULAM-compatible engineering project can look like in practice: technical work, in this case mechatronics, carried out with the community as its audience and not for a grade alone [26].

Neither body of work has yet linked service-learning explicitly to EAC outcome language or to assessment in the age of AI. A SULAM-linked engineering project is almost by definition hard to complete through AI substitution alone. It needs sustained contact with a community partner and adjustment to circumstances that no dataset records. Even so, we did not find a single study that makes this argument directly.

C. Value-Based Education

If service-learning supplies context, value-based education supplies an explicit ethical structure. Huang, Pagano and Marengo's Values-Based Education for Sustainable Development (VbESD) framework sets out eight connected components, summarised by the acronym MIRACLES: modelling, inner curriculum, reflection, atmosphere and ethos, curriculum, leadership, ethical vocabulary, and sustainable school operations. The aim is to make values an intrinsic part of sustainability education instead of an add-on module [27]. A validation survey of 157 respondents gave strong support to the framework's practicality. The study was set in general education and not in engineering, however, and the synthesis in Section V tries to address that gap.

For EAC 2024 the link is direct. Ethics (PO7) is among the outcomes AI finds hardest to substitute for, because ethical reasoning rests on judgement in a particular situation, and pattern-matching against training data does not supply that. A curriculum component built on reflection and an explicit "ethical vocabulary", to use Huang and colleagues' term, gives students practice in putting that judgement into words. Without it, programmes are left assuming the judgement will develop quietly through technical coursework.

MQF 2024 makes the national expectation explicit. It describes the implementation challenge as "differentiating and relating characters, personalities, attitudes and behaviours to values, assessing abstract values, maintaining academic rigour and managing potential inconsistencies in implementation" [7]. Huang and colleagues' MIRACLES framework is one answer to exactly that challenge. It turns modelling, inner curriculum, reflection, atmosphere and ethos, curriculum, leadership, ethical vocabulary and sustainable

operations into concrete components that can be assessed, where otherwise a programme would have only a single stated value [27]. MQF 2024 gives a Malaysian engineering programme the regulatory reason to take VBE seriously, and VbESD gives it a structure for doing so.

Concrete examples of this kind of teaching inside an engineering curriculum come from the wider literature on engineering ethics education, which we can draw on even where individual studies do not use the VBE label. Krishnan and colleagues systematically reviewed 159 studies published between 2013 and 2022 and catalogue how engineering programmes deliver ethics instruction. The formats include standalone ethics courses, ethics modules inside technical courses, capstone projects with an explicit ethical component, and experiential formats such as immersive simulations and internships. The assessments paired with them vary just as much, from reflective writing and scenario-based evaluation to structured interviews and concept mapping. The review groups outcomes under moral awareness, ethical knowledge and moral reasoning instead of a single competency [28]. Set beside Huang and colleagues' MIRACLES components, this gives a Malaysian engineering programme a menu of delivery formats that have already been tried, such as a capstone ethics component or a scenario-based reflection exercise. Formats like these can turn "ethical vocabulary" and "reflection" from abstract MIRACLES headings into something gradable, so that each programme does not have to invent an implementation from first principles.

Our programme's own curriculum mapping shows one way of using that menu. Six subjects currently carry the values-based education mandate for PO7 (Ethics). Two are university-wide, non-engineering courses, Integrity and Anti-Corruption and Appreciation of Ethics. The other four are engineering subjects: Product Design and Manufacturing (PDM), the capstone subject - Integrated Design Project (IDP, which has PDM as a prerequisite), Engineering Seminar, and Engineer and Society. Values-education curriculum design usually distinguishes three delivery approaches. Values can be infused into an existing subject's content and activities, embedded as a dedicated module inside a subject, or integrated as a restructured course outcome. The programme chose infusion for all six subjects, so values-based content is woven into existing teaching and assessment and is not delivered as a separate module or a redesigned course. The choice gives up a cleaner audit trail (a dedicated module is easier to point to in an accreditation review) in return for lower implementation cost, because no subject has to be rebuilt from the ground up to carry it.

D. Sustainable Development Goals (SDG) Integration

SDG integration is the only theme in this review with a named place in the EAC outcome list. The Engineer and The World (PO6) is defined in the Standard as the ability to "analyze and evaluate sustainable development impacts to: society, the economy, sustainability, health and safety, legal frameworks, and the environment, in solving complex engineering problems" [1]. SDG work in a Malaysian engineering programme therefore has something the other four themes mostly lack: a specific outcome to attach to, and through it a specific set of courses, once a programme has decided which of its courses should carry PO6. Several PBL strands already reviewed touch on sustainability, but a group of studies treats SDG integration as a deliberate design choice in the curriculum, where elsewhere it appears only as a side effect. Mahrishi, Ramakrishna, Hosseini and Abbas reviewed global trends in outcome-based education through an SDG lens. Engineering programmes increasingly frame their outcome statements in the language of sustainability, they find, but programmes vary a great deal in how rigorously they assess that framing as opposed to simply stating it [29]. El Youssfi, BenFilali and El Hammoumi describe a Moroccan engineering programme that wrote sustainability competencies directly into project briefs [30]. Hariharasakthisudhan, Logesh, Sathickbasha and Kannan propose a hybrid framework that combines design thinking, CDIO and root-cause analysis for sustainable product design projects [31]. Nakad, Gardelle and Abboud evaluate a new sustainability course added to a Lebanese engineering programme, an "add-on" approach to integration [32]. Alhassani, Saleem and Messner survey how engineering curricula around the world are (and are not) building students' capacity to work on sustainable development problems, and they point to curriculum rigidity, faculty preparation and assessment as persistent obstacles [33].

Pathare's case study is probably the most concrete picture in our reference set of SDG-mapped PBL in practice. Five student projects in a postharvest technology course were each mapped to the SDGs they addressed, and all five touched SDG 12 (responsible consumption). The technical results were substantial. One project cut weight

loss in coated tomatoes from 27.1% to 18.8%; another measured how bruising reduced apple firmness from 53.23N to 21.64N. This matters because it shows the SDG framing did not cost the projects their technical rigour [34]. Real technical achievement combined with explicit sustainability mapping is close to the model we propose for Malaysian engineering PBL in Section V.

In our manufacturing engineering and industrial engineering programs, SDG content is mapped to the same four engineering subjects that carry the PO7 and VBE mapping described in Section IV-C: PDM, IDP, Engineering Seminar, and Engineer and Society. Ethics and sustainability are not run as separate tracks needing separate subjects. Product Design and Manufacturing, and the Integrated Design Project that follows it, are natural homes for SDG framing because their project briefs already follow a physical product through its full lifecycle. Engineering Seminar and Engineer and Society carry the broader societal and policy framing that falls outside the project scope of PDM and IDP. Mapping the same subjects to PO6 and PO7, and to service-learning through SULAM, is one practical answer to the competition for resources discussed in Section V. Instead of finding four subjects for four strategies, the faculty concentrates them in a smaller set of subjects already placed to carry that content.

E. Communication Skills

Communication is an EAC outcome in its own right (PO9). Research on building it in engineering students is smaller than the PBL literature but bears more directly on employability. Wu, Xu and Philbin surveyed 130 engineering students and practitioners in China. Oral communication ($p < 0.01$) and visual communication ability ($p < 0.001$) both significantly predicted employability, and intercultural communication competence was also positively related. The authors describe a feedback loop in which better communication skills earn better evaluations from employers, and those evaluations in turn push further development of the skills. They recommend industry partnerships and dedicated communication teaching as practical responses [35].

Two systematic reviews take the picture beyond engineering. Culcasi and Fontana Venegas reviewed service-learning and soft skills in higher education, asking why universities use service-learning to develop soft skills in the first place, which implementation models exist, and where the field's methods fall short. Their review is a useful link back to the SULAM discussion in Section IV-B [36]. Orih and colleagues' wider review covered 38 soft-skills intervention studies from primary school to university. Project-based learning was already one of three recurring intervention types, with workshop-based activities and creative methods using drama and games as the other two. Only three of the 38 studies met their criteria for "best practice" evidence, and most were rated "promising" or "emerging" [37]. That quality gradient describes communication-skills research in engineering education fairly well. The evidence points consistently in one direction, but rigorous, engineering-specific studies are still scarce.

F. Research Gap and Contribution

Read side by side, the five literatures show a pattern, and the gap is wider than one missing study. PBL research is mature but seldom engages directly with assessment in the age of AI or with community context of the SULAM kind. Service-learning research documents strong gains in competencies but almost never uses EAC or accreditation-outcome language, even in the Malaysian SULAM literature. Value-based education has a clear framework (VbESD/MIRACLES) that has seen little testing in engineering. SDG-integration studies show what is technically possible and say little about assessment design. Communication-skills research connects most directly to employability yet stays largely apart from the other four themes. We found no study that treats all five as parts of one curriculum response to a single pressure: EAC 2024's revised outcomes arriving just as AI makes it possible to complete much of that curriculum without necessarily learning from it.

This is not the first attempt to bring project work, communication and sustainability into one engineering curriculum. CDIO (Conceive, Design, Implement, Operate) has done so since the early 2000s, and the hybrid framework by Hariharasakthisudhan and colleagues discussed above adds design thinking and root-cause analysis to a CDIO base [31]. What CDIO does not yet include is an answer to generative AI. A 2026 study of CDIO implementation, which surveyed 152 first-year students on how multimodal learning preferences interact with the framework, stays entirely within CDIO's existing logic of industry alignment and active learning.

ning. It never engages with generative AI or with the validity of assessment in the age of AI [38], and that silence matches what we saw across the CDIO-related literature more broadly. The synthesis we propose is best read as a response to a problem that CDIO's founding logic predates, and we do not offer it as a competing curriculum model. CDIO integrates PBL, communication and sustainability to prepare graduates for industry practice. The pressure this paper follows comes a step earlier. Can a curriculum built on any integrative model, CDIO included, still verify that a student did the reasoning behind a submitted project, now that the work can be largely AI-generated? SULAM-linked context and an explicit AI-use declaration are the two elements we add that CDIO does not have, and both are aimed at that verification problem more than at industry alignment.

We make three contributions. First, we bring five literatures that rarely cite each other into one frame, built around a shared diagnosis: the outcomes hardest to automate are the ones that PBL, SULAM, value-based education, SDG integration and communication instruction each build in their own way. Second, we read the literature on AI and accreditation (Teo; Saravanan, Meissner and Glenn; Martin and colleagues) alongside a curriculum-strategy literature that has so far developed without it. As far as we know, this has not been done before for the Malaysian EAC context. Third, we propose in Section V a concrete structure for combining the five strategies within one Malaysian engineering curriculum, so that they do not remain five separate recommendations.

TOWARDS AN AI-READY, EAC-ALIGNED CURRICULUM: A SYNTHESIS

Placed side by side, the five strategies suggest a structure more than a list. PBL is the delivery mechanism. A sustained project, as opposed to a string of exercises, gives teamwork, communication and ethical judgement room to develop, so they are not assessed as abstractions. SULAM gives the project real stakes. A community partner with actual needs raises the cost of poor teamwork or poor communication in a way that a simulated client brief cannot. Value-based education, through structured reflection and an explicit ethical vocabulary, gives students language for the judgement calls that a real community project will force on them. SDG framing gives the technical content a defensible rationale that goes beyond "the syllabus says so", and Pathare's case study suggests this need not reduce technical depth. Communication, finally, should no longer be something a project report is graded on almost as an afterthought. It should be an explicit criterion, assessed separately, as Wu, Xu and Philbin's employability findings suggest.

For a Malaysian engineering faculty deciding what to change this semester, four implications follow fairly directly from the literature. They work at two levels. One concerns the programme's curriculum map as a whole, and the other three concern individual project briefs and rubrics within it.

The first implication sits at programme level. Before any project brief is redesigned, a programme should work out, subject by subject, which of its existing courses actually carry PO6, The Engineer and The World, in its curriculum map. Many Malaysian programmes already have an obvious candidate in a course along the lines of "Engineers in Society", which is the very course Mat Isa, Jani and Mohd Pauzi used to demonstrate constructive alignment against the 2024 Standard [2]. Our faculty's mapping, described in Sections IV-B, IV-C and IV-D, shows what this step can produce when it is carried through. Four engineering subjects (PDM, IDP, Engineering Seminar and Engineer and Society) now carry PO6 and PO7 together, SULAM is attached to programme-specific electives instead of one shared course, and infusion was chosen deliberately as the delivery method for ethics content. Once the PO6-bearing subjects are known, SDG content and the "ethical vocabulary" of value-based education can be written into four documents that a programme already reviews on a fixed cycle, so they no longer depend on individual lecturers' initiative. The course synopsis is the first, so the SDG and values focus is visible before a student enrolls. The teaching plan or scheme of work is the second, so that particular weeks carry particular SDG-linked topics and the subject is not dispatched in one introductory lecture in week one. The Course Learning Outcomes (CLOs) are the third, worded so that a student must demonstrate sustainability and ethical reasoning and cannot simply pass by them. The assessment rubric is the fourth, with a scored criterion for SDG alignment and values-based reasoning in place of a mention buried in a general "content" mark. Mahrishi and colleagues' warning becomes most actionable at this point. Their finding that programmes often state sustainability outcomes without assessing them rigorously is, in practice, first a problem of synopses and CLOs, and it can be fixed at the same curriculum review where a programme maps PO6 [29].

The other three implications work one level down, inside the courses and projects a programme has already mapped to PO6 and its neighbouring outcomes. Second, PBL project briefs in those courses can be written together with SULAM community partners and mapped to one or two SDGs at the design stage. Treating community engagement and sustainability framing as separate compliance boxes, ticked after the technical brief is done, misses the point. Third, assessment rubrics need a real, separately weighted component for communication and teamwork, since a single combined "professionalism" mark is not enough. The rubric should also be built with Teo's concern about cognitive ownership in mind. If students have to document and defend their reasoning, and not only submit a polished final artefact, the rubric addresses the communication outcome and the problem of AI authenticity at the same time. In practice, that documentation can be a short, compulsory AI-use declaration attached to every submission, stating which tools the student used and what for. The rubric should treat the declaration as a matter of accountability, which asks more of a student than disclosure does. Using a tool to fix grammar, tidy language or formatting, or check a calculation is one thing. Presenting AI-generated data, results or analysis as one's own work is something else, and the two should never earn the same mark. A student who declares the first remains fully accountable for the submission. A student who does the second has not produced evidence of the learning the assessment was meant to certify, however good the final artefact looks, and the rubric should say so plainly instead of leaving it to be inferred later. The expectation is not new to the AI era. It extends a principle MQF 2024 already sets out for digital skills in general: ethical use of technology is part of what a graduate must demonstrate, and it cannot be assumed to follow from technical competence [7].

A minimal declaration could ask three things on a cover sheet. Which AI tools were used? For which specific parts of the submission (for example, "grammar editing of Sections III and IV", "initial literature search for related work", "debugging of a MATLAB script")? And it would carry a signed statement that no AI-generated data, results or analysis appear in the submission unless explicitly identified as such. With only three short fields, the declaration costs a student who used AI in permitted ways almost no extra time. Impermissible use then becomes a false declaration, which is easier to act on than misuse a marker has to detect unaided.

Teaching AI literacy of this kind need not wait for a rubric redesign. It can go straight into the syllabus as taught content, and at least one course in our faculty already does this. Before they begin their final-year project, students attend a structured lecture on permitted and non-permitted AI use. Using AI to search for and shortlist literature, to help structure or draft sections of the report, and to check grammar and language is taught as acceptable and declarable. Using AI to generate, analyse or fabricate data and presenting it as one's own finding is taught as impermissible. Putting this distinction into a syllabus session, instead of leaving students to infer it from a rubric line they first read at submission, is a cheap way to make the accountability principle above something students are taught and then graded on.

Fourth, a short reflective component based on the "ethical vocabulary" idea from value-based education, even a one-page structured reflection at project milestones, gives programmes concrete evidence of PO7 to show accreditors. Without it, they must rely on an ethics course taught separately from the project work.

The four implications pull against each other in places, and a programme adopting them should expect to manage trade-offs, since the pieces will not simply stack. PBL and SULAM draw on the same scarce resource: staff time spent supervising a project across a semester, which is far more than marking a single assignment takes. Adding SULAM's community liaison, a separately weighted communication rubric and a reflective ethics component to an existing PBL brief in a single semester could overload students, who must now produce and defend more than a technical deliverable, and staff, who must now assess more than technical correctness. A phased rollout is one way to manage the load while keeping the structure. A programme could start with the third implication alone, adding the AI-use declaration and a documented-reasoning criterion to an existing PBL rubric. These changes affect marking practice, leave course design untouched, and can be piloted in one course within a semester. SULAM partnership and explicit SDG mapping (the second implication) make a reasonable second phase once a course's assessment already rewards process over artefact, because a community partner raises the stakes of a process the rubric is by then built to capture. The reflective ethics component (the fourth implication) is best left until a programme has budget set aside for it. Krishnan and colleagues' review suggests that reflective and scenario-based ethics assessment carries its own marking load, separate from a technical or communication rubric, and does not fold cheaply into either [28]. None of this makes the resource question go

away. It only puts it in sequence, so that a department unable to do everything at once still has a defensible place to start.

None of it comes free. Govindaraju's account of SULAM's uneven institutionalisation is a fair warning that community-linked PBL depends on faculty readiness and institutional support, and neither can be assumed in every department [23]. Saravanan, Meissner and Glenn found that faculty already feel under-supported in responding to AI, which adds a second layer of strain to any proposal that also asks for redesigned assessment [4]. Phasing the changes in, as described above, is one practical response to that strain and no reason to postpone everything. Adopting the third implication alone, in one course, gives a department evidence on whether the rest is workable locally before it commits further. The evidence base has real limits too. Almost none of the studies reviewed were carried out in Malaysia. Several SDG-integration studies appear in newer journals whose long-term indexing status is still settling. And we found no study that tests an AI-use declaration or an AI-transparent assessment rubric in a live engineering PBL course. Future work should close these gaps, but they are no reason to hold back smaller changes now.

CONCLUSION

We set out to ask what Malaysia's revised EAC 2024 standard and the rise of generative AI mean together for engineering curriculum design, and which existing strategies answer both pressures at once. As we read it, the AI pressure arrives earlier than most of the literature places it. Long before graduates reach a job that asks them to use AI well, there is the question of whether they did the reading, the calculations and the independent reasoning their degree was meant to produce, now that AI lets them submit accomplished-looking work without any of it. Working from 36 verified, openly accessible sources together with the EAC 2024 and MQF 2024 standards, we find that project-based learning, service-learning through SULAM, value-based education, SDG integration and communication-skills instruction all rest on a sustained process. None of them can be satisfied by a single artefact handed in at the end. That is why they build outcomes AI cannot easily substitute for, and EAC 2024 now treats those outcomes as central. Our main limitation is one we share with the literature: these five strategies have mostly been studied apart from one another, and largely apart from the pressure AI now places on assessment. The synthesis in Section V, an integrated project structure that combines SULAM context, SDG framing, explicit communication assessment and reflective ethical practice, is our reading of where the evidence points. It is not a tested model, and we have not evaluated it empirically. Future work should try a version of this structure in a real Malaysian engineering course, track whether attainment on PO7, PO8 and PO9 measurably improves, and find out whether assessment based on cognitive ownership, including an AI-use declaration in the rubric, can be built into project milestones without adding an unsustainable marking load for staff who are already stretched.

It is worth being specific about what would count as evidence that the integrated approach works, so that later authors do not have to define it from nothing. At the level of outcomes, a pilot could track three measures against a matched comparison cohort. The first is rubric-scored attainment on the communication and teamwork criteria proposed in Section V (PO8, PO9), rated independently by at least two markers so that agreement can be checked. The second is a moral-reasoning or ethical-awareness instrument of the kind Krishnan and colleagues catalogue, given before and after the reflective component as a proxy for PO7 attainment [28]. The third is the AI-use declarations themselves, coded for how often declared use stays within the permitted categories in Section V and how often it drifts toward the boundary the rubric is meant to police. Cognitive ownership is the hardest of these to observe, and it is better approximated than measured outright. A short oral defence of two or three project decisions, scored against the student's declaration, would show whether the student can explain choices attributed to them in writing. Agreement between what a student wrote and what the student can defend live is the working stand-in for cognitive ownership that we propose, since no validated instrument for the construct yet exists. For piloting, the phased sequence in Section V doubles as an evaluation design. One course adopts the AI-use declaration and the documented-reasoning criterion first, which gives a department a semester of before-and-after rubric data with little disruption. Only when that pilot shows the extra marking load is sustainable would SULAM partnership, SDG mapping and the reflective component be added and evaluated in turn. The staged rollout is also how the marking-load concern raised by Saravanan, Meissner and Glenn's participants would be tested instead of simply asserted.

Until that evidence is in, we offer this as a structure worth trying. It has not yet been proven.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

This is a literature review article. No new primary data were generated or analysed. All sources reviewed are cited and publicly accessible via the DOIs or links listed in the References section.

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