Curriculum Gap Revisited: LLMs, Adaptive Expertise and PBL for IS

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Abstract: The Information Systems (IS) field has long faced a misalignment between curriculum guidelines and labour-market expectations. Drawing on prior studies comparing Swedish IS job advertisements with the IS 2010 Curriculum Guidelines and the IS2020 Competency Model (Steen and Pierce, 2020; Steen and Pierce, 2023), this paper argues that the mainstreaming of large language models (LLMs) since 2022 has intensified this gap. IS education remains largely organised around stable, codified competencies; the paper argues that, in the post-2022 context, employers will increasingly value adaptive expertise, critical AI literacy and robust transfer across contexts — a claim the planned empirical phase is designed to test. The Stanford AI Index from 2026 places this concern in wider context, reporting that formal education is lagging behind AI and that employment among software developers aged 22 to 25 fell nearly 20% from 2024, suggesting pressure on the entry-level roles for which IS programmes traditionally prepare graduates (Sajadieh et al, 2026). Against this backdrop, the paper makes a conceptual and programmatic case for problem-based learning (PBL), reconceived through Savin-Baden's (2014) new constellations framework and Barnett's (2017) feasible utopias, as a pedagogical architecture for developing adaptive expertise. Rather than proposing another curriculum revision, I argue for rethinking how IS education is designed and delivered, with LLMs functioning not as answer engines but as co-inquirers that stretch students' reasoning, judgment and metacognitive capacity. The paper engages the debate over minimally guided instruction (Kirschner, Sweller and Clark, 2006; Hmelo-Silver, Duncan and Chinn, 2007) and concludes with a research agenda comprising a regional employer survey and follow-up interviews. Prior content analysis of 12,358 Swedish IS job advertisements showed that interpersonal dispositions appeared in 97.3% of postings and enterprise architecture in 15.1%, areas current IS frameworks under-weight. A planned next phase will survey approximately one hundred employers in the Öresund cross-border region and conduct in-depth interviews with recruiters, IS managers and recent IS graduates, probing the reasoning behind employer expectations that the prior job-advertisement data could not reveal. The paper contributes a structural argument and a planned empirical programme to the IS education community.

Keywords: IS Education, Curriculum Gap, Problem-Based Learning, Large Language Models, Adaptive Expertise, Learning Ecologies

1. Introduction

The Information Systems field has always had an uneasy relationship with its own curriculum. This is not unique to IS; most applied disciplines struggle to reconcile the pace of industrial change with the rhythms of curriculum revision, but it is more acute in IS than in most. The community has responded with two major frameworks over the past sixteen years: the IS 2010 Curriculum Guidelines (Topi et al, 2010) and the IS2020 Competency Model (Leidig et al, 2022). Both were serious efforts to define what an IS graduate should know and be able to do. And yet, as my late colleague Odd Steen and I argued in a series of empirical studies of Swedish IS job advertisements, neither fully captured what Swedish employers were asking for (Steen and Pierce, 2020; Steen and Pierce, 2023). ICT System Administration was more prominent in employer expectations than in either framework. Enterprise Architecture, downgraded in IS2020 to a graduate-level concern, remained a meaningful presence in undergraduate job ads. Most tellingly, the interpersonal and communicative dispositions employers emphasised most, namely cooperation, communication and language proficiency, were treated with more ambivalence in the guidelines than the evidence warranted.

These gaps suggest a structural limitation in how the IS field conceptualises what education is for: an implicit assumption that the goal is to produce graduates who possess a defined set of competencies, rather than graduates capable of learning, adapting and exercising judgment in conditions that cannot be fully anticipated at the time of study. This distinction has long been made in the educational literature through concepts such as adaptive expertise, transfer and supercomplexity. Contemporary accounts of adaptive expertise and adaptive performance emphasise professionals' capacity to respond to novel and changing situations, rather than merely reproduce established routines (Pelgrim et al, 2022). Work on epistemic fluency similarly frames professional education as preparation for knowledgeable action across multiple forms of expertise, tools and contexts (Markauskaite and Goodyear, 2017). Meanwhile, the literature on wicked competencies highlights the difficulty, but necessity, of cultivating evaluative judgment, communication, collaboration and other complex graduate capabilities that resist simple curricular codification (Sridharan and Kinshuk, 2024).

Since the release of ChatGPT in November 2022 and the rapid proliferation of LLMs as everyday professional tools, the IS competency landscape has undergone a shift qualitatively different from the incremental changes

that typically prompt curriculum revision. This is not simply a matter of adding AI literacy or prompt engineering to the skill list; it is a recognition that LLMs have begun to automate precisely the codified, procedural competencies IS education has historically centred on. Routine programming, information retrieval, basic data analysis and system documentation are not disappearing from the IS professional's world, but they are becoming tasks that a capable professional manages and interrogates rather than performs from scratch. What this creates is a profound elevation of what might be called the judgment premium: the value placed on the capacity to evaluate, contextualise, reframe and critically engage with AI-generated outputs. The Stanford AI Index 2026 reports productivity gains of 14% to 26% in structured, process-driven tasks while tasks requiring more judgment showed weaker or negative effects (Sajadieh et al, 2026). Employment among software developers aged 22 to 25 fell nearly 20% from 2024, while older cohorts have not experienced the same decline. Correlation is not causation, but the directional signal is difficult to ignore.

This paper responds to that challenge as the conceptual foundation of a broader research programme. I draw on the prior job-advertisement studies to establish the curriculum–employer gap as it existed prior to the LLM inflection point, then argue that the post-2022 context has deepened that gap in ways no further iteration of the IS2020 framework is likely to address. The main contribution is a conceptual argument for problem-based learning, reconceived through Savin-Baden's account of new PBL constellations and Barnett's account of the ecological university as a feasible utopia, as a pedagogical architecture well suited to developing adaptive expertise.

The paper focuses on IS education at the undergraduate level, where curriculum guidelines are most prescriptive and the misalignment most consequential. The arguments are applicable more broadly to information system education. The learning ecologies perspective adopted here situates education not only within the classroom, but across the wider contexts, relationships, practices and institutional arrangements through which professional capability develops (Jackson, 2013; Barnett and Jackson, 2019).

2. The Curriculum-Employer Gap: What We Already Know

The empirical foundation for the present argument is the studies Odd Steen and I conducted between 2019 and 2023, which examined the relationship between IS curriculum guidelines and Swedish employer expectations. The first study (Steen and Pierce, 2020) examined the content and structure of nineteen Swedish undergraduate IS programmes alongside their Australian and US counterparts, revealing a distinctive national profile: stronger emphasis on enterprise architecture and application development than either comparator framework prescribed. The second study (Steen and Pierce, 2023) moved the lens from curriculum documents to the labour market itself, conducting content analysis of 12,358 IS job advertisements drawn from Platsbanken, the Swedish Public Employment Service's open-data job database, with publication dates spanning 2017 to early 2023.

Four findings are most relevant here. First, ICT System Administration was substantially more prevalent in the ads than either the IS 2010 Guidelines or the IS2020 Competency Model acknowledged: in the top ten occupations specifying an IS education background, three fell within this category, including the second most frequent overall (System Manager). Neither framework treats this as a significant competency domain. Second, the three most prominently demanded personal dispositions, being communicative, demonstrating language proficiency in Swedish and/or English and being cooperative, appeared in almost all (97.3%) of the IS-education-specifying ads. The IS2020 Competency Model is considerably more preoccupied with technical competency than with these dispositions, which I would argue treat as supplementary something employers regard as constitutive. Third, Enterprise Architecture, downgraded in IS2020 to a graduate-level concern, was mentioned in 15.1% of IS-education-specifying ads at roughly equivalent rates for undergraduate and graduate-level candidates. This reflects a broader tendency of the IS2020 framework to follow a US perspective; six of the eleven members of the IS2020 Task Force were from US institutions, and the primary data source for occupational analysis was the AIS Job Index, a US-specific dataset. Fourth, and most pertinent to the present paper, was the finding around programming. IS2020 re-established programming as a core competency, a move with considerable support in the literature given its demotion from the IS 2010 framework. Our evidence offered only partial support: while programming skills were present in the ads, the depth and specificity called for in IS2020 were not consistently reflected in employer expectations. More significantly, the original paper flagged that the rapid development of generative AI was already complicating the picture: recent work shows that LLM-based tools now provide code suggestions, explanations and debugging support in programming education, while also raising questions about how curricula can preserve algorithmic thinking, error detection and independent problem-solving as routine coding tasks become increasingly automated (Kohen-Vacs, Usher and Jansen, 2025). These prior findings establish the curriculum-employer gap as it stood up to early 2023; they do

not yet establish how the gap has shifted under LLM pressure, which is the present paper's conceptual focus and the question the planned next phase is designed to answer.

3. The LLM Inflection Point: From Competency Gap to Competency Crisis

The arrival of ChatGPT in November 2022 represents one of those rare moments when accumulated incremental pressures produce a qualitative shift in an applied field. I am not making a claim about technological singularity or artificial general intelligence; I am making a more modest but still significant claim about the nature of the IS professional's work and, by extension, the nature of IS education.

LLMs are extraordinarily effective at producing fluent, contextually plausible text in response to a prompt, including code. They perform well on tasks defined by a well-specified input-output relationship and drawing on patterns abundantly present in training data. What is instructive is what the Stanford AI Index 2026 calls the 'jagged frontier' of AI capability: frontier models now exceed human performance on structured benchmarks, from mathematically very complex problems to advanced coding competitions, while achieving only 50.1% accuracy in telling time from an analog clock (Sajadieh et al, 2026). This uneven profile maps with remarkable precision onto the routine/adaptive expertise distinction. LLMs are considerably less reliable at tasks requiring genuine novelty, deep contextual understanding, rigorous causal reasoning or what Schön (1983) called reflection-in-action: the situated judgment of assessing what a particular situation actually calls for, weighing factors that are not fully specified. The distinction between the production of plausible outputs and the exercise of genuine judgment is the central educational issue raised by LLMs.

This distinction has profound implications for IS education. The competencies foregrounded in IS 2010 and IS2020, specifically programming, data management, systems analysis and IT infrastructure, are largely competencies of codified knowledge: things that can be described, specified, practised and now, to a significant degree, automated. If IS graduates will work in environments where LLMs are routine professional tools, we need to ask what aspects of IS practice remain genuinely dependent on human expertise, judgment and the capacity for continuous learning.

The answer lies in two interconnected areas. The first is what Hatano and Inagaki (1986) called adaptive expertise: the capacity to handle novel problems that do not fit established routines, to recognise when standard approaches are inadequate and to generate new approaches through deep understanding and creative reasoning. Adaptive expertise is contrasted with routine expertise: high competence at familiar problem types, developed through repeated practice. Routine expertise is exactly what LLMs are increasingly good at providing. Adaptive expertise, which requires understanding why and being able to reframe and transfer that understanding, remains less securely supported by current LLM capabilities than routine performance. The second is what the learning ecologies literature frames as transfer across contexts (Jackson, 2013): the capacity to apply knowledge not just within the domain where it was acquired but across different professional and institutional settings, different kinds of problems and different sociotechnical arrangements. This boundary-crossing inquiry (Engeström, 2001) is the hallmark of what Barnett (2000) described as the graduate capable of functioning in supercomplexity, the condition in which not just the answers but the questions themselves are contested.

Looking at the IS2020 framework through this lens, one is struck by its structural bet on codification. The competency model is built around specifiable, teachable skill areas: application development, data and information management, IT infrastructure, IS management and strategy. These are genuinely important. But the framework's underlying logic is one of competency acquisition. This logic was already showing strain in the pre-LLM context, as our job ads study suggested. In the post-LLM context, it is structurally inadequate, not because the competencies identified are wrong, but because the conditions under which IS professionals must exercise those competencies have changed in a way that elevates a different order of capacity above them.

There is a longer-term learning dimension. The Stanford AI Index reports early but troubling evidence that heavy AI reliance may carry learning penalties that slow skill development (Sajadieh et al, 2026). The research is preliminary, but the directional concern is consistent with what educational theorists would predict. If students habitually outsource the generative and analytical stages of cognitive work to an LLM, they forgo the productive struggle through which adaptive expertise develops. The wider context the AI Index describes is one of formal education lagging behind AI: four in five U.S. high school and college students report using AI for schoolwork, while only around half of middle and high schools have AI policies and just 6% of teachers say those policies are clear (Sajadieh et al, 2026). This is not merely an administrative gap; it reflects pedagogical uncertainty about

what education should accomplish when the tools available to learners differ fundamentally from those available to the designers of their curricula.

There is also an ethical dimension. The use of LLMs raises questions about authorship, the distribution of cognitive labour, power and surveillance, and the environmental costs of large-scale AI computation (Kasneci et al, 2023). These are constitutive of what it means to be a responsible IS professional today. An IS education designed around adaptive expertise and critical AI literacy is inherently better positioned to address these dimensions than one designed around technical competency acquisition, precisely because it keeps judgment, including ethical judgment, at the centre of the educational enterprise.

4. The Pedagogical Response: Problem-Based Learning Reconceived

Having established the prior curriculum-employer gap and argued that LLMs have deepened it, I now want to make the positive case for problem-based learning as the pedagogical response adequate to the present moment. PBL is not a silver bullet, and its claims have been seriously contested. Kirschner, Sweller and Clark (2006) mounted an influential critique of minimally guided instruction, arguing on cognitive-load grounds that novice learners benefit more from worked examples and direct instruction than from open-ended inquiry. The response from Hmelo-Silver, Duncan and Chinn (2007) was that this critique conflated PBL with discovery learning and underestimated the role of scaffolding in well-designed PBL environments, which manages cognitive load while preserving inquiry. I take the Hmelo-Silver position seriously: the version of PBL I am advocating is heavily scaffolded, not free-form, and the role of the educator is to design problem environments in which inquiry is structured rather than abandoned to chance. As Savin-Baden (2014) observed, 'problem-based learning' covers a considerable range of pedagogical practices. What I am arguing for is not PBL as a generic method but PBL as theorised through what Savin-Baden (2014) calls new constellations: pedagogical arrangements explicitly designed to develop the capacity to engage with ill-structured problems, to work across disciplinary and contextual boundaries and to exercise judgment under uncertainty.

Savin-Baden's account is built around the idea that the most valuable learning happens at the edges of competence: when students encounter problems that do not yield to existing frameworks. This is well suited to the LLM context for a paradoxical reason: LLMs are very good at producing answers to questions that have answers. They are less useful when the question is genuinely open, when the task is not to retrieve information but to exercise judgment about what the problem actually is, what knowledge is relevant and what would count as an adequate solution.

Consider what this means for IS education. A systems analysis task that can be completed by prompting an LLM is unlikely to develop adaptive expertise. The educational value lies instead in tasks where students must interpret conflicting stakeholder interests, work with incomplete information, navigate value conflicts and recognise that technical choices have social and organisational consequences. These are the conditions under which professional judgment is formed. If IS education is to remain meaningful in an LLM-augmented world, it must create learning experiences that students cannot simply delegate to the machine.

Barnett's framework is particularly generative here. His account of supercomplexity, the condition in which not just practical problems but the frameworks for understanding them are multiple, contested and in tension, is both diagnosis and prescription. A graduate educated for supercomplexity has developed what Barnett calls the will and the capacity to engage: to act in uncertainty, to tolerate the discomfort of not knowing and to bring critical reflection to bear on the frameworks shaping their own understanding. This is precisely the disposition IS education for the LLM era needs to cultivate.

The learning ecologies perspective adds a further dimension. The idea that learning happens within and across interconnected systems of practice (Jackson, 2013; Barnett and Jackson, 2019) is directly relevant to the IS context, where the boundaries between educational and professional practice are particularly permeable. An IS graduate who has learned to exercise judgment within the bounded context of a university course but lacks the capacity to transfer that judgment to the different problems they encounter in practice has not yet learned what matters most. PBL designed around problems that cross institutional and disciplinary boundaries (Engeström, 2001) is better positioned than lecture-based or competency-focused instruction to develop this transferable capacity.

The dominant framing of LLMs in education positions them either as threats to academic integrity or as tutoring tools. Both share an assumption: the student is the learner and the LLM is the resource. What I am proposing is more demanding: in a PBL context designed for IS education, LLMs can function as co-inquirers, partners in the

inquiry process that students work with and against in developing their own judgment. This draws on a tradition in educational theory that sees thinking as fundamentally dialogical (Wegerif, 2007). What is novel is the character of the LLM as a dialogical partner: extraordinarily knowledgeable, fluent and tireless, always producing something plausible. The educational challenge is that plausibility and correctness are not the same thing, and learning to distinguish them is a form of reasoning that must be actively cultivated. This framing receives some empirical grounding: Anthropic (2025) reports that students using Claude often engage in cognitively consequential work, including creating and improving educational content and obtaining technical explanations or solutions. The sample is self-selected, with computer-science students overrepresented, but the headline pattern is suggestive: left to their own devices, students tend to use LLMs in the register of higher-order thinking. What PBL can add is a structured pedagogical architecture that makes the critical and reflective dimensions of this engagement explicit, sustained and subject to assessment.

5. Towards a Reconceptualised IS-PBL Framework

What follows is a set of design principles rather than a finished architecture; the empirical research programme described in the next section is necessary to test and refine them. The aim, to use Barnett's (2017) formulation, is a feasible utopia: ambitious enough to stretch what universities might do, grounded enough to be practicable. Each principle below operationalises one conceptual move from earlier sections: problem design and inquiry address adaptive expertise; transfer addresses cross-context capability; the ecological-ethical principle addresses ethics.

First, problem design. Problems in an LLM-era IS-PBL curriculum need to be built around genuinely wicked problems (Rittel and Webber, 1973): situations in which goals, constraints and relevant knowledge are not fully specifiable in advance, and in which multiple reasonable approaches exist, none straightforwardly correct. A problem that can be solved by prompting an LLM effectively has the wrong structure for educational purposes. This suggests a shift away from scenarios eliciting the application of known methods and towards scenarios built around the analysis of real organisational situations.

Second, the process of inquiry and the role of LLMs within it. LLMs should be integrated into IS-PBL not as tools for task completion but as generative interlocutors whose outputs are always provisional. Assessment cannot rest primarily on the quality of a student's final product, since it may be substantially LLM-assisted, but on the quality of the reasoning process, the capacity to evaluate and critique AI-generated inputs, and the ability to articulate and defend the judgments made. Process portfolios, reflective journals and structured peer critique become more important relative to conventional written assignments.

Third, transfer. A reconceptualised IS-PBL framework must be designed explicitly around the development of transfer capacity: the ability to take learning from one context and apply it, with appropriate adaptation, to another. If students are assessed only on performance within the bounded context of a course, we cannot know whether they have developed the flexible understanding adaptive expertise requires. Assessment that requires demonstrated transfer, and curricular arrangements that create continuity between educational and professional problem spaces, including internships and project partnerships, are important complements to classroom-based PBL.

Fourth, what Barnett (2017) calls the ecological university: the institution that takes seriously its relationships with broader social, environmental and epistemic contexts. An IS-PBL framework for the LLM era needs to foreground the ethical dimensions of AI use, including authorship, power, surveillance and environmental cost, not as a separate module but as an integral dimension of every problem scenario. The goal is IS graduates with sufficient stability of professional identity to engage with complex, contested situations without losing analytical rigour or ethical compass.

Together these principles constitute a departure from the competency-acquisition logic of IS2020. They do not reject the specific competencies IS2020 identifies, but situate competency development within a broader architecture that treats adaptive expertise, critical judgment and ethical reasoning as primary educational goals. This is empirically grounded: the Swedish job ads studies already suggested employers valued the dispositional and relational dimensions of IS graduate capability at least as highly as the technical ones; the LLM context makes this weighting more pronounced.

6. Discussion and Research Agenda

The argument developed here is conceptual and programmatic: it builds on prior empirical work, argues that the LLM context makes the curriculum-employer problem more urgent, and proposes PBL as a response. That empirical work is the task of the research programme of which this paper is the first instalment. Three claims separate what prior evidence has established from what the next phase will test: that the gap documented in 2017-2023 (Steen and Pierce, 2023) persists post-2022; that its character has shifted toward adaptive expertise and critical AI literacy; and that employers and recent graduates can articulate this shift in ways job-advertisement data alone cannot capture.

The next phase will be a survey of approximately one hundred organisations in the Öresund region, the cross-border metropolitan area encompassing Malmö and Copenhagen, designed to update the job ads evidence for the post-ChatGPT period and to gather direct employer perspectives on competencies they now regard as essential. The survey has two connected purposes: to test whether competency priorities have shifted since 2023 as predicted, and to assess whether employers are rethinking how they recruit and onboard IS graduates in light of LLM capabilities. The survey will be followed by in-depth interviews with a smaller number of key informants: recruiters, IS managers and recent IS graduates working in the region. The survey will use a paired-item design contrasting employer priorities for codified competencies (programming, data management) with priorities for adaptive capabilities (judgement, transfer, critical AI literacy), sampled from Platsbanken-registered employers and compared with the 2017-2023 ads data. The interviews are essential to this design: survey data and job-advertisement coding can reveal what employers prioritise, but only direct conversation with recruiters, IS managers and recent graduates can surface the reasoning, lived experience and tacit weightings that distinguish a post-LLM understanding of IS practice from its pre-LLM counterpart.

7. Conclusion

This paper has argued that IS education was already misaligned with employer expectations before the LLM inflection point, particularly in occupational coverage, personal dispositions, enterprise architecture and programming emphasis (Steen and Pierce, 2020, 2023). Since 2022, this misalignment has deepened qualitatively. LLMs have increased the value of adaptive expertise, critical judgment and knowledge transfer at the same time as IS education remains strongly shaped by codified competency frameworks. The Stanford AI Index 2026 gives this argument macro-level support, suggesting pressure on the entry-level roles IS programmes have traditionally prepared graduates to enter (Sajadieh et al, 2026).

In response, the paper has made a conceptual and programmatic case for PBL, reconceived through Savin-Baden's new constellations and Barnett's feasible utopias, as a pedagogical architecture for developing IS graduates capable of working critically and adaptively in LLM-augmented professional contexts. The argument engages the Kirschner-Sweller-Clark critique by advocating a scaffolded PBL design that preserves inquiry while managing cognitive load. This is an argument rather than a proof; the framework requires empirical testing and refinement. The research programme outlined here begins that work. The curriculum gap is not primarily a problem of content, but of educational design: what IS education is for, and how it can create the conditions for genuine learning rather than merely competency acquisition.

Ethics Declaration

This paper is conceptual and draws on already-published empirical work; no new human-subjects research was undertaken for it. No ethical clearance was therefore required.

AI Declaration

An AI assistant was used during the development of this paper to support structuring, prose review, text shortening and reference checking. All substantive arguments, interpretations and conclusions are the author's own. The author reviewed and verified all references and accepts responsibility for the final text.

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