

Universal Design Learning-Based Support TKYM Model for Malaysian Autism-Inclusion Centers

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Abstract

Universal Design for Learning (UDL) 3.0 provides a rights-aligned framework for autism inclusive education. This article presents the TKYM Model for Malaysian autism-inclusion centers, comprising four pillars: Transformative Access Pathways (T), Knowledge Co-construction (K), Yielding Learner Agency (Y), and Multimodal Environment Design (M). Three objectives guide the study: to synthesize UDL literature in the Malaysian context, to establish theoretical foundations, and to articulate TKYM's structure aligned with SDGs 4 and 10. A sequential mixed-methods design involved 15 practitioners and 50 autistic learners. UDL implementation readiness was below moderate ($M = 2.87$). TKYM offers a replicable, rights-based framework for Malaysian autism-inclusive practice.

Keywords: Inclusive Education, Sustainable Development Goals (SDGs), TKYM Model, Universal Design for Learning (UDL) 3.0

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1.0 Introduction

Conventional specialized autism-inclusion centers predominantly prioritize behavioral compliance and deficit-based intervention models, systematically overlooking the holistic educational, social, and identity-affirming needs of autistic learners (Jordan et al., 2026). Universal Design for Learning (UDL) forms the foundation of inclusive education, which is grounded in neuroscience research and recognized as supporting neurodiverse learners (Sgambelluri et al., 2025). It is built on three interconnected principles that empower everyone to have agency over their own learning. The TKYM Model is developed in response to the limitations of the feasibility of the implementation of any UDL-aligned model for Malaysian private autism-inclusion centers. The acronym TKYM reflects its four pillars: T - Transformative Access Pathways, which systematically remove physical, sensory, and curricular barriers; K - Knowledge Co-construction, which facilitates collaborative and participatory pedagogy; Y - Yielding Learner Agency, which fosters autistic learners' self-determination and intrinsic motivation; and M - Multimodal Environment Design, which configures the physical and digital learning environment as an active pedagogical variable. The model is grounded in UDL 3.0 (CAST, 2024), Vygotsky's (1978) Zone of Proximal Development, Neurodiversity Paradigm Theory, and Self-Determination Theory (Wehmeyer, 2003), and aligns with Malaysia's Zero Reject Policy (2018) and the SDGs 4 and 10.

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1.1 Problem Statement

A theoretically grounded, operationalized support approach for Malaysian autism-inclusion centers to create learning programs and environmental progress is lacking (Amira et al., 2023). Existing UDL applications in autism-inclusive settings have promising results (Guo & Wang, 2025), but they are context-agnostic and not customized to autism-specific developmental requirements or the Malaysian special education system. Neurodiversity-affirming frameworks such as Autistic SPACE (McGoldrick et al., 2023) and rights-based duties under SDGs 4 and 10 require educational models that actively promote equity and identity affirmation rather than mere concessions. The TKYM Model addresses this convergence of unfulfilled demands.

1.2 Research Aim and Objectives

This article aims to present the conceptual theoretical architecture of the TKYM Model. Specifically, three objectives are pursued: 1) to conceptualize the TKYM Model through a systematic literature review, 2) to develop and validate the TKYM Model, and 3) to pilot test the TKYM Model.

1.3 Significance of the Study

This article makes two field contributions. It positions UDL 3.0's new identity dimension as a distinct operational pillar, deviating from UDL-based autism models that approach identity as a background variable rather than an active design driver. It provides practitioners, policymakers, and academics with a structured, rights-aligned framework sensitive to the Malaysian institutional environment, thereby filling a policy-practice gap in autism-inclusive education. The model's clear alignment with SDG 4 and SDG 10 portrays autism-inclusive education reform as a worldwide educational obligation, not just a domestic policy issue.

2.0 Literature Review

2.1 Four Theories

The TKYM Model is built and grounded in four convergent theoretical underpinnings that create a robust framework for UDL-based autism-inclusive education in the Malaysian context: i) UDL3.0, ii) Vygotsky's ZPD, iii) Neurodiversity Paradigm, and iv) Self-Determination Theory. These theories do not apply independently within the model; rather, they function as mutually reinforcing layers that inform the design of each of the four TKYM pillars – Transformative Access Pathways (T), Knowledge Co-Construction (K), Yielding Learning Agency (Y), and Multimodal Environment Design (M).

2.1.1 Universal Design for Learning (UDL) 3.0

Theories like UDL 3.0 underpin the TKYM model. It offers thorough advice on developing inclusive learning settings and teaching autistic learners. i) Multiple Engagement Methods is one of UDL's three core ideas in TKYM. Motivation, self-regulation, and interest are fostered by engaging activities and flexible learning settings, addressing the TKYM Model's "Yielding Learner Agency" and "Multimodal Environmental Design" components (ii) Multiple Means of Representation. To address autism's diverse learning styles and sensory preferences, "Knowledge Co-Construction" and "Multimodal Environmental Design" present knowledge in auditory, visual, and tactile formats. Different ways to act and express. "Transformative Access Pathways" and "Yielding Learner Agency" enable learners to demonstrate their talent by refining their communication and performance skills. UDL 3.0 (CAST, 2024) formalizes learner identification and belonging as operational traits rather than philosophical aspirations. Guo and Wang (2025) found that full-fidelity UDL implementation, including the environmental and identity dimensions, maximizes learner engagement and a sense of belonging.

2.1.2 Vygotsky's Zone of Proximal Development (ZPD)

Vygotsky's ZPD emphasizes guided learning and social engagement. The TKYM Model emphasizes scaffolding through Knowledge Co-Construction, collaborative learning, and peer/educator support to help learners master tasks slightly beyond their independent ability. The paradigm encourages active participation and shared understanding in the learning environment because learning is social. In a comprehensive assessment of autism support outcomes, Jordan et al. (2026) found that collaborative, scaffolded learning structures linked with the ZPD construct promote social involvement more than therapist-directed techniques, supporting the K pillar's design logic.

2.1.3 Neurodiversity Paradigm Theory (NPT)

NPT views autism as a brain function variation rather than a disability. The strengths-based approach, acceptance, and inclusion match the TKYM Model. Neurodiverse people are recognized and included throughout the approach. It harnesses autistic people's talents and perspectives to promote awareness and appreciation of diverse ways of thinking and learning. McGoldrick et al. (2025) show that neurodiversity-based classrooms reduce anxiety and distress by statistically significant amounts compared to inclusive models, supporting TKYM's M pillar.

2.1.4 Self-Determination Theory (SDT)

SDT emphasizes intrinsic motivation and psychological requirements for autonomy, competence, and relatedness. The TKYM Model supports self-determination by i) autonomy: "Yielding Learner Agency" empowers learners to make choices based on their interests, ii) competence: accessible pathways and mastery-oriented activities help learners feel accomplished and confident, and iii) relatedness: "Knowledge Co-Construction" and the inclusive design foster a sense of belonging and belonging. Priyadharsini and Mary (2024) show

that structured self-determination supports in inclusive settings improve autistic learners' goal-setting and autonomous decision-making, supporting the Y pillar's focus on choice architecture and strengths-based planning.

The theoretical architecture of the TKYM Model and the relationships among its four foundational elements are shown in Figure 1.

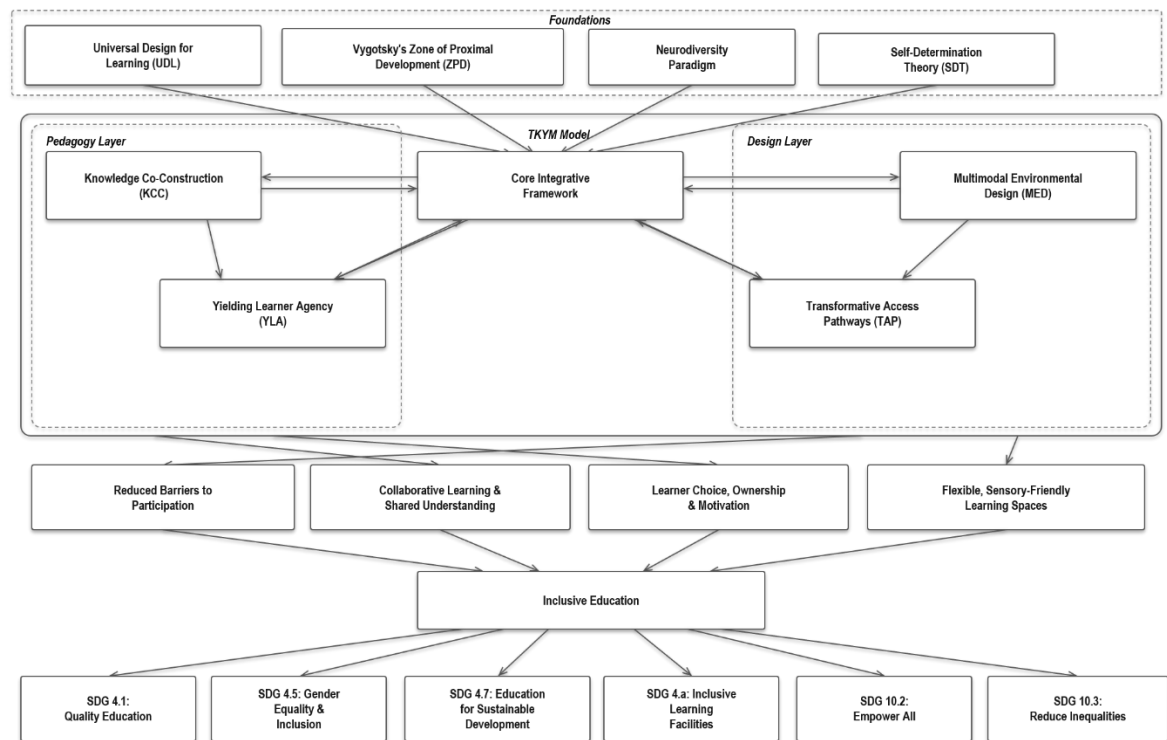


Fig.1: TKYM Model Theoretical Framework

2.2 TKYM Model

TKYM is a model for Malaysian autism-inclusion centers that corresponds with SDGs 4 and 10 to benefit society. It applies four theoretical principles to a practical, holistic methodology. It seeks to empower autistic students through inclusion and equity. Each component of the TKYM Model is integral to the theoretical framework and promotes autistic inclusion.

Figure 1 shows how Transformative Access Pathways, Knowledge Co-Construction, Yielding Learner Agency, and Multimodal Environmental Design work together to translate foundational learning theories into practical, inclusive learning experiences that reduce barriers, increase participation, and advance inclusive education.

2.2.1 Transformative Access Pathways (TAP)

TAP focuses on proactively identifying and removing systemic, physical, and pedagogical barriers to participation. It ensures that learning materials, activities, and communication methods are accessible from the outset. Supported by UDL 3.0, multiple means of action and expression ensure diverse ways for learners to navigate and engage with the curriculum. It also aligns with the Neurodiversity Paradigm by recognizing and accommodating diverse processing styles.

2.2.2 Knowledge Co-Construction (KCC)

KCC emphasizes collaborative learning; knowledge is not merely transmitted but actively constructed through interaction among learners, educators, therapists, and peers. It involves shared inquiry, problem-solving, and mutual understanding. Strongly rooted in Vygotsky's ZPD, promoting learning through social interaction and scaffolding. It aligns with UDL 3.0's multiple means of engagement by making learning a participatory, socially relevant experience.

2.2.3 Yielding Learner Agency (YLA)

YLA empowers learners with mild autism to take ownership of their learning journey. It provides opportunities for choice and self-direction, fostering intrinsic motivation and self-regulation. It is derived from SDT and nurtures autonomy, competence, and relatedness. It aligns with UDL 3.0 multiple means of engagement by supporting self-regulation and encouraging self-advocacy.

2.2.4 Multimodal Environmental Design (MED)

MED refers to the intentional creation of physical and digital learning environments that offer diverse sensory inputs, flexible arrangements, and support for various communications and learning preferences. It considers acoustics, visual stimuli, tactile elements,

and digital tools. It is closely tied to UDL 3.0: multiple means of engagement, and multiple means of action and expression. It also respects the sensory processing differences highlighted by NPT.

Table 1: TKYM Model Alignment with UDL 3.0 & SDG (4 & 10)

TKYM Pillar			UDL-3.0 Principle	SDG Contribution / Target
T K Y M	Transformative Access Pathways		Design Multiple Means of Representation – The “What” of learning	SDG 4.1(free, equitable quality education); SDG 4.a (inclusive learning environments); and SDG 10.2 (empowerment of all)
	Knowledge Co-construction		Design Multiple Means of Action & Expression – The “How” of learning	SDG 4.1 (quality learning outcomes); SDG 4.5 (eliminate disparities); and SDG 10.3 (equal opportunity)
	Yielding Learner Agency		Design Multiple Means of Engagement – The “Why” of learning	SDG 4.7 (sustainable development education); and SDG 10.2 (social, economic, political inclusion)
	Multimodal Environment (Identity layer)		Closely tied to Design Multiple Means of Engagement, and Multiple Means of Action & Expression	SDG 4.a (safe, inclusive learning environments); SDG 10.2 (social inclusion); and SDG 10.3 (non-discriminatory policies)

Source: Author Collection

2.3 Literature Review

Malaysia's inclusive education architecture reflects a structured yet imperfectly implemented commitment to the provision of Special Educational Needs (SEN). The three-tiered system of Program Pendidikan Inklusif (PPI) (low support), Program Pendidikan Khas Integrasi (PPKI) (moderate support), and special education school (high support) is theoretically designed to cover the full range of autistic learners. As of 2023, 6,641 primary and secondary schools had PPI (MARF, 2023). However, enrolment numbers do not guarantee the quality of inclusion. TKYM builds on, yet advances beyond, earlier UDL applications in autism-inclusive settings. CAST's UDL 2.0 guidelines (2018) established three core principles: Representation, Action and Expression, and Engagement, but do not include dimensions on identity or belonging. UDL 3.0 (CAST, 2024) addresses this by formally embedding learner identity as a fourth operational layer, which TKYM operationalizes through its M pillar.

Guo and Wang (2025) demonstrate that higher UDL implementation fidelity is associated with meaningful gains in learner engagement and a sense of belonging, providing empirical support for TKYM's integration of all four pillars. In contrast, Sgambelluri et al. (2025) report that UDL models limited to the original three-principal framework produced minimal improvement in autistic learners' self-determination. As per the precise deficit, TKYM's Y pillar addresses. Regionally, Malaysia's Zero Reject Policy (2018) commits to inclusive enrolment but, unlike Singapore's structured teacher-development pathway (Singapore Ministry of Education [SEED]), does not specify a pedagogical implementation framework. TKYM fills this gap.

Empirical studies identify three structural lacks in Malaysian autism-inclusive settings that TKYM directly addresses. First, teachers lack UDL-aligned training. Amira et al. (2023) confirm that Malaysian special education teachers rely on ad hoc adaptations rather than structured UDL frameworks, resulting in inconsistent pedagogical practice across centers. This gap corresponds to the K pillar. Second, learning environments prioritize behavioral compliance over identity-affirming inclusion. Across Southeast Asian contexts, compliance-based instructional approaches limit autistic learners' intrinsic motivation and identity development (McGoldrick et al., 2025). This pattern justifies the Y pillar's focus on self-determination. Third, no systematic UDL implementation framework exists for Malaysian private centers. MARF (2023) noted that existing Malaysian special education guidelines specify access requirements but provide no pedagogical implementation roadmap for the foundational gap that TKYM is designed to close.

3.0 Methodology

3.1 Research Design and Paradigm

The development and validation of the TKYM Model employs a three-phase sequential mixed-methods design within a pragmatic epistemological paradigm. Pragmatism is adopted as an overarching philosophical stance because it prioritizes research utility, accommodates integration of quantitative and qualitative data, and is consonant with the application of inclusive education research. The three phases progress sequentially: i) model conceptualization through systematic literature review, ii) structural validation through expert consensus, and iii) empirical evaluation through pilot implementation, which mirrors the sequential exploratory mixed methods typology.

3.2 Phase 1: Model Development – Systematic Literature Review

The TKYM Model's theoretical foundation was established through a systematic literature review in accordance with the PRIMA 2020 guidelines (Page et al., 2021). Five databases were searched in ERIC, Scopus, Web of Science, PsycINFO, and Google Scholar for terms including universal design for learning, autism, inclusive education, neurodiversity, and SDG 4 and SDG 10. Inclusion criteria specified peer-reviewed articles published 2014-2025 addressing UDL implementation, and autism-inclusive practice. A documentary analysis of Malaysian policy instruments, including the Education Blueprint (KPM, 2026), Zero Reject Policy, and inclusive education operational guidelines, was conducted concurrently.

3.3 Phase 2: Expert Validation

A purposively selected panel of 15 stakeholders, comprising 5 administrators, 5 educators, and 5 therapists. Round 1 used a Likert-scale questionnaire; Round 2 employed an open-ended questionnaire. All participants consent and assent procedures.

3.4 Phase 3: Pilot Implementation

The validated TKYM Model was piloted across 3 Malaysian autism-inclusive centers, purposively selected for geographic and socioeconomic diversity within the Klang Valley, Malaysia. The pilot sample included 50 autistic participants.

3.5 Data Collection Methods

Quantitative data collected using three instruments: i) the UDL Implementation Readiness Scale (Singh et al, 2025); ii) the Learner Engagement and Participation Scale; and iii) a self-developed Inclusive Environment Quality Checklist aligned to TKYM's four pillars. The scales are on a Likert scale: 1 = Not at all implemented, 5 = Fully implemented. Qualitative data were gathered through semi-structured interviews with administrators, educators, and therapists at the midpoint and endpoint of the pilot testing. Trustworthiness is addressed through member checking, thick description, and peer debriefing. Mixed-methods integration occurred at the interpretation stage through a convergent joint display comparing quantitative outcomes with qualitative thematic findings.

3.6 Data Analysis

Quantitative analysis employed SPSS for paired sample *t*-tests to assess pre- to post-changes in engagement and fidelity, with Cohen's *d* calculated for significant comparisons. Qualitative analysis employed thematic analysis using NVivo15.

4.0 Findings

The quantitative data is presented first, followed by the qualitative data. Both data are triangulated to construct an integrated understanding of UDL readiness, implementation barriers, and the applicability of the TKYM Model within the Malaysian private autism-inclusive education context.

4.1 UDL Implementation Readiness Across TKYM Pillars

Table 2 presents the 32-item UDL Implementation Readiness Scale, organized by the four TKYM pillars. A mean score ≤ 3.00 indicates the need for structured intervention, aligning with Rose and Meyer (2002) thresholds.

Table 2. TKYM Pillar Implementation Readiness

TKYM Pillar	Items (n)	M	SD	Readiness Level
T – Transformative Access	8	3.15	0.82	Moderate
K – Knowledge Co-construction	8	2.94	0.79	Below Moderate
Y – Yielding Learner Agency	8	2.61	0.88	Below Moderate
M – Multimodal Environmental Design	8	3.08	0.74	Moderate
Overall UDL Implementation	32	2.87	0.91	Moderate

Note. Readiness levels: 4.00–5.00 = High; 3.00–3.99 = Moderate; 2.00–2.99 = Below Moderate; 1.00–1.99 = Low.

Source: Author Collection

The included centers have modest UDL compliance across all four TKYM pillars ($M = 2.87$, $SD = 0.91$). The least adopted inclusive practice is the systematic development of autistic learners' self-determination and agency, as the Y pillar ($M = 2.61$, $SD = 0.88$) got the lowest readiness score. In special education, self-determination is both the most important and the most overlooked outcome, according to Buttigieg et.al. (2025)

In line with the Malaysia Education Blueprint 2026's investment in accessible infrastructure (Tan, 2026), centers have made greater progress in the physical and environmental dimensions of inclusion than in the pedagogical and agency dimensions, as measured by the K and Y pillars.

4.2 Qualitative Thematic Analysis Finding

Thematic analysis generated four themes aligned with the TKYM pillars. Across all themes, the defining characteristic of practice in Malaysian private autism-inclusion centers is the fragmentation between physical access and substantive pedagogical transformation. Table 3 presents the four practitioner-identified themes and their alignment with the TKYM pillars, illustrating how real-world practices reveal gaps between intended inclusive design principles and actual implementation across access, co-construction, learner agency, and multimodal environmental design.

Table 3. Four Practitioner-Identified Themes and TKYM Pillar Alignment (n = 15)

Theme	TKYM Pillar	Sub-themes / Key Patterns	Illustrative Quote & Implication
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1	Access Without Accommodation	T	- Physical access present; pedagogical accommodation absent - Visual supports used inconsistently	"We have ramps and wide corridors, but our teaching materials are the same for everyone." - Educator, Center 3 Implication: Transformative Access requires both environmental and curricular redesign.
2	Compliance Over Co-construction	K	- Instruction predominantly compliance-based - Assessment single-mode, summative	"Most of our sessions are one-to-one drills. There is no space for them to explore or build understanding with others." - Therapist, Center 1 Implication: PD in collaborative pedagogy is a prerequisite, not an enhancement.
3	Agency as Exception, Not Norm	Y	- Learner choice offered ad hoc, not structurally embedded - Self-regulation supports largely absent	"We sometimes let them choose their activity at the end of the day as a reward. Building in choice as a learning principle — that is not something we have been trained to do." - Administrator, Center 2 Implication: Agency must be structurally embedded, not offered as an occasional privilege.
4	Technology Present, Pedagogy Absent	M	- AAC/visual schedules present but not systematically integrated - Sensory spaces in only 3 of 10 centers	"We bought the AAC tablets two years ago. We have no policy. The environment looks inclusive, but it does not feel inclusive." - Educator, Center 3 Implication: Multimodal design requires policy-level embedding and staff training, not merely tool procurement.

Source: Author Collection

5.0 Discussion

The findings indicate autism-inclusion centers have fragmented UDL-aligned practices. The absence of system-level coherence restricts scalability and equity, whether TKYM aspects are implicitly performed through access redesign, multimodal education, or learners' flexible expression.

Malaysia's SDG4 progress report (DOSM, 2026) shows inclusion gaps, especially for disabled students, confirming that legislative purpose has overtaken classroom transformation. TKYM suggests shifting from compliance-driven inclusion to transformative learning ecosystems that actively foster access, co-construction, agency, and environment as interdependent aspects.

This study warns against teacher-centric improvisation as a substitute for systematic UDL capacity-building. Systematic studies recommend contextualized UDL training modules, paving the door for institutional adoption of the TKYM Model as an organizing framework rather than an add-on.

Table 4: TKYM Model Four Pillar Architecture, Learner Outcomes with UDL 3.0 Alignment

Pillar	Full Name	UDL-3.0 Principle	Description	Learner Outcomes
T	Transformative Access Pathways	Representation - "What" of learning	This pillar systematically dismantles physical, sensory, and curricular barriers within autism-inclusion centers. Ensuring that all autistic learners are available regardless of support needs, can access content through multiple, flexible means. Strategies include sensory-sensitive classroom design, accessible digital materials, and the integration of assistive technology.	- Increased transition readiness - Enhanced self-advocacy - Reduced learning anxiety
	Knowledge Co-construction	Expression - "How" of learning	This pillar promotes participatory pedagogy in which autistic learners co-construct knowledge through collaborative tasks, peer networks, and flexible modes of expression. Educators act as facilitators rather than transmitters, positioning autistic learners as active epistemic agents.	- Improved academic comprehension - Greater cross-modal access - Sustained knowledge retention - Equitable participation in discourse
Y	Yielding Learner Agency	Engagement - "why" of learning	This pillar cultivates intrinsic motivation, autonomy, and self-regulation in autistic learners. Through choice architecture, strengths-based learning plans, and goal-setting supports, learners develop the capacity to direct their own educational journeys, thereby moving beyond compliance toward genuine self-determination.	- Positive autistic identity formation - Improved well-being and belonging - Reduced internalized stigma
M	Multimodal Environment (Identity layer)		This pillar addresses the physical, sensory, and cultural environments as active pedagogical variables. Sensory regulation zones, AAC tools, visual schedules, and culturally responsive practices collectively create spaces where autistic learners' diverse neurological profiles are not merely accommodated but valued and celebrated.	- Reduced sensory-related distress - Increased expressive communication - Higher assessment participation rates

Source: Author Collection

6.0 Conclusion, Limitations, and Recommendations

The TKYM Model, a Universal Design Learning-based support framework for Malaysian autism-inclusion centers, addresses a documentation gap in inclusive education for autistic learners in inclusive settings by integrating UDL 3.0, its three principles, and an

explicit fourth dimension: learner identity and agency. TKYM promotes neurodiversity-affirming agentic inclusivity beyond accommodation.

The model promotes disability-inclusive education worldwide and is a Malaysian policy instrument due to its alignment with SDG4 and SDG 10. Malaysian policymakers can execute the Zero Reject Policy's rights commitments in inclusive classrooms using TKYM. Practitioners receive evidence-based, pillar-based implementation guidance. Researchers can repeat three-phase validation to construct Southeast Asian and other inclusive education system-specific UDL frameworks.

Full-scale multi-site validation, longitudinal study of TKYM's impact on post-school outcomes, and iterative model improvements with autistic learners and their families might be prioritized after the pilot. Autistic people should co-design the model, which is theoretically consistent with TKYM's identity-affirming goals and practically important for its long-term relevance and legitimacy.

Four limitations are acknowledged. Only Klang Valley private autism-inclusion centers were sampled. Thus, findings are indicative and cannot be generalized to public PPKIs or rural Malaysia without further confirmation. Second, TKYM's single-country, single-region scope limits cross-cultural transferability; other Southeast Asian systems would need revalidation. Third, self-report fidelity assessments may overestimate preparation due to social desirability bias; future studies should include classroom observation. Fourth, Short pilots don't capture long-term development.

Three findings-based suggestions. The Malaysian Ministry of Education may offer TKYM-aligned professional development courses for the national SEN teacher certification pathway to supplement inclusive enrolment under the Zero Reject Policy (2018) with organized pedagogical preparation. Center managers can incorporate structured choice architecture into daily procedures to prioritize the lowest-scoring Y pillar rather than giving learners a choice. Future validation studies should include autistic kids and their families as co-designers to ensure model relevance and legitimacy. At least one academic year of longitudinal study is recommended.

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Paper Contribution to the Related Field of Study

This research introduces the TKYM Model, comprising transformative access, knowledge co-construction, yielding learner agency, and multimodal environments. As a novel, theory-based framework for applying UDL in Malaysian autism-inclusion centers. By demonstrating that the TKYM model improves learning outcomes and fosters **learner agency**, this study bridges the gap between theoretical inclusive pedagogy and classroom practice within the Malaysian socio-cultural context. Furthermore, the findings align localized educational strategies with global mandates, specifically advancing the SDGs 4 and 10 by promoting equitable quality education and reducing inequalities for autistic learners.

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