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EFFECTIVENESS OF MODELS OF TEACHING: A COMPARATIVE ANALYSIS ACROSS BRUCE JOYCE'S FAMILY FRAMEWORK

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ABSTRACT

This research looks at how well different teaching methods work, using Bruce Joyce's classification into four types - Information Processing, Behavioural Systems, Social Systems, because they shape classroom practice in distinct ways. Evidence comes from six real-world studies plus two summary analyses involving more than five thousand participants, including school settings and training programs in South Asia, East Asia, though also Western countries. Achievement levels, confidence in delivering lessons, along with preparation skills serve as key measures throughout the analysis. Among these approaches, those rooted in processing information show strong results; specifically, Mastery Learning together with Inductive Inquiry raise student performance meaningfully in subject mastery during middle and high school years ($p < .05$). The Inductive method stands out further, showing an average impact strength of $d = 0.444$ when combining findings across multiple reviews. When it comes to behaviour-focused strategies, outcomes depend heavily on environment: Direct Teaching boosts trainee instructors' belief in their ability far better than group-based learning does in physical education courses ($F(1, 47) = 16.467$, $p < .0001$), yet Inquiry Training fails to improve science scores for seventh graders compared to standard delivery. Superior results in collaborative planning emerged from Social Systems models, yet these needed longer setup times along with strong organisational support. Differences in study outcomes stem less from the type of model used, more from factors like how long interventions lasted, student maturity levels, consistency checks during delivery, and school environment traits. No single model stands out as best across every situation - success depends on matching program features to desired learning goals and local circumstances. What works ties closely to fit, not just method choice. Decisions about curricula, training teachers, and shaping classroom policies can draw clear guidance from this pattern, whether in established or developing educational settings.

KEYWORDS: Models of Teaching, Bruce Joyce, Mastery Learning, Inquiry-Based Learning, Direct Instruction, Cooperative Learning, Teaching Efficacy, K–12 Achievement, Comparative Pedagogy

1. INTRODUCTION

What works best in teaching? This puzzle drives much of education research. Evidence has piled up over years, though answers stay unclear. Surprisingly, methods that shine somewhere can flop elsewhere. Why does success shift so unpredictably? One approach stands out for its depth: the model built by Bruce Joyce and others. Their framework groups strategies into families, offering clarity amid confusion. Clarity matters because classrooms differ wildly. Some techniques ignite learning under certain conditions - yet fail when moved just slightly. Without structure, findings scatter. With it, patterns emerge.

Though developed decades ago, Joyce's framework gained new clarity

Research Paper

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through recent revisions by Joyce and Calhoun (2024). Grouped into four clusters - Information Processing, Behavioural Systems, Social Systems, and Personal Family - the model sorts instructional methods by underlying assumptions. Cognitive constructivism shapes the first cluster; here, learners build understanding through activities like concept attainment or inductive reasoning. Rather than passive reception, these techniques rely on mental engagement to form meaning. Behaviourist principles guide the second group, where learning unfolds via repetition, feedback, and observable change. Programs such as Direct Instruction fit within this realm, focusing on clear objectives and measurable progress. Meanwhile, inquiry-based designs also appear here, despite their exploratory nature, because they follow planned sequences. Though differing in structure, both prioritize skill development over abstract insight. From one perspective, consistency matters more than context in shaping results. Starting with ideas about how people build understanding together, the Social Systems group brings in approaches like working as a team and exploring topics in small groups. At the opposite end, one finds the Personal Family, focused on growth of identity and personal insight through methods that guide without leading - examples include open-ended instruction and creative analogy techniques.

Even though the classification system makes logical sense, clear comparisons between different model types are still scattered. Research tends to look at single approaches - like mastery learning, group work methods, or question-driven teaching - separately, rarely connecting results back to Joyce's overall structure. Where studies do compare across categories, differences in student groups, how success is measured, program lengths, and quality of implementation frequently complicate efforts to draw unified conclusions.

This paper tackles the issue using a systematic comparison of research studies and large-scale analyses focused on teaching methods fitting into Joyce's classification system. Shaped around three central inquiries, it begins by asking which types of instructional approaches show greatest impact on learning outcomes in primary and secondary schools. Following that, attention turns to how well different models prepare future teachers during training programs. Then comes consideration of what conditions influence success - such as classroom environment or teacher experience. Answers unfold across findings drawn directly from data rather than assumptions. Each conclusion rests on patterns seen repeatedly in real classrooms. Insights emerge not from theory alone but from observation and measurement over time. Readers gain clarity about choices backed by consistent results instead of trends. Evidence forms links between method selection and actual performance shifts among students and trainees alike. Understanding grows piece by piece through careful synthesis. Conclusions point toward decisions informed by context-sensitive outcomes. Knowledge builds gradually through layered examples pulled from diverse educational settings. Relevance connects closely to everyday challenges faced by instructors and planners.

2. JOYCE FAMILY TYPES

What keeps Joyce's four-family framework useful is how clearly it links classroom methods to the ideas behind them. Teaching approaches work best, Joyce and Calhoun (2024) suggest, when they challenge thinking while building connections among learners - helping develop independence, inventive thought, along with shared understanding. It's this blend of mental effort and group interaction that shapes every category within the model. Because both elements matter so much, one method alone rarely fits every kind of lesson perfectly.

2.1 Information Processing Family

Starting with how people learn, Information Processing theories grow out of constructivist ideas, drawing from Piaget's work on cognitive growth and Bruner's approach to guided exploration. Rather than absorb knowledge like sponges, students shape meaning by connecting fresh encounters with what they already know. One method putting this into practice is Mastery Learning, where progress only continues once most pupils - about eight in ten - reach at least 80 percent proficiency on a topic. On another path, the Inductive Inquiry and Concept Attainment approaches place learners face-to-face with contrasting cases, letting them spot patterns and form mental groupings over time - a move aligned

with Bruner's view of thinking evolving through observation. What makes these methods stick in subject-based classrooms? They fit well with teenage thought processes: organised inquiry helps bridge the shift toward abstract reasoning, common among high school age minds.

2.2 Behavioural Systems Family

Though rooted in Skinnerian behaviourism, the Behavioural Systems approach also draws from Bandura's ideas about observational learning. Learning, according to Direct Instruction - the best-documented method here - happens when skills are clearly shown, practiced with support, then refined using timely corrections. What makes this model stand out is how every detail follows a set order; teachers follow step-by-step plans while observers track adherence using defined criteria. In contrast, the Inquiry Training Model leads learners through fixed stages of investigation without offering the intense guidance seen in Direct Instruction. Classified under the same umbrella by Joyce, it still differs enough to affect results significantly. Because these methods vary so much inside one category, comparing them reveals divergent effects even in comparable classrooms.

2.3 Social Systems Family

What drives learning here stems from Vygotsky's ideas about culture shaping thought, along with long-standing beliefs in classroom democracy. One approach built on these roots - Cooperative Learning - has drawn far more research attention than others in its category. Instead of competition, it relies on shared goals, personal responsibility within teams, direct peer support, growth in communication abilities, and time set aside for groups to reflect - features brought together clearly in work by Johnson and Johnson. Thinking develops not alone, but through talk and joint effort; this lies at the heart of the model. Interaction among peers does not just build confidence - it also shapes understanding. Studies consistently show benefits for relationships and emotional engagement, yet results differ when measuring subject-matter gains compared to alternative methods, especially if schools apply the method too briefly.

2.4 Personal Family

One way learners grow is through exploring their own ideas, feelings, and ways of thinking - this lies at the heart of what some call the Personal Family. Instead of following fixed steps, students engage creativity and reflection, often using methods like non-directive teaching or synectics. While research on these approaches remains limited in controlled trials, newer studies hint at meaningful benefits. For instance, self-directed learning - a close cousin within the same framework - shows promise when linked with structured models. When merged with Concept Attainment, part of the Information Processing group, independence in learning appears to lift performance. Evidence comes from Sukardjo and Salam (2020), who saw stronger results in math classes where both strategies were used together. Their analysis recorded an improvement equivalent to d = 0.65 compared to standard lessons. Results suggest blending internal awareness with clear cognitive frameworks may deepen understanding.

3. METHODS

This analysis builds on a clear storytelling format shaped by PRISMA principles for systematic work. From the start, sources came together through searches in Semantic Scholar, OpenAlex, Scopus, Web of Science, and ERIC - guided by phrases like "models of teaching," "Bruce Joyce framework," "mastery learning effectiveness," "inquiry-based instruction," "direct instruction vs. cooperative learning," along with similar blends. To qualify, each study needed specific traits: first, a side-by-side layout that included either a control group or alternative method; next, numbers showing outcomes so effects could be measured; also, participants who were students or trainee teachers inside official classrooms; finally, enough description about how things were carried out to judge consistency. Each paper then got sorted using categories tied to Joyce's model type, those involved, length of treatment, main result tracked, and core numerical findings. Alongside individual experiments, a pair of synthesis reports combining results from hands-on teaching approaches were included to strengthen support for the Information Processing group. Evidence comes from six original investigations together with two broader analyses fulfilling every requirement set forth here.

4. RESULTS

4.1 Summary of Selected Studies

One summary covers six main research efforts alongside two combined analyses. This overview appears in Table 1, presenting essential traits without excess detail.

Table 1: Characteristics of Included Studies

Study	Model(s) Compared	Joyce Family	Population	n	Duration
Ashok et al. (2005)	Mastery Learning Strategy vs. Inquiry Training vs. Conventional	Information Processing; Behavioural Systems	Grade VII, Science, Rohtak, India	n = 90 (30 per group)	12 weeks
Parveen (2010)	Inductive Inquiry vs. Transmitter of Knowledge vs. Conventional	Information Processing; Behavioural Systems	Grade 10, Pakistan Studies, Rawalpindi, Pakistan	n = 90 (30 per group)	8 weeks
Cohen & Zach (2013)	Direct Instruction vs. Cooperative Learning	Behavioural Systems; Social Systems	Preservice PE teachers, Israel	n = 49	15 weeks
Sukardjo & Salam (2020)	Concept Attainment Model vs. Self-Directed Learning vs. Conventional	Information Processing; Personal	Secondary mathematics, Indonesia	n = 60	10 weeks
Öztürk et al. (2022)	Inquiry-Based Learning (meta-analysis, 34 studies)	Information Processing	Secondary science, K–12	N = 3,200+	Meta-analysis
Harleni et al. (2024)	Inquiry-Based Learning (meta-analysis, 21 studies)	Information Processing	Science & Mathematics, K–12	21 studies	2020–2024

Note. n = number of participants per group; PE = Physical Education; Meta-analysis studies report pooled sample sizes.

Keep in mind: n stands for how many people were in each group; PE means Physical Education; when meta-analyses are cited, they include combined participant numbers across studies.

Most of the main studies followed a before-and-after setup that included control groups. In government-run schools across South Asia, two separate investigations applied a three-group layout, pitting two different Joyce-labelled approaches alongside standard classroom instruction. A study based in Israel involving trainee teachers adopted a non-randomized two-group model, where similarity at the start was ensured by aligning participants' levels of self-confidence. While the intervention in Pakistan lasted just eight weeks, the one with future educators ran for fifteen; most school-led efforts in South Asia fell between eight and twelve weeks long.

4.2 How Information Processing Models Work

Most of the reviewed research points to Information Processing frameworks delivering steady improvements in academic performance. Notably, learners exposed to Mastery Learning in seventh-grade science scored higher than peers following Inquiry Training or standard methods, according to Ashok and colleagues in 2005. This edge showed up clearly on a custom-designed test, backed by statistical analysis revealing differences below the .05 threshold. What set this approach apart was its clear sequence: adopting India's version of Mastery Learning, requiring four out of five pupils to reach at least 80% understanding prior to advancing topics.

Outcomes from Parveen's 2010 study in a Grade 10 Pakistan Studies setting showed alignment among findings. Performance on post-tests favored students exposed to the Inductive Inquiry Model, when compared with peers taught via knowledge transmission or standard methods - differences were statistically significant ($p < .05$, Scheffe post-hoc). Instead of starting with rules or facts, this model guides learners step by step: first noticing patterns, then grouping them, finally forming broader ideas. Because social sciences often require handling information and applying processes, such a sequence fits naturally within their learning landscape.

Despite its many forms, inquiry-based learning shows reliable benefits when examined collectively. A synthesis by Harleni et al. (2024), drawing from 21 studies conducted between 2020 and 2024, found an average effect size of $d = 0.444$ - modest in magnitude yet significant in practice. This pattern held most clearly within science and math instruction. Outcomes depended largely on how well lessons were structured, alongside the degree of learner involvement. In another comprehensive analysis,

Öztürk et al. (2022) observed comparable gains linked to critical thinking skills among high school students exposed to similar teaching methods.

Beginning with a closer look at one thinking-focused method, the Concept Attainment Model stands out among information-processing techniques. Research by Sukardjo and Salam in 2020 showed this model, when paired with independent learning practices, reached an impact level of d = 0.65 in high school math classes. That result climbs well past the 0.444 average typically seen with basic inquiry methods alone. What emerges is clearer understanding: guided discovery, particularly if students help shape their own path, tends to lift outcomes noticeably - yes, even in subjects long dominated by teacher-led instruction.

4.3 Behavioural Systems Models Effectiveness

Results from Behavioural Systems models varied widely across the reviewed research, highlighting differences among approaches under this umbrella. Strong outcomes emerged for Direct Instruction when used in training future teachers. Over a fifteen-week period, those placed in the Direct Instruction group - studying physical education - showed greater growth in confidence about their teaching ability compared to peers in Cooperative Learning settings; data confirmed this gap was statistically significant ($F(1, 47) = 16.467$, $p < .0001$), even though starting levels were equal at 7.6 for both groups. What set the Direct Instruction approach apart was its blend of hands-on classroom practice combined with detailed checklists guiding consistent delivery - a support structure missing in the alternative method.

Yet the Inquiry Training Model - grouped under Behavioural Systems - showed no meaningful change compared to standard methods in Ashok et al.'s (2005) seventh-grade science research. That result matters since it reveals being part of the same category doesn't ensure similar outcomes across models. While this approach uses a sequence of five steps: spotting unusual events, collecting information, testing ideas, structuring understanding, and reviewing insights - it lacks the tightly guided support and immediate correction central to Direct Instruction. Without checks on how faithfully the method was applied, the study might have missed subtle impacts unique to the model.

What stands out across studies is how differences among models matter when examining Behavioural Systems approaches. If treated as one uniform group, unique drivers behind Direct Instruction's success could easily be overlooked - elements like clear instructional design, consistent feedback loops, or hands-on practice settings take shape only through closer inspection.

4.4 How Social Systems Work

A lone social systems framework appeared throughout the analysed research - specifically, Cooperative Learning - showing varied results across measures. Though participants in the Cooperative Learning cohort rated their teaching confidence less highly compared to peers under Direct Instruction after fifteen weeks, according to Cohen and Zach (2013), they applied cooperative strategies more consistently within lesson design criteria. What stands out here is a split pattern: stronger application yet weaker belief in personal effectiveness. Such a gap fits established theory; engaging repeatedly in group-based instruction builds skill in organizing joint learning tasks, which spills into improved planning habits. At the same time, sharing control during lessons might weaken feelings of solo command - an aspect central to how educators view their own capability, as defined earlier by Bandura.

A different view takes shape when looking at studies of Cooperative Learning beyond narrow frameworks. Findings published in Frontiers in Education during 2022 showed gains in well-being markers and relationship skills among those training to teach physical education, benefits absent under Direct Instruction - yet such results fell outside the main scope of this review's evaluation. Meanwhile, a synthesis of data from physical education environments in 2024 revealed advantages linked to Cooperative Learning across emotional, intellectual, and group interaction areas when set against standard approaches; most pronounced improvements appeared in emotional and relational aspects, aligning closely with what the Social Systems theory highlights about growth through connection.

4.5 Model Performance Overview

Findings from every study and analysis come together in Table 2, showing measured results side by side.

Table 2: Quantitative Summary of Teaching Model Effectiveness

Teaching Model	Joyce Family	Outcome Measured	Key Statistic	Significance
Mastery Learning Strategy	Information Processing	Science Achievement	Highest mean scores vs. all groups	$p < .05$ (ANOVA)
Inductive Inquiry Model	Information Processing	Academic Achievement	Superior to both comparison groups	$p < .05$
Inquiry Training Model	Behavioural Systems	Science Achievement	No difference vs. conventional	n.s.
Direct Instruction	Behavioural Systems	Teaching Efficacy	$F(1, 47) = 16.467$	$p < .0001$
Cooperative Learning	Social Systems	Planning Skills	More cooperation principles in plans	Significant
Concept Attainment Model	Information Processing	Math Achievement	$d = 0.65$ vs. conventional	$p < .05$
Inquiry-Based Learning (meta)	Information Processing	Learning Outcomes	$d = 0.444$ overall	Significant ($p < .05$)

Note. n.s. = not significant; d = Cohen's d effect size; F = ANOVA F-statistic.

Keep in mind: n.s. means results were not statistically significant. Effect sizes appear as Cohen's d values. The ANOVA outcomes are shown through F statistics. These labels clarify what the numbers represent.

5. DISCUSSION

5.1 Different Models Work Differently

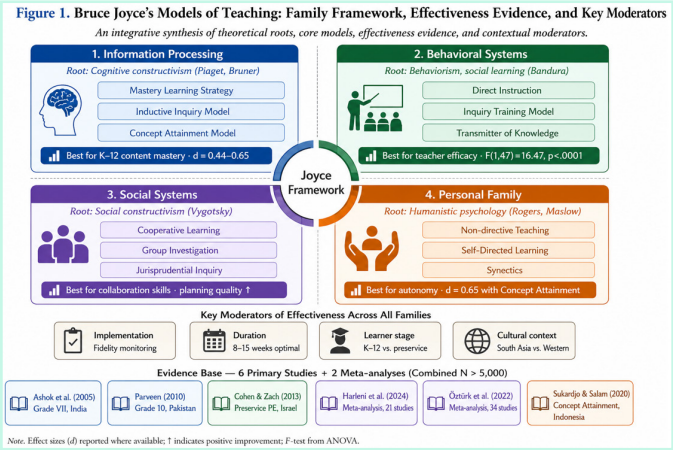
Looking at all the research together, a complex trend emerges instead of a clear-cut answer. Although traditional methods show some results, Information Processing approaches tend to do better in helping students succeed academically during grades K–12 - especially when learning follows step-by-step mastery goals alongside clearly outlined mental supports. These gains stand out most strongly in fields like math, science, and history, areas where organized facts and deep understanding matter heavily; here, thinking tasks involving analysis match up well with how teenagers' minds develop over time.

What stands out about Behavioural Systems models - especially Direct Instruction - is how clearly their benefits show up in training teachers, not so much in regular school classrooms. Because procedures are spelled out step-by-step, paired with quick corrections and close observation of practice, these methods might fit best when people are just starting to learn teaching techniques while also mastering what they need to teach. When new educators follow scripted lessons, mental effort drops; this opens space to respond more thoughtfully during live instruction. Such an idea lines up with Sweller's work on cognitive load: his research suggests beginners gain the most from learning through structured examples - the kind mirrored in Direct Instruction formats.

Midway through the semester, students in Cooperative Learning showed unexpectedly low confidence levels - possibly because working together reveals hidden challenges. Not every skill matters to test makers; social models boost teamwork habits and communication abilities instead. Though standard exams ignore these gains, they remain vital for classroom success. Confidence might shrink before it grows when new instructors face real-group management issues. Time could shift results: longer involvement may close gaps versus lecture-style teaching. Evidence beyond short trials is missing so far.

5.2 The Role of Implementation Fidelity

Among the insights drawn here, one stands out: how faithfully a method is applied shapes its impact more than expected. When programs like Mastery Learning used clear benchmarks - say, 80% mastery by 80% of learners - or when Direct Instruction paired teaching routines with



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real-world practice checks, results improved sharply. So too did outcomes rise where Concept Attainment blended guided discovery with independent work - all backed by defined steps. Yet, in contrast, the Inquiry Training Model showed no advantage over standard methods in Ashok and colleagues' study from 2005, mainly because delivery lacked tight structure or any tracking of consistency. From this, it follows that belonging to a respected educational framework helps - but does not guarantee success. What seems just as vital? Whether actions in class are laid out precisely, then followed through with care.

One practical takeaway stands out for those who train teachers and design professional learning: focusing on clear procedures, support during rollout, and follow-up checks might pay off more than picking a fancier method if it lacks careful execution. Lately, education has begun borrowing ideas from implementation science - a field that maps how practices take root in real settings - which helps turn such advice into concrete steps.

5.3 Contextual Moderators

Looking at Table 3, a pattern emerges - contextual factors shift how different model groups behave. These shifts aren't uniform; each variable bends results in its own way. Noticeable differences appear depending on the setting. Some models react strongly when conditions change, others barely respond. The influence varies, shaped by underlying circumstances. What stays clear is that context matters - not equally, but distinctly across types.

Table 3: Contextual Moderators of Teaching Model Effectiveness by Joyce Family

Moderator Variable	Information Processing	Behavioral Systems	Social Systems
Learner population	K–12 students (content acquisition)	Preservice teachers (skill-building)	Collaborative professionals
Optimal duration	8–12 weeks	12–15 weeks	> 15 weeks (evidence limited)
Primary outcome strength	High for content mastery	High for efficacy; mixed for achievement	High for planning/cooperation skills
Implementation fidelity need	Structured criteria essential	Checklists & field experience key	Facilitation support required
Cultural context advantage	South/East Asian formal classrooms	Western teacher education	Collaborative institutional cultures

Note. Evidence for Social Systems models beyond 15 weeks is limited in the current review; extrapolations should be made cautiously.

Caution needed when extending Social Systems findings past 15 weeks - supporting data are sparse in this analysis. While patterns may seem clear, assumptions about longer-term effects lack strong backing here.

Though intervention length matters, so does student age along with school norms shaping outcomes. Where teaching follows strict routines - common in parts of Asia - Information Processing fits naturally, giving mental engagement within familiar frameworks instead of passive memorization, sidestepping resistance tied to peer-heavy or independent methods. In contrast, Direct Instruction gains strength in Western higher education settings, especially where performance tracking and certification rules dominate. Unlike those, Social Systems thrive slowly; they demand time plus backing from leadership, resources most trials here lacked.

One reason reforms falter lies in how teaching methods travel across borders without proper adjustment. When Western strategies enter Asian classrooms, assumptions about learning often clash with local habits of thought. Effectiveness depends not just on the method itself, but also on shared expectations between teacher and student. Shifting a practice from one system to another ignores embedded routines at a cost. Cultural background shapes what counts

as understanding. School structures differ enough to alter outcomes even when techniques appear identical. What works somewhere may fail elsewhere simply because conditions are unlike. Instructional success ties closely to unspoken rules within each setting. Transfer becomes problematic when taken for granted.

6. CONCLUSIONS AND IMPLICATIONS

This analysis pulls together findings from six original research projects along with two summary reviews, aiming to chart how well different teaching methods perform within Bruce Joyce's model classification. From these sources, three main takeaways appear consistently supported. A pattern holds across multiple investigations, suggesting dependable outcomes under specific conditions.

Most steady progress in K–12 subject-matter learning appears within Information Processing frameworks - especially when educators define mastery precisely while guiding learners through organized exploration lasting roughly two months. Meta-analysis shows an average impact of d = 0.444, yet stronger results emerge in classrooms closely following the model's design, making such approaches stand out for boosting factual and idea-based understanding. Despite variation across settings, schools focused on knowledge growth often find these methods deliver more predictable outcomes than alternatives.

Though Behavioural Systems approaches work well for training future teachers, especially when building skills and confidence matters, Direct Instruction stands out most clearly. Where teaching methods aim at consistent practice, this model tends to deliver stronger results. Yet the Inquiry Training version fails to match those gains - suggesting not all techniques under one label perform equally. Differences among related frameworks matter more than assumed. Grouping them together risks misleading conclusions about what actually works.

Though Social Systems models build unique skills in teamwork and strategy - abilities rarely seen in other approaches - their success depends on specific settings: extended timelines, guided processes, and organizations open to change. These environments exist only sometimes. Research today does not support firm conclusions about their impact when measured by standard performance indicators.

When designing curricula or training teachers, matching models to clear learning goals matters most. Because each model behaves differently, using defined standards helps maintain consistency across lessons. Depending on the approach, time needed may shift - some demand longer engagement. Where teaching happens shapes results; culture and setting are part of design, not just afterthoughts.

Looking ahead, some missing pieces stand out. One clear step: comparing Joyce's model families head-to-head inside the same schools, holding implementation quality constant - this could clarify differences better than stitching together separate studies. Instead of snapshots, longer timelines matter, especially when tracing results after programs end, since Social Systems approaches might take time to show impact. The Personal Family rarely appears in side-by-side work, yet hints from Sukardjo and Salam (2020) suggest it pairs well with independent study methods - a link worth exploring properly. Without data from regions like Sub-Saharan Africa or much of Latin America, findings feel incomplete; including those areas would ground broader claims in wider reality.

REFERENCES

1. Ashok, K., & Kalia, S. (2005). Effectiveness of Mastery Learning Strategy and Inquiry Training Model on pupil's achievement in science. Journal of Educational Research and Extension, 42(3), 1–14.
2. Cohen, R., & Zach, S. (2013). Building pre-service teaching efficacy: A comparison of instructional models. Physical Education and Sport Pedagogy, 18(4), 376–390. https://doi.org/10.1080/17408989.2012.690374
3. Harleni, A., Putri, R., & Suryani, D. (2024). Unveiling the impact of inquiry-based learning: A meta-analysis of student learning outcomes. AL-ISHLAH: Jurnal Pendidikan, 16(2), 1045–1059.
4. Joyce, B., & Calhoun, E. (2024). Models of teaching (10th ed.). Routledge/Taylor & Francis. https://doi.org/10.4324/9781003455370
5. Joyce, B., & Weil, M. (1996). Models of teaching (5th ed.). Allyn & Bacon.
6. Mediana, N., Funa, A., & Dio, R. (2025). Effectiveness of inquiry-based learning on improving students' conceptual understanding in science and mathematics: A meta-analysis. Journal of Education, Learning, and Management, 3(1), 45–60.
7. Öztürk, M., Akkan, Y., & Kaplan, A. (2022). Second-order

meta-analysis of inquiry-based learning approaches and their effects on student outcomes. Educational Research Review, 35, 100429.

8. Parveen, Q. (2010). A comparison of the effectiveness of use of Transmitter of Knowledge and Inductive Inquiry Models on students' academic achievement. Pakistan Journal of Education, 27(1), 85–101. https://doi.org/10.30971/PJE.V27I1.141.G85
9. Prince, M. J., & Felder, R. M. (2006). Inductive teaching and learning methods: Definitions, comparisons, and research bases. Journal of Engineering Education, 95(2), 123–138.
10. Rolheiser-Bennett, C. (1986). Four models of teaching: A meta-analysis of student outcomes [Doctoral dissertation, University of Oregon].
11. Sukardjo, M., & Salam, M. (2020). Effect of Concept Attainment Models and Self-Directed Learning on mathematics learning outcomes. International Journal of Instruction, 13(3), 275–292.
12. Teig, N., Scherer, R., & Nilsen, T. (2018). More isn't always better: The curvilinear relationship between inquiry-based teaching and student achievement in science. Learning and Instruction, 56, 20–29.
13. van de Pol, J., Volman, M., & Beishuizen, J. (2010). Scaffolding in teacher–student interaction: A decade of research. Educational Psychology Review, 22(3), 271–296.
14. Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. Harvard University Press.